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Linking Neighbors' Fertility:
Third Births in Norwegian Neighborhoods

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Abstract: Geographical variations in fertility and the diffusion of fertility across space and social networks are central topics in demographic research. Less is known, however, about the role of neighborhoods and neighbors with regard to geographical variations in fertility. This paper investigates spatial variations in family size by analyzing third births in a neighborhood context. Using unique geo-data on neighbors and neighborhoods, this paper introduces a new geographical dimension of fertility variation and contributes to our understanding of geographical variations in fertility.

Flexible, ego-centered neighborhoods are constructed using longitudinal geo-data taken from administrative registers (2000-2014). Data on inhabitants' residential address, their housing, family situation and fixed effects for statistical tracts are used to account for sorting into housing and urban versus rural districts.

The analysis shows that the likelihood of two-child couples having another child increases with the share of families in the neighborhood that have three or more children. This relationship remains unchanged, even after controlling for the socio-demographic characteristics of couples, the educational level attained by neighboring women as well as time-constant characteristics of neighborhoods. Results are consistent across various neighborhood definitions ranging from the 12 to the 500 nearest neighbors. However, the association between neighbors' fertility becomes stronger as the number of neighbors increases, suggesting that selective residential sorting is an important driver. Consequently, this study indicates that transitions to third birth may be linked to social interaction effects among neighbors, in addition to well-known processes of selective residential sorting.

Keywords: Spatial fertility · k-nearest neighbors · Fertility diffusion · Family size · Third births

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1 Introduction

Declining family sizes and, in particular, fewer women having a third child, are principal causes of overall fertility decline worldwide (*Zeman et al.* 2018). Research on higher parity birth progressions is thus once more a focus of attention in several countries, such as France (*Breton et al.* 2005), Germany (*Diabaté/Ruckdeschel* 2016), and Turkey (*Greulich et al.* 2016). The link between the declining number of three-child families and declining total fertility rates has traditionally been considered important in Norway (*Kravdal* 1992), and while the number of large families is falling, almost half of the Norwegian ISSP respondents in 2012 continue to regard three or more children as the ideal number for a family (*ISSP Research Group* 2016).

Young people's fertility preferences have been shown to vary considerably by their regional childbearing context (*Testa/Grilli* 2006), and research on local geographical patterns of childbearing highlight potential normative (*Ruckdeschel et al*. 2018) and cultural influences (*Fulda* 2015). The spatial diffusion of fertility behavior is an inherent part of demographic transition theories (*Bongaarts/Watkins* 1996; *Lesthaeghe/Neels* 2002), and the importance of compositional and contextual factors in shaping fertility variation is increasingly acknowledged (*Vitali et al.* 2015).

Geographical variations in fertility are well recognized at the level of regions, nation states, and along the urban-rural dimension. For instance, they are documented for the Nordic countries (*Kulu et al*. 2007), the Netherlands (*de Beer/Deerenberg* 2007), Austria, Switzerland, and Germany (*Basten et al.* 2011), Italy (*Vitali/Billari* 2015), Great Britain (*Fiori et al.* 2014), and Australia (*Gray/Evans* 2018). However, there is little research that considers the importance of different geographical scales or focuses on neighborhoods (*Logan* 2012). Neighborhoods can form arenas where neighbors interact and influence each other's childbearing behavior through emotional contagion, social learning and social pressure (*Bernardi/Klarner* 2014), and studies have shown that neighbors become more important for couples' networks when entering parenthood (*Rözer et al.* 2017; *Kalmijn* 2012). However, because neighborhoods are important contexts of childrearing, couples may also sort geographically based on their fertility preferences.

Using unique geo-data drawn from Norwegian registers, this study aims to provide an insight into spatial variations in family sizes by analyzing third births in neighborhood context. In order to acknowledge the dimensionality and complexity of neighborhood definitions (*Sharkey/Faber* 2014), it also analyzes how the correlation of neighbors' fertility varies depending on the chosen neighborhood scale. In this paper, neighborhoods are defined as networks of neighbors using k-nearest neighbor measures and are couple-centered and scalable (*Östh et al.* 2015). While other fields increasingly use individualized neighborhoods to capture the residents' environment (*Türk/Östh* 2019), fertility research focusing on families' immediate residential context is sparse (but see *Malmberg/Andersson* 2019). Given that there is considerable interest in geographical variations in fertility and the diffusion of fertility across space and social networks, neighborhoods and neighbors are potentially important but understudied drivers of the observed larger geographical variations. Furthermore, comparing results for individualized neighborhoods of different sizes has the potential to shed light on the explanatory importance of neighborhood context, residential sorting and social influence among neighbors and might therefore increase our knowledge on the spatial diffusion of fertility behavior (*Logan* 2012).

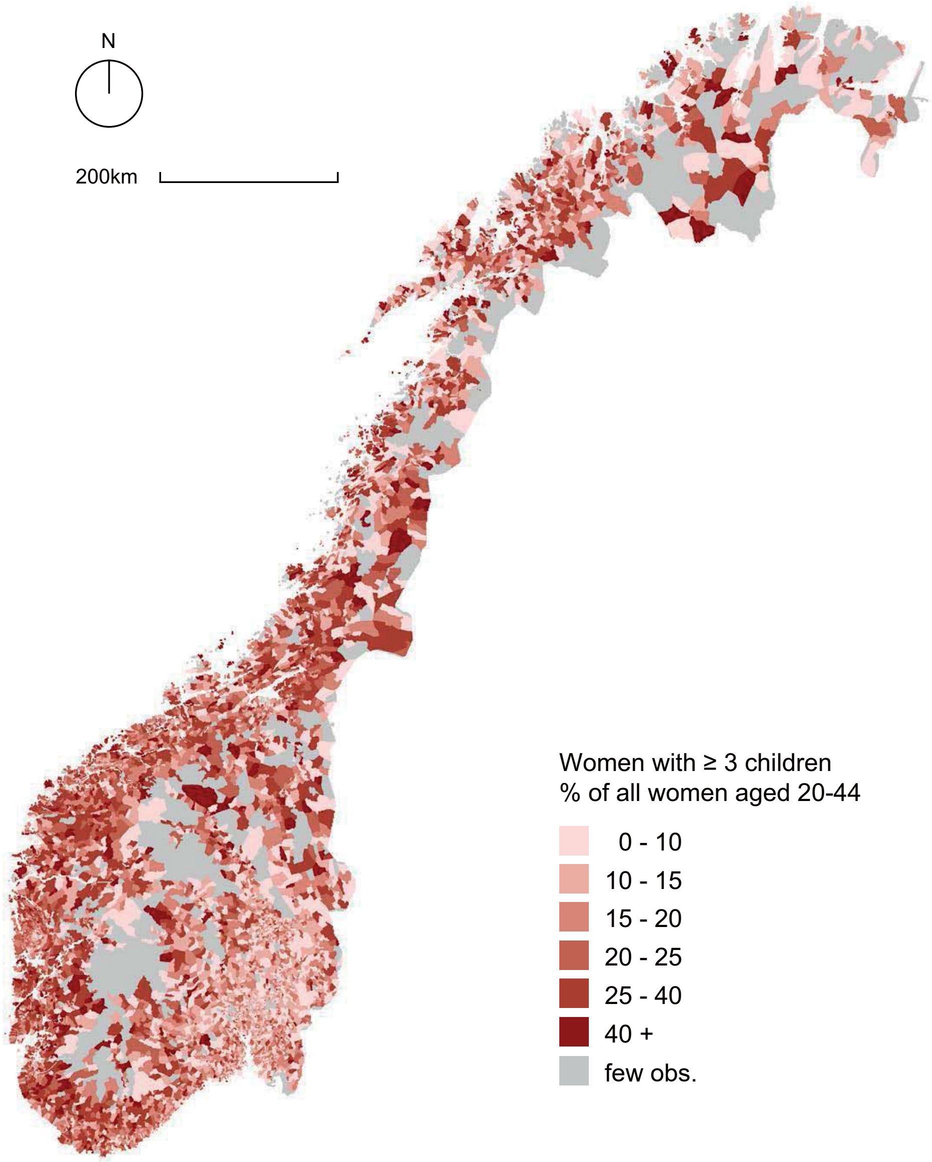
At the same time, family transitions and residential relocations remain highly interrelated (*Kulu/Steele* 2013; *Wagner/Mulder* 2015). This means that geographical clustering of fertility, even at small scales and net of many important area-level influences, may reflect both residential sorting and social interaction (*Manski* 1993). The present analyses use detailed longitudinal data from Norway (2000-2014), covering inhabitants' residential address, their housing, family situation and fixed effects for statistical tracts, thus accounting for central sorting mechanisms related to housing and sorting into urban districts or villages. The questions posed are: (i) Are couples in neighborhoods with many large families more likely to also have a third child? (ii) At what neighborhood scale do we observe the strongest association? (iii) To what degree is the association weakened when controls for other individual and area-level influences are included?

2 The case of Norway

In the European low-fertility context, Norway and the other Nordic countries are known for relatively high birth rates. In 2014, the last year of observation in the current study, the total fertility rate (TFR) for Norway was 1.76, but it has since declined to 1.53. As is the case in many European countries, there seems to be a two-child family ideal (*Frejka* 2008; *Sobotka/Beaujouan* 2014), and 40 percent of all Norwegian women above the age of 45 had given birth to two children (*Dommermuth et al*. 2015). In stark contrast to other European countries, a deviation from the two-child norm results in women having more than two children, rather than fewer children. In 2014, 14 percent of all women aged 45 were childless, another 14 percent had one child, and 32 percent had three or more children (*Dommermuth et al*. 2015). However, across Norway this pattern is not evenly distributed geographically.

Figure 1 illustrates the distribution of large families across Norway in 2014, by plotting the proportion of women aged 20-44 with three or more children. Primarily, an east-west divide regarding family sizes is visible. The number of women in the southwestern parts of Norway, also called the Norwegian Bible Belt, having at least three children is greater than that in the more metropolitan southeast. This finding is consistent with regional variations that have been documented for previous decades (*Lappegård* 1999), and reveals persisting regional fertility cultures. Besides these regional patterns, fertility rates also differ between neighborhoods. For example, within the capital city of Oslo, the difference in total fertility rates between urban districts stood at 0.8 children in 2015 (TFR of 2.08 in Bjerke versus 1.29 in St. Hanshaugen) (*Syse et al.* 2016). In contrast, the difference between counties is 0.3 children (*Syse et al.* 2016). While the association between sociodemographic characteristics and third births in Norway is relatively well-studied (*Kravdal/Rindfuss* 2008; *Hart et al.* 2015), the origin of the uneven spatial distribution of large families is less explored.

Fig. 1: Map of regional variations in third births in Norway, 2014. Basic statistical units (N=14,000)



Source: Map from the Geodatabase at Statistics Norway. Data from Norwegian administrative registers.

3 Third births: why should the context matter?

As for all parity transitions, having a third child depends on having the resources, the partner, and the ability to continue childbearing (see also *Balbo et al*. 2013). Whereas a woman's education is less important for *completed* fertility in relatively high-fertility countries such as the Nordic nations and France, becoming a mother at a later age is well known to lower a woman's probability of having many children (*Breton et al*. 2005; *Andersson et al*. 2009). Beyond individual determinants, in post-transitional societies too recent studies also relate the number of children in families to social interaction, e.g. social pressure from network members (*Balbo/Mills* 2011) or social influence by role models (*Ruckdeschel et al.* 2018). In line with this, couples alter their family size intentions during the life course due to changing circumstances, new information, reference groups, and perceived norms (*Iacovou/Tavares* 2011; *Clay/Zuiches* 1980; *Thomson* 2015; *Liefbroer* 2009).[1]

To the extent that socially embedded preferences drive third birth probabilities, one may expect to see geographical clusters of large families. This could emerge because neighbors sort residentially by lifestyle and fertility preferences, and/or because neighbors influence each other's fertility preferences. Empirically, several studies corroborate such geographical clustering, e.g. *Meggiolaro's* (2011) study of Milanese neighborhoods.

Moreover, fertility intentions have been shown to vary with regional fertility contexts in Europe (*Testa/Grilli* 2006). However, planning or having many children is also often linked to intergenerational transmission and rather stable religious values (*Adsera* 2006; *Cools/Hart* 2017). These are factors known to be unevenly distributed across space (*Mönkediek et al*. 2017). At the same time, early internalized family values and religious orientations are less likely to change with contemporary living contexts, or if so, rather slowly.

So, why might we observe similar fertility behavior among neighbors? Correlated fertility behavior within neighborhoods and variations in the number of children between neighborhoods may emerge through similar channels as for other geographical aggregates. Theoretical divisions are often made between explanations focusing on: (i) population composition and residential sorting; (ii) contextual effects; and (iii) social interaction and diffusion, although these often prove difficult to distinguish empirically.

(i) Population composition and residential sorting

National, regional, and local fertility dynamics can, in part, be understood through the compositions of the inhabitants and the residential sorting of individuals into

1 In the contemporary Norwegian context, there is broad access to contraception and early medical abortion. Unintended pregnancies are therefore assumed to be a minor issue and are not discussed further. Also, this paper makes no strict distinction between the desired or intended number of children versus the actual number, because desires and intentions are interrelated and subsequently revised to match possibilities and constraints (e.g. *Iacovou/Tavares* 2011).

places (*Hank* 2002; *Dribe et al.* 2017). With regard to population composition, one typical notion is that cities have a TFR below the national TFR because of the over-representation of highly educated women in urban areas, who are more likely to remain childless (*Kulu/Washbrook* 2014). However, this relation could likewise emerge from a so-called contextual effect if the cities' universities and labour markets not only attract highly educated individuals but also foster a career-oriented culture – also resulting in lower fertility rates, not only for highly-educated women.

The migration patterns of families additionally influence the population composition. Importantly, families do not move at random, and residential relocations often coincide with family expansion (*Kulu/Steele* 2013). Couples who intend to have many (more than two) children may tend to favor the same residential areas, either because these provide playmates for their children or offer other goods preferred by families. Such residential sorting tends to be empirically difficult to disentangle from contextual effects, but in most cases, population composition and residential sorting alone is not a sufficient explanation for spatial patterns in fertility (*de Beer/Deerenberg* 2007; *Kulu/Washbrook* 2014; *Kulu et al.* 2007; *Kulu/Boyle* 2009; *Fiori et al.* 2014; *Basten et al.* 2011; *Gray/Evans* 2018).

(ii) Contextual factors

Different places provide unique economic and social conditions for families which may influence moving and childbearing patterns and may be particularly salient and important to families with many children. In the Norwegian context, the propensity of having a third child has previously been associated with contextual factors such as settlement size or opportunity structures for families in a municipality. For instance, living in a rural area or a smaller town increases the probability of a third birth compared to living in larger cities (*Kulu et al.* 2007), whereas aggregate unemployment decreases the number of higher-order births (*Kravdal* 2002). Childcare availability has shown positive effects on all parities (*Rindfuss et al*. 2010), highlighting opportunities for having a large family as an important contextual factor. Within neighborhoods, proper and affordable housing is another crucial aspect (*Clark* 2012). Usually, home ownership and/or living in a single-family house is seen as the best option for families, but what is perceived as proper housing varies within and between countries (*Mulder* 2013). In addition to a family-friendly infrastructure and housing opportunities, broader cultural differences related to place-specific traditions or local social norms may play a role in the existence and persistence of local fertility patterns (*de Beer/Deerenberg* 2007; *Fulda* 2015). Several studies examine the relationship between local social norms and fertility, including linkages between neighborhood disadvantage and early childbearing (*Lupton/Kneale* 2012) as well as living in elite neighborhoods and late childbearing (*Malmberg/Andersson* 2019).

(iii) Social interaction and diffusion

The pace and spread of new fertility behaviors, such as nonmarital births, has led to the recognition of fertility diffusion as an important mechanism (*Bongaarts/Watkins* 1996; *Casterline* 2001). Such diffusion of fertility behavior between neighboring *regions* has been documented in several European contexts, for instance in France, Belgium, and Switzerland (*Lesthaeghe/Neels* 2002), Italy (*Vitali/Billari* 2015), historical Prussia (*Goldstein/Klüsener* 2014), and Norway (*Vitali et al*. 2015). As family dynamics are found to spread across regions, it can be expected that they also spread within neighborhoods. Neighborhoods can form arenas where neighbors interact and influence each other's childbearing behavior through mechanisms such as emotional contagion, social learning, and social pressure (*Bernardi/Klarner* 2014). This may be especially true for parents, as couples' networks have been shown to shift to more local ties after becoming parents (*Rözer et al.* 2017; *Kalmijn* 2012). Parents have many opportunities to interact with neighbors in a similar family situation, and such interaction might be particularly relevant. In line with this, results from a Swiss panel study show that after having a child, respondents feel closer to more neighbors and report more neighborly contact and support than before the childbirth (*Kalmijn* 2012).

Neighboring families may influence each other's fertility through similar channels as other networks (*Bernardi/Klarner* 2014). They may share knowledge, provide information, and behavioral examples, and social contagion may be apparent. Social contagion among neighbors has been documented among welfare recipients for instance (*Mood* 2010a; *Markussen/Røed* 2015). Previous studies find fertility contagion among friends (*Balbo/Barban* 2014), siblings (*Lyngstad/Prskawetz* 2010), and colleagues (*Pink et al*. 2014), though these tend to be potentially confounded by self-selection and contextual effects. Furthermore, the likelihood of becoming a parent has been found to be greater among individuals in cases where many network members have young children (*Lois/Becker* 2014). Drawing on similar mechanisms, neighbors' fertility (ideals) have been associated with family sizes and fertility limitation in several high-fertility contexts, for example in Nepal (*Axinn/Yabiku* 2001; *Jennings/Barber* 2013) and Cairo (*Weeks et al.* 2004). In low-fertility countries, however, theneighborhood dimension appears to be understudied when it comes to fertility behavior.

In summary, geographical variations in family size might be rooted in different opportunity structures of places, but they may also reflect local culture and/or norms. These contextual drivers may influence local fertility patterns through attracting certain couples or through influencing those already living there. Above that, social interaction may reinforce existing patterns. Hence, the phenomenon that couples with many children tend to live in similar neighborhoods may emerge due to a combination of compositional effects and residential sorting, specific characteristics of the residential context, and possibly social interaction.

4 Hypotheses

Based on the theoretical background and previous research, a strong association between the share of neighbors with more than two children and the probability of two-child couples of having another child is expected (Hypothesis 1). However, because of residential sorting, it is also expected that this relationship will be moderated and in part explained by individual characteristics of couples (Hypothesis 2a), and by enduring observed and unobserved characteristics of the residential context (Hypothesis 2b). More specifically, the following individual characteristics are considered: age, global region of birth, union status, education, employment and income. Other factors that are also taken into consideration are housing, time since the last move, and neighborhood characteristics such as the share of highly educated women, centrality and region. Lastly, unobserved characteristics of administrative neighborhoods are captured using fixed effects for statistical tracts.

Next, the relationship between neighbors' family sizes and a couple's probability of having another child depends on and varies with the chosen scale of the neighborhood fertility measure (Hypothesis 3). Spatial analysis always suffers from the modifiable areal unit problem (MAUP) where decisions about unit scaling and zoning influence the results one obtains (*Openshaw* 1984). The question is therefore not only *whether* neighbors' fertility behavior is related (*Sharkey/Faber* 2014), but also *at what scale* neighborhoods are relevant. In previous studies, regions, municipalities and census tracts have most commonly been examined as fertility contexts beyond the nation state (*Petrović et al.* 2018). *Weeks* (2004: 389) says: "The only real solution to both aspects of the MAUP is to begin with individual level data that are geocoded to specific locations, and thus, be able to aggregate the data to any scale that the researcher desires, and delimit any set of boundaries that the researcher believes is appropriate to the data."

The neighborhood scales that this study considers range from the closest 12 to the closest 500 households and may represent families' local activity spaces. With fewer neighbors, each neighbor's family size is given more weight. *Andersson* and *Musterd* (2010) argue that a grid of 100 x 100 metres, comprising on average 30-40 neighbors, is most relevant if social interaction among neighbors is of interest. Restricting the focus to very few neighbors increases the possibility of relevant neighbors being excluded, with the risk that couples' perception of their neighborhood is not captured. At the same time, it is common to attribute correlated behavior at small scales to social interaction among neighbors (e.g. *Andersson/Musterd* 2010), while the influence of unmeasured confounding characteristics and self-selection grows with neighborhood scale. Consequently, comparing the association at different scales might also indicate the relative importance of social interaction versus residential sorting and other contextual effects.

5 Data and measures

This study uses high-quality longitudinal data from several Norwegian administrative registers covering the entire population of Norway in the years 2000 to 2014. Using universal personal identification numbers and detailed address codes, time series on individual information from registers were linked and connected to individuals' residential information, the nationwide housing stock, and other geocoded information. Geographical coordinates for each inhabitant's place of residence were used to find couples' (k-)nearest neighbors in each year of observation.

The study sample consists of 257,527 married and unmarried co-residential couples. To identify them, information from Norwegian population registers was used and women who gave birth to their second child in the study period were selected, provided they were aged between 20 and 44 when their second child was born and lived in the same household as the child's father. Selection was based on the woman's parity since she is most involved with childbearing and childrearing. For almost 10 percent of couples, the birth of the second child represented the couples' first joint child. Whether the father or mother had children from previous partners was included as a control variable. Couples were censored when they moved abroad, one partner died, the woman turned 44 or the observation period exceeded 10 years. As periods in which couples did not share an address were excluded, separation also led to their removal from the risk set. Quarters of years are the time units, and process time (time since second childbirth) was included in the models using linear and quadratic terms. Thus, 5,413,443 couple-quarter observations were included in the regression analysis.

Outcome: The event under study is a woman's third childbirth, backdated to the start of pregnancy[2]

A range of *individual and couple characteristics* that are known to impact childbearing and that are unevenly distributed across neighborhoods were included as control variables in the models. They were measured yearly and for both partners, if relevant. All couples in the study sample were registered at the same address and were therefore co-residential. Whether they were married is included as a time-varying measure for their *union status*. *Stepchildren* were documented using the following categories: (i) No children from previous partners; (ii) Both partners had children from previous partners; (iii) Only the woman had children from previous partners; (iv) Only the man had children with previous partners; and lastly (v) Couples had more complicated prehistories or missing information. *Global region of birth* was measured for both partners, distinguishing between those born in Asia, Africa, South, and Central America, and those born in any other region, including Norway. Furthermore, both partners' *age* when entering the risk set was included.

2 Originally, the event of interest is a couple's decision to have a third child. Because register data do not provide information about when that decision was taken, I use the first trimester of the pregnancy leading to the live birth of the female partner's third child. The analyses thus capture individual and neighborhood circumstances at the time the female partner becomes pregnant with her third child. Note that abortions and miscarriages are not captured by these data.

Next, a *woman's employment status* was defined as active if her annual income exceeds the social security base income. *Educational enrollment* was documented for both partners using a dummy measure that is updated annually. Each partner's *highest educational level* was measured using the following categories: (i) Primary education (≤ 10 years); (ii) Secondary education (11-13 years); (iii) Short university education (14-17 years); and (iv) Long university education (≥ 18 years). Moreover, the annual *household income* from wages and salaries (inflation-adjusted to 2013-NOK) was included using five categories: (i) No income; (ii) < 600,000 NOK; (iii) 600,000-800,000 NOK; (iv) 800,000-1,000,000 NOK; and (v) > 1,000,000 NOK.

Housing: To indicate whether couples' current housing had room for another child, a variable combining the number of rooms and dwelling type in six different categories was used; distinguishing between single-family houses, terraced/row houses, and apartments, and comparing whether each house type had up to 4 rooms, or 5 rooms and more.

Residential relocations: Addresses and dates on residential relocations exist for the whole study period and couples continued to be followed even after moving. The point at which the couple moved to the current neighborhood was measured as a time-varying covariate with the following categories: (i) Moved to the neighborhood during the last year; (ii) Lived in the neighborhood for up to 5 years; (iii) Up to 10 years; or (iv) More than 10 years.

Neighborhood definition: The geographical coordinates of a couple's residential address form the center of their individual neighborhood. Through calculating straight-line distances to surrounding residents using the Modeclus procedure in SAS, the geographically nearest neighbors were selected up to the desired number (K = 12, 25, 50, 100, 250, and 500). Since population density varies across Norway and perceptions of personal neighborhoods are spatially limited, maximum distances between neighbors were defined (ranging between 15 and 100 km, respectively, see Appendix Table A1). Consequently, couples residing in remote places were given smaller numbers of potential neighboring peers. Neighborhoods were defined at 31 December for each study year.

Neighborhood fertility: This is the percentage of female neighbors with at least three children out of all female neighbors aged between 20 and 44. The neighbor's number of children was obtained from individual-level population registers and, for each year, aggregated at the defined scales. Clear overrepresentation or underrepresentation of large families in the neighborhood may have had greater impact on couples' further childbearing. To detect such nonlinearity or thresholds, the measure was divided into five categories: (i) < 10 percent; (ii) 10 up to 15 percent; (iii) 15 up to 20 percent; (iv) 20 up to 25 percent; (v) ≥ 25 percent.

Neighboring women's educational level: Using the same strategy, the percentage of neighboring women with a university education was calculated for each study year and included as a continuous control variable.

Municipal centrality: The centrality of a couple's residential municipality was included in the models without fixed effects since the rural, urban, and suburban dimensions have been emphasized in previous studies. Centrality describes a municipality's geographical position in relation to urban settlements and the population size of these settlements (see Statistics Norway Standard Classification of Centrality at http://stabas.ssb.no/, 2014 classifications). This study used the following five categories: (i) Municipality with a regional center; (ii) Municipality within 35 minutes' commuting time to a regional center; (iii) Municipality within 36 to 75 minutes' commuting time to a regional center; (iv) Relatively central municipalities; and (v) Less and least central municipalities.

Regions: To catch dynamics at higher spatial levels ("regional cultures"), dummies for the seven main regions in Norway were included. These are: Oslo and Akershus (Capital region), South Eastern Norway, Hedmark and Oppland, Agder and Rogaland, Western Norway, Trøndelag, and Northern Norway.

6 Statistical models

Linear probability models (LPM) were implemented with robust standard errors, adjusting for potential heteroscedasticity due to the binary dependent variable, and the correlation of observations over time or within units (*Mood* 2010b; *Snijders/Bosker* 2012: 197).[3] Results from discrete-time hazard regression models produced similar conclusions and can be found in Appendix Table A5 and Figure A1. In the first part of the analysis, the following models are estimated:

$$Y_{it} = \beta_0 + \beta_{Nbors} X_{Nbors,it} + \beta_{Time} Z_{Time,it} + \beta_{TimeSq} (Z_{Time,it} \times Z_{Time,it}) + \varepsilon_{it} \qquad \text{(Model 1)}$$

where Y_{it} is a couple's predicted probability of becoming pregnant with the third child during a certain quarter of the year and the subscripts denote the i^{th} couple in the t^{th} quarter of the year. $X_{Nbors,it}$ represents the percentage of neighbors with at least three children among couple i's k-nearest neighbors in year t in intervals (0-10, 10-15, 15-20, 20-25 and 25+ percent). $Z_{Time,it}$ is a continuous counter variable (process time) where the first couple-quarter for each couple is coded as 0, and each subsequent quarter of year incremented by 1.

Model 2 additionally includes sociodemographic characteristics of couples, where $Z_{Sociodem,i}$ represents time-constant couple-characteristics as the woman's and man's age at second childbirth, the presence of stepchildren and global region of birth, while $Z_{Sociodem,it}$ represents time-varying characteristics such as the cou-

[3] *Mood* (2010b: 78f.) presents the use of LPM as a valid solution to avoiding comparability issues in logistic regression. According to Mood, main reservations against using linear regression with binary dependent variables stem from the fear of: (1) getting predicted probabilities out of range; (2) heteroscedastic and non-normal residuals which could lead to invalid standard errors; and (3) a misspecified functional form. While (1) is not a problem here, (2) is solved by using robust standard errors, and (3) is of minor relevance because nearest neighbors' fertility is measured in categories. Hence, no continuous probability function is modeled but discrete probabilities associated with each neighborhood fertility category. LPM coefficients are closely related to the often-used average marginal effects from logit models (*Breen et al.* 2018: 50).

ple's union status, the woman's employment status, educational enrolment, highest educational level and annual household income:

$$Y_{it} = \beta_0 + \beta_{Nbors} X_{Nbors,it} + \beta_{Time} Z_{Time,it} + \beta_{TimeSq} (Z_{Time,it} \times Z_{Time,it}) + \beta_{Sociodem} Z_{Sociodem,it} + \beta_{Sociodem} Z_{Sociodem,i} + \varepsilon_{it} \quad \text{(Model 2)}$$

The next model adds covariates measuring residential characteristics ($Z_{ResidChar,it}$) such as housing, time since last move and neighboring women's educational level, all of which are time-varying:

$$Y_{it} = \beta_0 + \beta_{Nbors} X_{Nbors,it} + \beta_{Time} Z_{Time,it} + \beta_{TimeSq} (Z_{Time,it} \times Z_{Time,it}) + \beta_{Sociodem} Z_{Sociodem,it} + \beta_{Sociodem} Z_{Sociodem,i} + \beta_{ResidChar} Z_{ResidChar,it} + \varepsilon_{it} \quad \text{(Model 3)}$$

In model 4, $Z_{Region,it}$ denotes dummies for region of country and $Z_{Centrality,it}$ the centrality of the municipality where the couple lived using five categories. Both varied over time only if the couple had relocated during the observation period.

$$Y_{it} = \beta_0 + \beta_{Nbors} X_{Nbors,it} + \beta_{Time} Z_{Time,it} + \beta_{TimeSq} (Z_{Time,it} \times Z_{Time,it}) + \beta_{Sociodem} Z_{Sociodem,it} + \beta_{Sociodem} Z_{Sociodem,i} + \beta_{ResidChar} Z_{ResidChar,it} + \beta_{Region} Z_{Region,it} + \beta_{Centrality} Z_{Centrality,it} + \varepsilon_{it} \quad \text{(Model 4)}$$

With the k-nearest neighbor approach the "neighborhoods" of interest were ego-centered and thus, in essence, a characteristic of the couple. As a result, clustering observations within neighborhoods was neither possible nor needed in this study.[4] However, the risk remained that the main estimates capture other unmeasured neighborhood characteristics which had influenced predominant family sizes. Additional models with fixed effects based on administrative neighborhood boundaries were therefore utilized in model 5. Fixed effects take account of all time-constant features of these neighborhoods, which may be the built environment, childcare facilities, and other opportunity structures for families that were shared at this or a higher neighborhood level and that remained constant over the observation period, including relatively time-stable values or norms.

$$Y_{it} = \beta_0 + \beta_{Nbors} X_{Nbors,it} + \beta_{Time} Z_{Time,it} + \beta_{TimeSq} (Z_{Time,it} \times Z_{Time,it}) + \beta_{Sociodem} Z_{Sociodem,it} + \beta_{Sociodem} Z_{Sociodem,i} + \beta_{ResidChar} Z_{ResidChar,it} + \beta_{StatTract} Z_{StatTract,it} + \varepsilon_{it} \quad \text{(Model 5)}$$

4 Because observations over time are nested within couples, but not necessarily nested within *one* (higher level) geographical unit, the data are non-hierarchical or cross-classified when it comes to neighborhoods. This makes them less suitable for multilevel models, which would become computationally demanding (*Snijders/Bosker* 2012: 207). Hence, the influence of other neighborhood factors besides the nearest neighbors' fertility is treated as "disturbance" rather than the phenomenon to be studied in this paper.

As the data cover the whole country – containing both densely populated cities and sparsely populated rural regions – the chosen administrative unit was statistical tracts. $Z_{StatTract,it}$ are dummies for the approximately 1,550 statistical tracts in Norway (statistical tract fixed effects). Statistical tracts represent a level between the smallest statistical unit and municipalities and were constructed to comprise naturally coherent units of communication and space. In urban areas they ideally comprise 3,000-6,000 inhabitants, in rural areas around 1,000-3,000 inhabitants.[5] In the models with statistical tract fixed effects, associations at lower scales will be better identified. To the extent that associations are found, these capture how individual neighborhoods deviate from the statistical tract where the couple lived.

7 Descriptive statistics

In total, 29.5 percent of the 257,527 couples in the study sample got pregnant with their third child during the years 2000 to 2014 (see Appendix Table A2). The average spacing between a second childbirth and the pregnancy was 10.6 quarters of years, which corresponds to 2.7 years; the whole study sample was observed for 4.6 years on average. Men and women in couples who conceived a third child were, on average, 1.6 years younger than the sample average when the second child was born and were more often found among those who were born abroad and who were married. In addition, when the woman's first child was from a previous relationship, couples more often had another child (see Appendix Table A2).

Table 1 gives descriptive statistics about couples' residential contexts. Two-child families in Norway most commonly lived in relatively spacious single-family houses, regardless of whether they were expecting another child or not. Over 40 percent of all final observations were on couples who lived in a single-family house with 5 rooms or more. Furthermore, in the last year of observation, most of the families (40.3 percent) had lived in their respective neighborhood for up to 5 years; couples expecting a third child were overrepresented among those with shorter residencies. As previously shown (Fig. 1), descriptive statistics confirm that couples conceiving their third child more often lived in the least central municipalities and were overrepresented in certain regions of Norway. Also, the share of neighboring women with a university education was somewhat lower among women expecting their third child.

Looking at neighbors' family sizes, we see from Table 2 that among most couples, 10 to 20 percent of the nearest neighbors had three or more children. As expected for neighborhoods which referred to the 50 nearest neighbors or fewer, observations are more dispersed and are more often found in the lower, but also in the highest categories. However, irrespective of whether the neighborhood fertility measure refers to the 12 or the 500 nearest neighbors, third births are most com-

[5] Consequently, in rural regions in particular, statistical tracts may overlap with a neighborhood size of 500 neighbors.

Tab. 1: Descriptive statistics of residential context variables (last couple-observation)

	Sample total		Couples with a 3rd birth	
	N (total)	Mean	N (total)	Mean
Neighbor women with a university education				
% of 500 nearest neighbors	257,527	43.0	75,847	39.2
250 nearest neighbors	257,527	43.0	75,847	39.1
100 nearest neighbors	257,527	43.3	75,847	39.2
50 nearest neighbors	257,527	43.6	75,847	39.4
25 nearest neighbors	257,527	43.9	75,847	39.5
12 nearest neighbors	257,526	44.2	75,846	39.7
	N (cell)	Pct (col)	N (cell)	Pct (row)
Dwelling type and number of rooms				
single-family house, 5 rooms or more	109,203	42.4	30,593	28.0
single-family house, 4 rooms or less	73,845	28.7	20,062	27.2
terraced/row house, 5 rooms or more	11,388	4.4	2,974	26.1
terraced/row house, 4 rooms or less	18,739	7.3	5,275	28.1
apartment, 5 rooms or more	1,691	0.7	514	30.4
apartment, 4 rooms or less	20,253	7.9	6,621	32.7
missing housing information	22,408	8.7	9,808	43.8
Residential time in current neighborhood				
moved during the last year	35,701	13.9	16,658	46.7
last relocation up to 5 years ago	103,746	40.3	39,243	37.8
last relocation up to 10 years ago	75,646	29.4	17,487	23.1
last relocation more than 10 years ago	42,434	16.5	2,459	5.8
Centrality of residential municipality				
municipality with regional center	67,620	26.3	19,605	29.0
travel time to regional center < 36 min	69,825	27.1	19,011	27.2
travel time to regional center 36-75 min	43,648	17.0	11,965	27.4
relatively central	41,544	16.1	12,344	29.7
less and least central	34,890	13.6	12,922	37.0
Region of Norway				
Oslo and Akershus (Capital region)	63,887	24.8	16,107	25.2
Hedmark and Oppland	17,173	6.7	4,505	26.2
South Eastern Norway	46,310	18.0	11,277	24.4
Agder and Rogaland	41,373	16.1	14,424	34.9
Western Norway	45,148	17.5	16,067	35.6
Trøndelag	22,522	8.8	6,652	29.5
Northern Norway	21,114	8.2	6,815	32.3
Total	257,527	100	75,847	29.5

Source: Data from Norwegian registers on a quarterly/yearly basis 2000-2014. Descriptive statistics for the last year of observation for each couple.

Tab. 2: Descriptive statistics of the independent variable (last couple-observation)

	Sample total		Couples with a 3rd birth	
	N (cell)	Pct (col)	N (cell)	Pct (row)
Neighbors with at least 3 children out of				
500 nearest neighbors				
0-10%	33,788	13.1	7,454	22.1
10-15%	94,597	36.7	19,253	20.4
15-20%	72,579	28.2	22,208	30.6
20-25%	39,281	15.3	15,643	39.8
25+%	17,282	6.7	11,289	65.3
250 nearest neighbors				
0-10%	37,102	14.4	7,941	21.4
10-15%	88,831	34.5	18,999	21.4
15-20%	70,077	27.2	20,637	29.4
20-25%	40,365	15.7	15,707	38.9
25+%	21,152	8.2	12,563	59.4
100 nearest neighbors				
0-10%	44,815	17.4	9,678	21.6
10-15%	72,399	28.1	16,330	22.6
15-20%	68,175	26.5	19,194	28.2
20-25%	41,515	16.1	14,885	35.9
25+%	30,623	11.9	15,760	51.5
50 nearest neighbors				
0-10%	51,335	19.9	11,582	22.6
10-15%	74,634	29.0	17,891	24.0
15-20%	48,740	18.9	13,917	28.6
20-25%	47,460	18.4	15,998	33.7
25+%	35,358	13.7	16,459	46.5
25 nearest neighbors				
0-10%	75,642	29.4	17,727	23.4
10-15%	44,586	17.3	11,406	25.6
15-20%	41,970	16.3	11,791	28.1
20-25%	35,932	14.0	11,297	31.4
25+%	59,397	23.1	23,626	39.8
12 nearest neighbors				
0-10%	116,797	45.4	29,546	25.3
10-15%	1,997	0.8	700	35.1
15-20%	62,676	24.3	18,063	28.8
20-25%	1,778	0.7	680	38.2
25+%	74,278	28.8	26,857	36.2
Total	257,527	100	75,846	29.5

Source: Data from Norwegian registers on a quarterly/yearly basis 2000-2014. Neighbors updated yearly. Descriptive statistics for the last year of observation for each couple.

mon among two-child couples who live in neighborhoods with the greatest proportion of (25+ percent) large families. This is consistent with the first hypothesis claiming that there is a positive relationship between the percentage of neighbors with more than two children and the probability among two-child couples of having another child. So far, the more neighbors the neighborhood fertility measure refers to, the clearer the pattern.

8 Results from the regression models

To address the research questions and test the previously posed hypotheses, several regression models as described in chapter 6 were estimated where the outcome is a third birth and the predictor of interest is the share of women with three or more children among each couple's 250 nearest neighbors. First, a basic model including the neighbors' fertility and process time (model 1) is shown. Then, sociodemographic characteristics of couples are included (model 2). Next, a model with individual residential characteristics, such as housing (model 3), and a model including observed area-level characteristics (model 4) is discussed, before unobserved neighborhood characteristics at the level of statistical tracts are held constant (model 5). Finally, to analyze the impact of neighborhood scaling (MAUP) and to test Hypothesis 3, results for neighborhood measures referring to couples' 12, 25, 50, 100, and 500 nearest neighbors are compared.

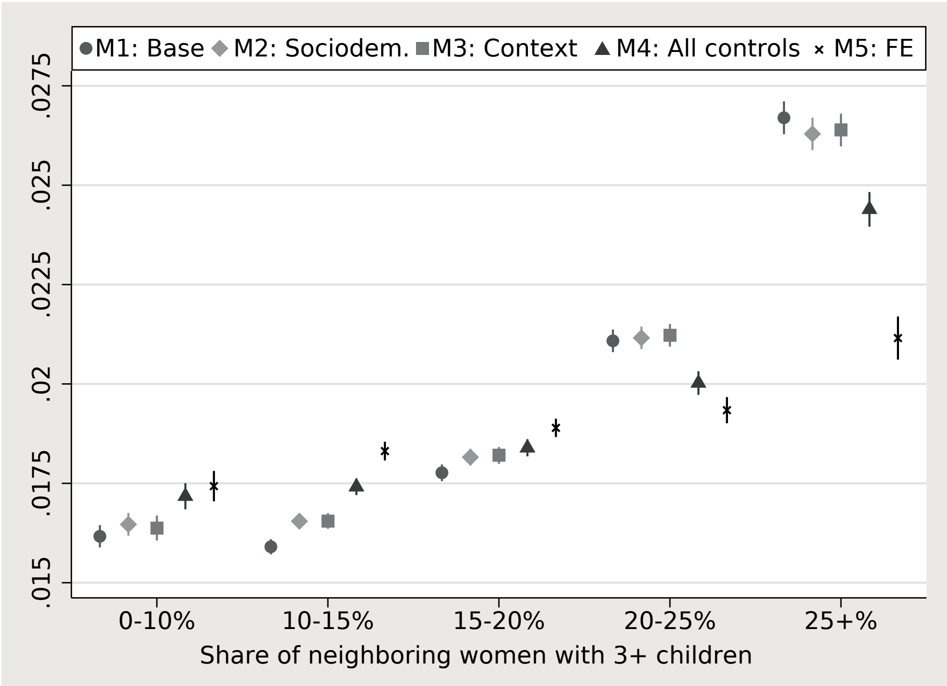
8.1 Stepwise models

Results from the first models with stepwise inclusion of sociodemographic, residential and area-level variables, as well as fixed effects, are illustrated in Figure 2 and shown in Appendix Table A3. As seen in the first baseline model, including only the neighborhood fertility measure and process time, having a third child was most likely among couples who lived in neighborhoods with many other large families (25+ percent). The predicted probability of being pregnant with a third child three years after the second childbirth was about 66 percent higher for these couples compared to couples who lived in neighborhoods where the proportion of large families was less than 10 percent. This is consistent with Hypothesis 1.

However, Hypothesis 2a states that this association exists either partly or fully because couples with initially different probabilities of giving birth to a third child sort into different neighborhoods. Comparing couples living in different neighborhoods, while controlling for partners' age, global region of origin, union status, the presence of stepchildren, the man's or woman's level of education and educational enrolment, the woman's labor force participation and household income (model 2), the positive association between neighbors' family sizes and a couple's likelihood of having another child persisted. In fact, the predicted probabilities do not appear to be substantially different from the previous model (see Fig. 2).

Surprisingly, adding residential characteristics such as couples' dwelling type and size, residential time in the neighborhood, and the share of neighboring women

Fig. 2: Model comparison using predicted probabilities with 95 percent CIs for being in the 1st trimester of pregnancy with the subsequent live-born 3rd child, at the time the 2nd child turns 3 years of age, by neighborhood fertility (250 nearest neighbors)



Note: All models include process time and process time squared. Additional covariates included in models 2 to 5 are: both partners' age at start, global region of birth, union status, stepchildren, both partners' educational attainment and enrolment, the woman's employment status and household income. Models 3 to 5 additionally include measures for housing, residential time in current neighborhood and neighboring women's education. Model 4 includes dummies for country region and municipal centrality, while Model 5 includes fixed effects for statistical tracts (see also chapter 6).

Source: Data from Norwegian registers on a quarterly/yearly basis 2000-2014.

with a university education (model 3) did not impact the main relationship either. Usually, housing as well as women's average education represent important sorting dimensions and are assumed to explain much spatial correlation of fertility behavior (e.g. *Kulu/Boyle* 2009). Indeed, families who lived in apartments, row houses, or in houses with four rooms or less were less likely to increase their family size than couples who lived in spacious single-family houses (see Appendix Table A3). It is also evident that couples who had remained in place for a while were less likely to have a third child than couples who had relocated during the last year. Hence, the findings confirm that anticipatory moves and appropriate housing were important predictors of third births. However, including these variables did not alter the relationship between neighbors' family size and third births. Taken together, results from model

2 and 3 therefore consolidate Hypothesis 1 but provide only limited support for Hypothesis 2a, claiming that parts of the association between neighbors' family sizes are moderated and explained by individual characteristics of couples that were included in these models.

The main relationship appeared noticeably different first when indicators for the centrality of a couple's municipality and country region dummies were added (model 4). As the share of neighboring women with three or more children increases, the variance in the predicted probability of having a third birth was less when these area characteristics were taken into account (see Fig. 2). Consequently, results from the fourth model support Hypothesis 2b, stating that parts of the association between neighbors' family sizes and a couple's probability of having another child were explained by other characteristics of the residential context. However, note that area variables had more impact on the relationship of interest than individual measures such as housing and the education of couples' nearest neighbors. Moreover, the characteristics that could be included in model 4 were limited to those available in the dataset. Introducing neighborhood fixed effects at the level of statistical tracts, the fifth model controls for unobserved variation between these tracts.

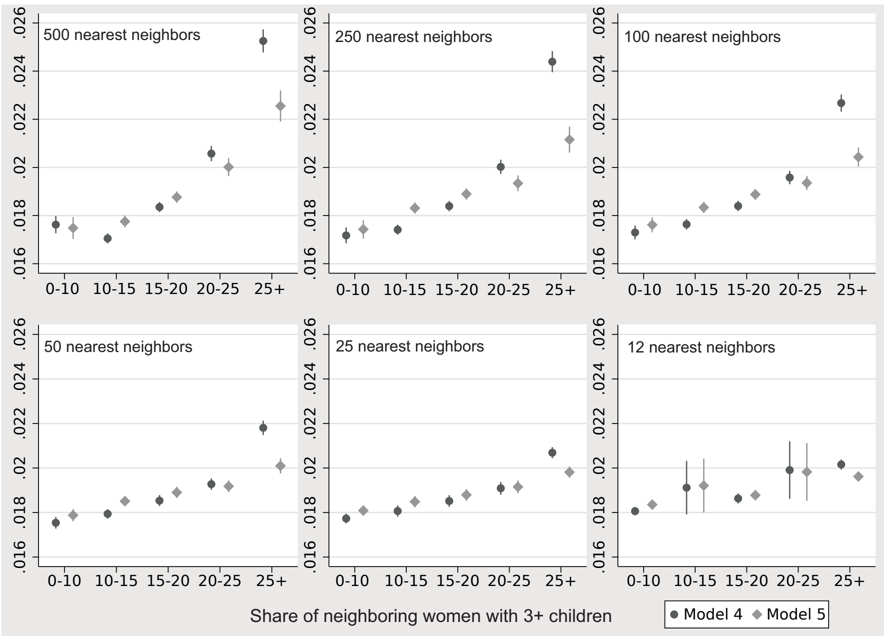
The model with fixed effects replaces the controls for municipal centrality and region with a fixed term that captures all time-constant features at the level of statistical tracts and higher levels. Consequently, residential sorting at larger scales, into regions and larger "neighborhoods", is accounted for, and the main estimates capture remaining variation in third birth probabilities between the smaller individual neighborhoods. When applying these fixed effects, the predicted probability of having a third child for couples living among many large families (25+ percent) was reduced in particular. In this model, their predicted probability of being pregnant with a third child three years after the second childbirth was only about 20 percent higher compared to couples who lived in neighborhoods where the share of large families was less than 10 percent. Generally, the remaining variation between the different neighborhood categories was much lower. The fifth model therefore also supports Hypothesis 2b and shows that parts of the association between neighbors' family sizes and a couple's probability of having another child were explained by unobserved characteristics of the neighborhoods.

Nonetheless, results from the regression models using neighborhoods which refer to couples' 250 nearest neighbors still support the first hypothesis claiming that the family size of neighbors was positively related to a couple's propensity to have a third child. Parts of this relationship were (slightly) moderated by individual characteristics of couples and their housing situation, but even more so by observed and unobserved characteristics of the broader residential context. These findings support Hypothesis 2b in particular and indicate that residential sorting at larger spatial scales is important for the spatial clustering of fertility. However, the relationship of interest remained, even after controlling for these characteristics of couples and their larger neighborhoods, and was thus relatively consistent.

8.2 Scale comparison

To show how sensitive results are for the scaling of the individual neighborhoods, results for fertility measures of a couple's nearest 12, 25, 50, 100, 250, and 500 neighbors are presented in Figure 3 (see also Appendix Table A4). Overall, the association between the share of neighbors with more than two children and the probability of two-child couples having another child was weaker as the number of neighbors to which the neighborhood fertility measure referred decreases. This was especially true for the predicted probability of third births among couples who were surrounded by a high percentage of large families (25+ percent). On the other hand, for couples living in neighborhoods where large families were scarce (0-10 percent), the predicted probabilities for third births were relatively similar regardless of how many neighbors the measure referred to.

Fig. 3: Neighborhood scale comparison using predicted probabilities with 95 percent CIs for being in the 1st trimester of pregnancy with the subsequent live-born 3rd child, at the time the 2nd child turns 3 years of age, models 4 and 5



Note: Covariates included are: process time, both partners' age at start, global region of birth, union status, stepchildren, both partners' educational attainment and enrolment, the woman's employment status, household income, housing, residential time, neighbors' education, centrality and region (last two only in model 4). Model 5 additionally includes fixed effects for statistical tracts. For k-12, few observations fell in the categories 10-15 and 20-25 percent (see also Table 2).

Source: Data from Norwegian registers on a quarterly/yearly basis 2000-2014.

From Figure 3, we also notice that the estimates with increasing neighborhood scale also differ more between model 4, which includes all previously mentioned control variables, and model 5, which uses fixed effects for statistical tracts.[6] This confirms that the influence of unmeasured confounding neighborhood characteristics grows with neighborhood scale. Meanwhile, with decreasing numbers of neighbors, the variation in predicted third birth probabilities by neighborhood fertility generally decreased.

Given the observed variation, the results confirm the previously discussed MAUP and thus support the third hypothesis, which states that (the strength of) the relationship between neighbors' family sizes varies with the chosen neighborhood scale. Specifically, the strength of the relationship between neighbors' fertility increased with neighborhood scale, which might emphasize the relative importance of other contextual effects over social interaction effects. Nevertheless, a correlation between the percentage of neighboring families with many (3+) children and a couple's transition to having a third child is apparent, even if only the twelve nearest neighbors were considered.

9 Conclusion and discussion

Previous research has found that couples' decisions about fertility behavior are influenced by their social context, in which immediate neighborhoods and neighbors may also play a significant role. Neighborhoods are important contexts of childrearing. Families may therefore sort geographically based on their fertility preferences, but they may also increasingly interact with neighboring families (*Kalmijn* 2012). Even so, with few exceptions (e.g. *Malmberg/Andersson* 2019), neighborhoods and neighbor networks have to date been severely understudied in fertility research.

This study indicates that fertility behavior is sociogeographically situated through potential social interaction effects among neighbors as well as well-known processes of selective moves. The analyses showed that two-child couples who lived in neighborhoods with a higher share of families with more than two children were more likely to have a third child than were other two-child couples. Conversely, two-child couples who lived in neighborhoods where families with at least three children were scarce were less likely to have a third child.

In previous studies, spatial variations in fertility have often been explained by population composition and residential sorting, regional cultures and specific characteristics of the residential context, such as housing and centrality (*Hank* 2002; *Kulu et al.* 2007; *de Beer/Deerenberg* 2007; *Fulda* 2015). In this study, observed and unobserved characteristics of the residential context and, to a lesser degree, sociodemographic characteristics of couples, moderated the relationship between

6 Because the fixed effects are at the level of statistical tracts regardless of the scale of the individual neighbourhood, they might impact individual neighbourhoods differently, as discussed earlier (e.g. note 2). As a result, it may not be the ideal model for a scale comparison. However, because the fixed effect model remains a stronger model than model 4, both are presented.

fertility in the neighborhood and a couple's probability of continued childbearing. Accounting for broader area-level variables had more impact on the relationship of interest than individual measures such as housing and the education of couples' nearest neighbors. This indicates that residential sorting at *larger* spatial scales is important for the spatial clustering of fertility, aligns well with regional variations that have been documented for previous decades (*Lappegård* 1999), and underlines the persistent regional fertility cultures. Moreover, the results also confirmed previous findings that the propensity to have many children is highest among couples living in spacious single-family houses in rural regions. But beyond these characteristics, the fertility of nearest neighbors also seems to matter. This correlation has never been shown at such a small scale.

The neighborhood scales that were considered in this study range from the nearest 12 to the nearest 500 neighbors and may all reasonably represent families' everyday activity spaces. The more neighbors referred to in the neighborhood measure, however, the stronger the correlation between neighbors' family size and couples' continued childbearing became. This was especially true for couples living in neighborhoods where large families were overrepresented. The analyses also revealed that the influence of unmeasured confounding neighborhood characteristics grew with neighborhood scale. In sum, these results might emphasize the relative importance of other contextual effects and selection over social interaction effects. Family events and residential relocations are highly intertwined processes. The positive association that was found between third births and recent residential relocations may also point towards selective or anticipatory relocations, or perhaps towards new neighborhoods and neighbors stimulating couples' child desires. While the latter is not completely unlikely if one assumes that desired family size is subject to change (*Thomson* 2015), the mechanisms cannot be distinguished empirically.

9.1 Limitations and strengths

The aim of this paper was to gain more insight into spatial variations in family sizes by ascertaining the importance of the family behavior of couples' nearest neighbors relative to those of other neighborhood characteristics. It is notoriously difficult to distinguish between self-selection into neighborhoods and causal effects of neighborhood contexts, and studies rarely succeed in this endeavour. Importantly, families do not move at random, and couples who intend to have many (3+) children may tend to favor the same residential areas. Even if very small neighborhood scales were used and a range of traits and fixed effects could be included in the models, shared unmeasured confounders among neighbors are likely to remain.

In future studies, it might be interesting to elaborate further on the residential segregation of families, including by dimensions such as country of origin and socioeconomic status. Such segregation is particularly prevalent in larger cities and is most likely important because contact with neighbors might depend on more commonalities than simply sharing the children's playground. The study was also limited to current neighborhoods and thus did not address couples' neighborhood histories. There could be cumulative (or contradictory) effects over the life course, which call for an inclusion in future studies of time lags, the upbringing context, and the family of origin (*Miltenburg/van der Meer* 2018). To test whether there are any discrepancies or changes over the life course, it would also be interesting to analyze how fertility ideals, and not only actual fertility behavior, are interrelated among neighbors and within neighborhoods. Unfortunately, such data are not available for Norway.

Nevertheless, this study brought together both the spatial and social context by introducing small-scale neighborhoods using k-nearest neighbor measures. By defining individual neighborhoods of different sizes, this study introduced a new dimension of spatial fertility variation and has contributed to an emerging awareness of scale sensitivity. The correlation between neighbors' fertility behavior could be shown even at the very small scale of the 12 nearest neighbors. As such, this paper contributes to a broadening of spatial and network thinking in fertility research to include neighborhoods and neighbors. Above all, this study has shown that neighborhoods and neighbors matter – through attracting couples and inducing selective moves and potential social interaction effects.

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References

Adsera, Alicia 2006: Religion and Changes in Family-Size Norms in Developed Countries. In: Review of Religious Research 47,3: 271-286.

Andersson, Gunnar et al. 2009: Cohort Fertility Patterns in the Nordic Countries. In: Demographic Research 20,14: 313-352. https://doi.org/10.4054/DemRes.2009.20.14

Andersson, Roger; Musterd, Sako 2010: What Scale Matters? Exploring the Relationships between Individuals' Social Position, Neighbourhood Context and the Scale of Neighbourhood. In: Geografiska Annaler: Series B, Human Geography 92,1: 23-43. https://doi.org/10.1111/j.1468-0467.2010.00331.x

Axinn, William G.; Yabiku, Scott T. 2001: Social Change, The Social Organization of Families, and Fertility Limitation. In: American Journal of Sociology 106,5: 1219-1261. https://doi.org/10.1086/320818

Balbo, Nicoletta; Barban, Nicola 2014: Does Fertility Behavior Spread among Friends? In: American Sociological Review 79,3: 412-431. https://doi.org/10.1177/0003122414531596

Balbo, Nicoletta; Billari, Francesco C.; Mills, Melinda 2013: Fertility in Advanced Societies: A Review of Research. In: European Journal of Population 29,1: 1-38. https://doi.org/10.1007/s10680-012-9277-y

Balbo, Nicoletta; Mills, Melinda 2011: The Effects of Social Capital and Social Pressure on the Intention to Have a Second or Third Child in France, Germany, and Bulgaria, 2004-05. In: Population Studies 65,3: 335-351. https://doi.org/10.1080/00324728.2011.579148

Basten, Stuart; Huinink, Johannes; Klüsener, Sebastian 2011: Spatial Variation of Sub-National Fertility Trends in Austria, Germany and Switzerland. In: Comparative Population Studies 36,2-3: 573-614. https://doi.org/10.4232/10.CPoS-2011-08en

Bernardi, Laura; Klarner, Andreas 2014: Social Networks and Fertility. In: Demographic Research 30,22: 641-669. https://doi.org/10.4054/DemRes.2014.30.22

Bongaarts, John; Watkins, Susan C. 1996: Social Interactions and Contemporary Fertility Transitions. In: Population and Development Review 22,4: 639-682. https://doi.org/10.2307/2137804

Breen, Richard; Karlson, Kristian Bernt; Holm, Anders 2018: Interpreting and Understanding Logits, Probits, and Other Nonlinear Probability Models. In: Annual Review of Sociology 44,1: 39-54. https://doi.org/10.1146/annurev-soc-073117-041429

Breton, Didier; Prioux, France; Dutreuilh, Catriona 2005: Two Children or Three?: Influence of Family Policy and Sociodemographic Factors. In: Population (English Edition) 60,4: 415-445. https://doi.org/10.2307/4148181

Casterline, John B. 2001: Diffusion Processes and Fertility Transition: Introduction. In: *Casterline, John B.* (Ed.): Diffusion Processes and Fertility Transition: Selected Perspectives. Washington, DC: The National Academies Press: 1-38.

Clark, William A. V. 2012: Do Women Delay Family Formation in Expensive Housing Markets? In: Demographic Research 27,1: 1-24. https://doi.org/10.4054/DemRes.2012.27.1

Clay, Daniel C.; Zuiches, James J. 1980: Reference Groups and Family Size Norms. In: Population and Environment 3,3: 262-279. https://doi.org/10.1007/bf01255342

Cools, Sara; Hart, Rannveig Kaldager 2017: The Effect of Childhood Family Size on Fertility in Adulthood: New Evidence From IV Estimation. In: Demography 54,1: 23-44. https://doi.org/10.1007/s13524-016-0537-z

de Beer, Joop; Deerenberg, Ingeborg 2007: An Explanatory Model for Projecting Regional Fertility Differences in the Netherlands. In: Population Research and Policy Review 26,5-6: 511-528. https://doi.org/10.1007/s11113-007-9040-y

Diabaté, Sabine; Ruckdeschel, Kerstin 2016: Gegen den Mainstream – Leitbilder zu Kinderlosigkeit und Kinderreichtum zur Erklärung der Abweichung von der Zweikindnorm. In: ZfF 28,33: 328-356. https://doi.org/10.3224/zff.v28i3.26044

Dommermuth, Lars et al. 2015: Kunnskapsstatus om Fruktbarhet og Samliv i Norge. Reports 31. Oslo: Statistics Norway.

Dribe, Martin; Juárez, Sol Pía.; Scalone, Francesco 2017: Is It Who You Are or Where You Live? Community Effects on Net Fertility at the Onset of Fertility Decline: A Multilevel Analysis Using Swedish Micro-Census Data. In: Population, Space and Place 23,2. https://doi.org/10.1002/psp.1987

Fiori, Francesca; Graham, Elspeth; Feng, Zhiqiang 2014: Geographical Variations in Fertility and Transition to Second and Third Birth in Britain. In: Advances in Life Course Research 21: 149-167. https://doi.org/10.1016/j.alcr.2013.11.004

Frejka, Tomas 2008: Overview Chapter 2: Parity Distribution and Completed Family Size in Europe: Incipient Decline of the Two-Child Family Model. In: Demographic Research 19,4: 47-72. https://doi.org/10.4054/DemRes.2008.19.4

Fulda, Barbara E. 2015: Culture's Influence: Regionally Differing Social Milieus and Variations in Fertility Rates. MPIfG Discussion Paper 15/4. Köln: Max-Planck-Institut für Gesellschaftsforschung.

Goldstein, Joshua R.; Klüsener, Sebastian 2014: Spatial Analysis of the Causes of Fertility Decline in Prussia. In: Population and Development Review 40,3: 497-525. https://doi.org/10.1111/j.1728-4457.2014.00695.x

Gray, Edith; Evans, Ann 2018: Geographic Variation in Parity Progression in Australia. In: Population, Space and Place 24,2. https://doi.org/10.1002/psp.2080

Greulich, Angela; Dasre, Aurelien; Inan, Ceren 2016: Two or Three Children? Turkish Fertility at a Crossroads. In: Population and Development Review 42,3: 537-559. https://doi.org/10.1111/j.1728-4457.2016.00148.x

Hank, Karsten 2002: Regional Social Contexts and Individual Fertility Decisions: A Multilevel Analysis of First and Second Births in Western Germany. In: European Journal of Population 18,3: 281-299. https://doi.org/10.1023/A:1019765026537

Hart, Rannveig K.; Rønsen, Marit; Syse, Astri 2015: Hvem Velger å Få (flere) Barn? Økonomiske analyser 4/2015: 48-59.

Iacovou, Maria; Tavares, Lara P. 2011: Yearning, Learning, and Conceding: Reasons Men and Women Change Their Childbearing Intentions. In: Population and Development Review 37,1: 89-123. https://doi.org/10.1111/j.1728-4457.2011.00391.x

ISSP Research Group 2016: International Social Survey Programme: Family and Changing Gender Roles IV – ISSP 2012. GESIS Data Archive, Cologne. ZA5900 Data file Version 4.0.0. https://doi.org/10.4232/1.12661

Jennings, Elyse A.; Barber, Jennifer S. 2013: The Influence of Neighbors' Family Size Preference on Progression to High Parity Births in Rural Nepal. In: Studies in Family Planning 44,1: 67-84. https://doi.org/10.1111/j.1728-4465.2013.00344.x

Kalmijn, Matthijs 2012: Longitudinal Analyses of the Effects of Age, Marriage, and Parenthood on Social Contacts and Support. In: Advances in Life Course Research 17,4: 177-190. https://doi.org/10.1016/j.alcr.2012.08.002

Kravdal, Øystein 1992: The Emergence of a Positive Relation Between Education and Third Birth Rates in Norway with Supportive Evidence from the United States. In: Population Studies 46,3: 459-475.

Kravdal, Øystein 2002: The Impact of Individual and Aggregate Unemployment on Fertility in Norway. In: Demographic Research 6,10: 263-294. https://doi.org/10.4054/DemRes.2002.6.10

Kravdal, Øystein; Rindfuss, Ronald R. 2008: Changing Relationships between Education and Fertility: A Study of Women and Men Born 1940 to 1964. In: American Sociological Review 73,5: 854-873. https://doi.org/10.1177/000312240807300508

Kulu, Hill; Boyle, James P. 2009: High Fertility in City Suburbs: Compositional or Contextual Effects? In: European Journal of Population 25,2: 157-174. https://doi.org/10.1007/s10680-008-9163-9

Kulu, Hill; Steele, Fiona 2013: Interrelationships Between Childbearing and Housing Transitions in the Family Life Course. In: Demography 50,5: 1687-1714. https://doi.org/10.1007/s13524-013-0216-2

Kulu, Hill; Vikat, Anders; Andersson, Gunnar 2007: Settlement Size and Fertility in the Nordic Countries. In: Population Studies 61,3: 265-285. https://doi.org/10.1080/00324720701571749

Kulu, Hill; Washbrook, Elisabeth 2014: Residential Context, Migration and Fertility in a Modern Urban Society. In: Advances in Life Course Research 21: 168-182. https://doi.org/10.1016/j.alcr.2014.01.001

Lappegård, Trude 1999: Regionale Variasjoner i Fruktbarheten i Norge. Reports 99/7. Oslo: Statistics Norway.

Lesthaeghe, Ron; Neels, Karel 2002: From the First to the Second Demographic Transition: An Interpretation of the Spatial Continuity of Demographic Innovation in France, Belgium and Switzerland. In: European Journal of Population 18,4: 325-360. https://doi.org/10.1023/a:1021125800070

Liefbroer, Aart C. 2009: Changes in Family Size Intentions Across Young Adulthood: A Life-Course Perspective. In: European Journal of Population 25,4: 363-386. https://doi.org/10.1007/s10680-008-9173-7

Logan, Jon R. 2012: Making a Place for Space: Spatial Thinking in Social Science. In: Annual Review of Sociology 38,1: 507-524. https://doi.org/10.1146/annurev-soc-071811-145531

Lois, Daniel; Becker, Oliver Arránz 2014: Is Fertility Contagious? Using Panel Data to Disentangle Mechanisms of Social Network Influences on Fertility Decisions. In: Advances in Life Course Research 21: 123-134. https://doi.org/10.1016/j.alcr.2013.10.001

Lupton, Ruth; Kneale, Dylan 2012: Theorising and Measuring Place in Neighbourhood Effects Research: The Example of Teenage Parenthood in England. In: *van Ham, Maarten et al.* (Eds.): Neighbourhood Effects Research: New Perspectives. Dordrecht: Springer Netherlands: 121-145. https://doi.org/10.1007/978-94-007-2309-2_6

Lyngstad, Torkild H.; Prskawetz, Alexia 2010: Do Siblings' Fertility Decisions Influence Each Other? In: Demography 47,4: 923-934. https://doi.org/10.1007/BF03213733

Malmberg, Bo; Andersson, Eva K. 2019: Adolescent Neighbourhood Context and Transition to Parenthood: A Longitudinal Study. In: Population, Space and Place 25, e2228. https://doi.org/10.1002/psp.2228

Manski, Charles F. 1993: Identification of Endogenous Social Effects: The Reflection Problem. In: The Review of Economic Studies 60,3: 531-542. https://doi.org/10.2307/2298123

Markussen, Simen; Røed, Knut 2015: Social Insurance Networks. In: Journal of Human Resources 50,4: 1081-1113. https://doi.org/10.3368/jhr.50.4.1081

Meggiolaro, Silvia 2011: Do Neighbourhoods Have an Influence on Reproductive Intentions? Empirical Evidence from Milan. In: Regional Studies 45,6: 791-807. https://doi.org/10.1080/00343401003713399

Miltenburg, Emily M.; van der Meer, Tom W. 2018: Lingering Neighbourhood Effects: A Framework to Account for Residential Histories and Temporal Dynamics. In: Urban Studies 55,1: 151-174. https://doi.org/10.1177/0042098016639012

Mood, Carina 2010a: Neighborhood Social Influence and Welfare Receipt in Sweden: A Panel Data Analysis. In: Social Forces 88,3: 1331-1356. https://doi.org/10.1353/sof.0.0304

Mood, Carina 2010b: Logistic Regression: Why We Cannot Do What We Think We Can Do, and What We Can Do About It. In: European Sociological Review 26,1: 67-82. https://doi.org/10.1093/ESR/JCP006

Mulder, Clara H. 2013: Family Dynamics and Housing: Conceptual Issues and Empirical Findings. In: Demographic Research 29: 355-378. https://doi.org/10.4054/DemRes.2013.29.14

Mönkediek, Bastian; Rotering, Paul; Bras, Hilde 2017: Regional Differences in the Intergenerational Transmission of Family Size in Europe. In: Population, Space and Place 23,2: e2003. https://doi.org/10.1002/psp.2003

Openshaw, Stan 1984: The Modifiable Areal Unit Problem. In: CATMOG 38: 1-22.

Petrović, Ana; Manley, David; Ham, Maarten van 2018: Freedom from the Tyranny of Neighbourhood: Rethinking Socio-Spatial Context Effects. IZA Discussion Paper Series 11416. Bonn: Institute for the Study of Labor.

Pink, Sebastian; Leopold, Thomas; Engelhardt, Henriette 2014: Fertility and Social Interaction at the Workplace: Does Childbearing Spread Among Colleagues? In: Advances in Life Course Research 21: 113-122. http://dx.doi.org/10.1016/j.alcr.2013.12.001

Rindfuss, Ronald R. et al. 2010: Child-Care Availability and Fertility in Norway. In: Population and Development Review 36,4: 725-748.

Ruckdeschel, Kerstin et al. 2018: Unequal Neighbours? A French-German Comparison of Family Size Intentions. In: Comparative Population Studies 43: 187-210. https://doi.org/10.12765/CPoS-2018-12en

Rözer, Jesper; Poortman, Anne-Rigt; Mollenhorst, Gerald 2017: The Timing of Parenthood and Its Effect on Social Contact and Support. In: Demographic Research 36,62: 1889-1916. https://doi.org/10.4054/DemRes.2017.36.62

Sharkey, Patrick; Faber, Jacob W. 2014: Where, When, Why, and For Whom Do Residential Contexts Matter? Moving Away from the Dichotomous Understanding of Neighborhood Effects. In: Annual Review of Sociology 40,1: 559-579. https://doi.org/10.1146/annurev-soc-071913-043350

Snijders, Tom A. B.; Roel J. Bosker 2012: Multilevel Analysis: An Introduction to Basic and Advanced Multilevel Modeling. Los Angeles: Sage.

Sobotka, Tomas; Beaujouan, Éva 2014: Two Is Best? The Persistence of a Two-Child Family Ideal in Europe. In: Population and Development Review 40,3: 391-419. https://doi.org/10.1111/j.1728-4457.2014.00691.x

Syse, Astri; Hart, Rannveig K.; Aase, Kjersti N. 2016: Befolkningsframskrivinger 2016-2100: Fruktbarhet. In: Økonomiske analyser 3/2016: 14-24.

Testa, Maria R.; Grilli, Leonardo 2006: The Influence of Childbearing Regional Contexts on Ideal Family Size in Europe. In: Population (English Edition) 61,1/2: 109-137.

Thomson, Elizabeth 2015: Family Size Preferences. In: *Wright, James D.* (Ed.): International Encyclopedia of the Social & Behavioral Sciences. Vol. 8. 2nd Edition. Oxford: Elsevier: 805-808. https://doi.org/10.1016/B978-0-08-097086-8.31064-9

Türk, Umut; Östh, John 2019: How Much Does Geography Contribute? Measuring Inequality of Opportunities Using a Bespoke Neighbourhood Approach. In: Journal of Geographical Systems 21,2: 295-318. https://doi.org/10.1007/s10109-019-00297-z

Vitali, Agnese; Aassve, Arnstein; Lappegård, Trude 2015: Diffusion of Childbearing Within Cohabitation. In: Demography 52,2: 355-377. https://doi.org/10.1007/s13524-015-0380-7

Vitali, Agnese; Billari, Francesco C. 2015: Changing Determinants of Low Fertility and Diffusion: a Spatial Analysis for Italy. In: Population, Space and Place 23,2: e1998. https://doi.org/10.1002/psp.1998

Wagner, Michael; Mulder, Clara H. 2015: Spatial Mobility, Family Dynamics, and Housing Transitions. In: KZfSS Kölner Zeitschrift für Soziologie und Sozialpsychologie 67,1: 111-135. https://doi.org/10.1007/s11577-015-0327-4

Weeks, John R. 2004: The Role of Spatial Analysis in Demographic Research. In: *Goodchild, Michael F.; Janelle, Donald G.* (Eds.): Spatially Integrated Social Science. Oxford: Oxford University Press: 381-399.

Weeks, John R. et al. 2004: The Fertility Transition in Egypt: Intraurban Patterns in Cairo. In: Annals of the Association of American Geographers 94,1: 74-93. https://doi.org/10.1111/j.1467-8306.2004.09401005.x

Zeman, Krystof et al. 2018: Cohort Fertility Decline in Low Fertility Countries: Decomposition Using Parity Progression Ratios. In: Demographic Research 38,25: 651-690. https://doi.org/10.4054/DemRes.2018.38.25

Östh, John; Clark, William A. V.; Malmberg, Bo 2015: Measuring the Scale of Segregation Using k-Nearest Neighbor Aggregates. In: Geographical Analysis 47,1: 34-49. https://doi.org/10.1111/gean.12053

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Appendix

Tab. A1: Distances and number of neighbors included after different choices of neighborhood size

	Defined neighborhood size (*k-nearest neighbors*):					
k=	500	250	100	50	25	12
Number of neighbors actually included†						
Minimum	499	66	66	1	1	1
Maximum	890	645	500	416	416	416
Mean	500	250	100	50	25	12
SD	3	3	3	3	3	3
Max. distance to a neighbor (in meters)						
Defined max.	100,000	50,000	50,000	25,000	20,000	15,000
Final max.	98,830	50,000	49,978	25,000	19,999	14,980
Mean	3,497	2,154	1,149	710	444	265
SD	6,237	3,888	2,266	1,474	988	614
Median distance to neighbors (in meters)						
Mean	2,077	1,349	721	457	290	177
SD	3,840	2,579	1,513	1,008	670	426

† Values above the defined "*k*" are due to housing block coordinates making it impossible to identify exactly the desired number of nearest neighbors. Values below the defined "*k*" stem from the distance cut-off.

Source: Data from Norwegian registers on a quarterly/yearly basis 2000-2014.

Tab. A2: Descriptive statistics of sociodemographic control variables (last couple-observation)

	Sample total		Couples with a 3rd birth	
	N (total)	Mean	N (total)	Mean
Process time: quarters of years (max. 40)	257,527	18.2	75,847	10.6
Age at 2nd childbirth				
woman (min. 20, max. 44)	257,527	31.1	75,847	29.4
man (min. 17, max. 77)	257,527	33.9	75,847	32.3
	N (cell)	Pct (col)	N (cell)	Pct (row)
Country of birth: Asia, Africa, South or Central America				
female partner	23,406	9.1	7,941	33.9
male partner	19,695	7.7	7,510	38.1
Marital status (married)	182,313	70.8	59,390	32.6
Children from previous partners				
neither of the partners	211,150	82.0	60,776	28.8
both partners	5,936	2.3	1,813	30.5
only woman	16,952	6.6	7,997	47.2
only man	18,593	7.2	3,756	20.2
complex/missing	4,896	1.9	1,505	30.7
Highest educational level attained, woman				
Compulsory or unknown	37,395	14.5	12,717	34.0
High school	77,800	30.2	21,729	27.9
Short university	107,962	41.9	32,272	29.9
Long university	34,370	13.4	9,129	26.6
Highest educational level attained, man				
Compulsory or unknown	39,395	15.3	12,199	31.0
High school	112,695	43.8	32,179	28.6
Short university	67,659	26.3	20,123	29.7
Long university	37,778	14.7	11,346	30.0
Women in education	19,329	7.5	5,164	26.7
Man in education	11,072	4.3	4,095	37.0
Woman in labor force†	234,697	91.1	66,385	28.3
Annual household income‡				
None	1,294	0.5	583	45.1
up to 600,000 NOK	37,192	14.5	17,792	47.8
600,000 – 800,000 NOK	52,551	20.4	20,451	38.9
800,000 – 1,000,000 NOK	65,599	25.5	17,738	27.0
1,000,000 + NOK	100,706	39.1	19,282	19.1
Total	257,527	100	75,846	29.5

Note: Means are given for continuous measures, percentages are given for categories.
† Defined as active if annual income exceeds social security base income.
‡ From wages and salaries, inflation-adjusted to 2013-NOK, NOK 1000 ~ € 135 (in 2013).
Source: Data from Norwegian registers on a quarterly/yearly basis 2000-2014. Descriptive statistics for the last year of observation for each couple.

Tab. A3: Comparing Model 1 to 5: Linear probability models for having a third child, 2000-2014

	Model 1	Model 2	Model 3	Model 4	Model 5
Neighbors with at least 3 children					
0-10% of 250 nearest	-0.0016***	-0.0017***	-0.0018***	-0.0012***	-0.0015***
10-15% of 250 nearest	-0.0019***	-0.0016***	-0.0017***	-0.0010***	-0.0006***
15-20% of 250 nearest	ref.	ref.	ref.	ref.	ref.
20-25% of 250 nearest	0.0033***	0.0030***	0.0030***	0.0016***	0.0004*
25+% of 250 nearest	0.0089***	0.0081***	0.0082***	0.0060***	0.0023***
Process time (quarters of years)†	0.0011***	0.0012***	0.0013***	0.0013***	0.0014***
Dwelling type and number of rooms					
single-family house, 5 rooms or more			ref.	ref.	ref.
single-family house, 4 rooms or less			-0.0012***	-0.0012***	-0.0011***
terraced/row house, 5 rooms or more			-0.0018***	-0.0020***	-0.0017***
terraced/row house, 4 rooms or less			-0.0021***	-0.0024***	-0.0022***
apartment, 5 rooms or more			-0.0001	-0.0001	-0.0011
apartment, 4 rooms or less			-0.0007**	-0.0010***	-0.0019***
missing housing information			0.0006**	0.0004*	0.0001
Residential time in current neighborhood					
moved during the last year			ref.	ref.	ref.
last relocation up to 5 years ago			-0.0009***	-0.0009***	-0.0010***
last relocation up to 10 years ago			-0.0045***	-0.0045***	-0.0045***
last relocation > 10 years ago			-0.0041***	-0.0042***	-0.0043***
Neighboring women with a university education					
% of 250 nearest neighbors			0.0000***	0.0000	-0.0002***
Centrality of residential municipality					
municipality with regional center				-0.0024***	-
travel time to regional center < 36 min				-0.0030***	-
travel time to regional center 36-75 min				-0.0030***	-
relatively central				-0.0028***	-
less and least central				ref.	-

Tab. A3: Continuation

	Model 1	Model 2	Model 3	Model 4	Model 5
Region of Norway					
Oslo and Akershus (Capital region)				ref.	-
Hedmark and Oppland				-0.0003	-
South Eastern Norway				-0.0014***	
Agder and Rogaland				0.0021***	-
Western Norway				0.0024***	-
Trøndelag				-0.0006**	-
Northern Norway				-0.0001	-
Individual and couple covariates	No	Yes	Yes	Yes	Yes
Fixed effects for statistical tracts	No	No	No	No	Yes
F-value	5153.0	1543.2	1158.9	927.1	1078.3
Couple-quarter observations					5,413,443

Note: Table shows beta coefficients and significance levels: * p<0.05; ** p<0.01; *** p<0.001. Covariates included in models 2 to 5 are: both partners' age at start, global region of birth, union status, stepchildren, both partners' educational attainment and enrolment, the woman's employment status and household income.

† Process time squared (not shown) was included and negative but close to zero in all models.

Source: Data from Norwegian registers on a quarterly/yearly basis 2000-2014.

Tab. A4: Comparing different neighborhood scales: Linear probability models for having a third child, 2000-2014

	k=12†	k=25	k=50	k=100	k= 250	k=500
			Model 4 with covariates			
Neighbors with 3+ children						
0-10 %	-0.0006***	-0.0008***	-0.0010***	-0.0011***	-0.0012***	-0.0007***
10-15 %	0.0005	-0.0004**	-0.0006***	-0.0008***	-0.0010***	-0.0013***
15-20 %	ref.	ref.	ref.	ref.	ref.	ref.
20-25 %	0.0013	0.0006**	0.0007***	0.0012***	0.0016***	0.0022***
25 + %	0.0015***	0.0022***	0.0033***	0.0043***	0.0060***	0.0069***
F-value	921.5	923.0	924.1	925.4	927.1	928.5
			Model 5 with tract fixed effects			
Neighbors with 3+ children						
0-10%	-0.0004***	-0.0007***	-0.0010***	-0.0013***	-0.0015***	-0.0013***
10-15%	0.0004	-0.0003	-0.0004**	-0.0005***	-0.0006***	-0.0010***
15-20%	ref.	ref.	ref.	ref.	ref.	ref.
20-25%	0.0010	0.0004*	0.0003	0.0005**	0.0004*	0.0012***
25+%	0.0008***	0.0010***	0.0012***	0.0016***	0.0023***	0.0038***
F-value	1073.5	1074.6	1075.3	1076.2	1078.3	1077.5
Couple-quarter observations						5,413,443

Note: Table shows beta coefficients and significance levels: * p<0.05; ** p<0.01; *** p<0.001. Covariates included but not shown are: process time, both partners' age at start, global region of birth, union status, stepchildren, both partners' educational attainment and enrolment, the woman's employment status, household income, housing, residential time, neighbors' education, centrality and region (last two only in model 4).

Source: Data from Norwegian registers on a quarterly/yearly basis 2000-2014.

Tab. A5: Discrete time event-history models on having a third birth, 2000-2014

	Model 1	Model 2	Model 3	Model 4	Model 5
Neighbors with at least 3 children					
0-10% of 250 nearest	-0.125***	-0.139***	-0.154***	-0.110***	-0.141***
10-15% of 250 nearest	-0.155***	-0.140***	-0.143***	-0.094***	-0.063***
15-20% of 250 nearest	ref.	ref.	ref.	ref.	ref.
20-25% of 250 nearest	0.225***	0.202***	0.204***	0.109***	0.027*
25+% of 250 nearest	0.508***	0.454***	0.459***	0.310***	0.098***
Process time (quarters of years)	0.158***	0.166***	0.170***	0.171***	0.174***
Process time squared	-0.007***	-0.007***	-0.007***	-0.007***	-0.007***
Dwelling type & number of rooms					
single-family house, 5 rooms or more			ref.	ref.	ref.
single-family house, 4 rooms or less			-0.085***	-0.084***	-0.077***
terraced/row house, 5 rooms or more			-0.139***	-0.151***	-0.128***
terraced/row house, 4 rooms or less			-0.163***	-0.179***	-0.166***
apartment, 5 rooms or more			-0.017	-0.015	-0.078
apartment, 4 rooms or less			-0.040*	-0.053**	-0.125***
missing housing information			0.034**	0.023*	0.000
Residential time in current neighborhood					
moved during the last year			ref.	ref.	ref.
last relocation up to 5 years ago			-0.058***	-0.059***	-0.060***
last relocation up to 10 years ago			-0.271***	-0.273***	-0.279***
last relocation > 10 years ago			-0.521***	-0.530***	-0.544***
Neighboring women with a university education					
% out of 250 nearest neighbors			0.002***	-0.001***	-0.011***
Centrality of residential municipality					
municipality with regional center				0.032*	-
travel time to regional center < 36 min				-0.019	-
travel time to regional center 36-75 min				-0.010	-
relatively central				ref.-	
less central				0.177***	-

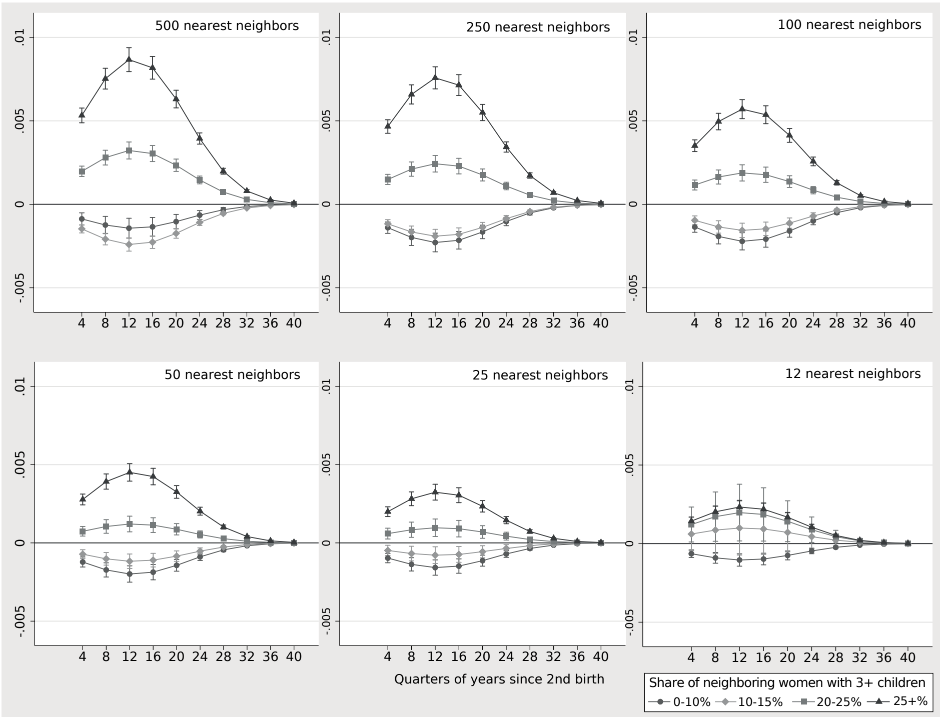
Tab. A5: Continuation

	Model 1	Model 2	Model 3	Model 4	Model 5
Region of Norway					
Oslo and Akershus (Capital region)				0.015	-
Hedmark and Oppland				ref.	-
South Eastern Norway				-0.099***	-
Agder and Rogaland				0.170***	-
Western Norway				0.183***	-
Trøndelag				-0.004	-
Northern Norway				0.032	-
Intercept	-4.793	-1.715	-1.889	-1.911	-
Individual and couple covariates	No	Yes	Yes	Yes	Yes
Fixed effects for statistical tracts	No	No	No	No	Yes
Couple-quarter observations					5,414,443

Note: Table shows beta coefficients from a logistic regression and significance levels: * $p<0.05$; ** $p<0.01$; *** $p<0.001$. Covariates included but not shown in model 2 to 5 are: both partners' age at start, global region of birth, union status, stepchildren, both partners' educational attainment and enrolment, the woman's employment status, household income.

Source: Data from Norwegian registers on a quarterly/yearly basis 2000-2014.

Fig. A1: Results from discrete-time hazard regression models for being in the 1st trimester of pregnancy with the subsequent, live-born 3rd child. Neighborhood scale comparison using average marginal effects with 95 percent CIs at all observation points, 2000-2014



Note: Neighborhoods with 15-20 percent neighboring women with 3 or more children serve as reference. Covariates included are: Both partners' age at start, global region of birth, union status, stepchildren, both partners' educational attainment and enrolment, the woman's employment status, household income, housing, residential time, neighbors' education, centrality and region. Comparable to results from linear probability model 4.

Source: Data from Norwegian registers on a quarterly/yearly basis 2000-2014.

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