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Impact of superstitious beliefs on the timing of marriage and childbirth: Evidence from Denmark

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Abstract

We study the influence of numerological superstitions on family-related choices made by people in Denmark. Using daily data on marriages and births in Denmark in 2007-2019 we test hypotheses associated with positive perception of numbers 7 and 9 and a negative perception of number 13, as well as the impact of February, 29, April 1, St. Valentine's Day and Halloween. There is significant negative effect of the 13th on the popularity of both wedding and birth dates. However, some other effects associated with special dates and the cultural representations of unofficial holidays have a stronger effect. In addition, after controlling for many factors, February 29 and April 1 turn out to be desirable for weddings, but not for childbirth, implying the context dependence of cultural stereotypes. Evidence of birth scheduling for non-medical reasons is especially worrisome because of the associated adverse health outcomes associated with elective caesarian sections and inductions.

Keywords: superstitions, jinx number, lucky number, numerology, childbirth, marriage

1 Introduction

The question of whether and to what extent superstitions affect people's choices has become a concern of social and marketing researchers in the last decades in Asian countries as it is the area where people seem to be influenced by superstitious omens the most (Pratt & Kirillova, 2019; Pratt & Kwan, 2019). In some Asian countries people even consult with numerologists before opening a business or signing an important contract (Chinchanachokchai, Pusaksrikit & Pongsakornrungsilp, 2017). Surprisingly, even people who are involved in market trading activities are responsive to such superstitions. Fluke, Webster and Saucier (2014) reported that solar eclipses are correlated with lower-than-average returns on four American stock indices and these slumps were reversed the day after the eclipse. In Europe people's choices are also sometimes dictated by superstitious habits that today may seem as cultural traditions, particularly in Czech Republic, drinking beer from the 'wrong' mug is considered to bring a 'bad' luck (Seignovert, n.d.). Thus, when buying a new mug people may be especially interested in the 'right' type of a mug. De Paola, Gioia and Scoppa (2014) conducted an experiment (in need of replication) to determine whether the "lucky" and "unlucky" seats influence test results of students at an Italian University. The study was conducted among 700 students during important exams. The authors selected sixty-one students who had to write the exam on the seat number 17 which the Italians consider "unlucky". Also, for more accurate results, one hundred and eight students were assigned to seats 13 and 30 ("lucky" numbers in Italy), while others performed tasks on the exam on neutral seats. As a result, the researchers showed that there was no relationship between the "lucky" and "unlucky" numbers of seats and exam grades. At the same time, women were more confident in high scores when they sat on successful seats and were more upset of the fact that their grades did not depend on the "luckiness" of the seat number (De Paola, Gioia & Scoppa, 2014). Not accidentally, there are no seats 17 in Italian cinemas, rooms 17 in Italian hotels and even row 17 in "Alitalia"'s aircrafts. Many instances when superstition-driven expectations cause consumers to make purchase decisions that run counter to economic rationality have been presented in the literature (Block & Kramer, 2009; Kramer & Block, 2011).

While sometimes superstitions manifest merely in preferences without leading to substantial benefits or losses for those who account for these superstitions, in some cases they affect market outcomes and overall welfare. For example, superstitious investors submitting more limit orders at 8 (lucky number in the Chinese culture) than at 4 (unlucky number) apparently have higher trading losses (Bhattacharya, Kuo, Lin & Zhao, 2018). Buyers pay less for homes with addresses containing more unlucky numbers and fewer unlucky numbers and more for homes with lucky addresses in Singapore (He, Liu, Sing, Song & Wong, 2020). Antipov and Pokryshevskaya (2015) studied numerological superstitions on people's buying behavior in the apartment market

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of Saint-Petersburg, Russia. Using unique sales data for the primary market, authors compared the quantity of bought apartments on the 7^{th} ("lucky") floor with ones on floors 6 and 8, the same comparison was made for floor 13 ("unlucky") with floors 12 and 14. Using the fact that all the floors were constructed alike, the researchers were able to identify the expected effects of the "lucky" and "unlucky" floors. Burakov (2018) showed that a 10% discount was sufficient to mitigate the impact of such numerological superstition and help to boost the sales of "unlucky" apartments in Moscow.

The problem of childbirth scheduling for non-medical reasons (including but not limited to superstitions) is another example of biased decision-making associated with welfare losses. According to Schulkind and Shapiro (2014), scheduling births for non-medical reasons has become an increasingly common practice in the United States and around the world. Using data on all births in the U.S. from 1990 to 2000 they confirmed that families respond to the financial incentives (tax benefits) by electing to give birth in December rather than January and found that most of the manipulation comes from changes in the timing of caesarian sections. Scheduling births has negative health consequences (lower birthweight, a lower Apgar score, and an increase in the likelihood of being low birthweight) for the newborn from accelerating deliveries, including short-term movements within "full-term" pregnancies (Schulkind & Shapiro, 2014; Tita et al., 2009). There have been several research studies related to auspicious birth dates. A study based on the national US data from 1996 to 2006 found that on Valentine's Day there systematically was an increase and on Halloween – a decrease of both spontaneous and cesarian births (Levy, Chung & Slade, 2011). Two other studies concentrated on Chinese superstitions: the first one used microdata from individual vital statistics natality records covering all live births in California from years 1991–2002, collected and maintained by the California Office of Statewide Health Planning and Development (Almond, Chee, Sviatschi & Zhong, 2015). The second — as well as 2014–2016 birth certificates data Guangdong Province of China (Huang, Ma, Zhang & Zhao, 2020). The impact of Chinese numerological superstitions associated with numbers 8 (lucky) and 4 (unlucky), as well as of the thirteenth, especially Friday the 13th, on timings of birth has been confirmed in both studies for children born from Chinese parents. Lin, Xirasagar and Tung (2006) used data from Taiwan on all singleton deliveries during 1997–2003 and showed that cesarean delivery rates were significantly lower during the inauspicious "ghost month" of July, and higher than normal during June, representing pre-emptive c-section to avoid delivering in July. These results agree with those obtained by Halla, Liu, and Liu (2019)

While preferences towards certain wedding dates are unlikely to have such serious impact on one's welfare as birth date manipulations, some interesting patterns and even long-lasting consequences have been identified in the literature using data on marriages as well. Using Dutch marriage and divorce registries from 1999 to 2013, Kabátek and Ribar (2018) identified several distinct types of popular wedding dates including Valentine's Day and numerically special days (dates with the same or sequential number values, e.g., 09.09.99, 01.02.03), showing that on an adjusted basis, the incidence of weddings on such dates was 137–509% higher than ordinary dates. After statistically controlling for couples' observable characteristics, special-date weddings were more vulnerable, with 10–17% higher divorce odds compared to ordinary dates. These relationships are even stronger for couples who have not married before.

The numbers of marriages and, especially, of births on each day of the year are surprisingly rarely disclosed publicly. For example, today this information is not publicly disclosed even by the traditionally generous US agencies. Not surprisingly, we have found no recent research on daily variations in births or marriages based on European data. European researchers have considered birth seasonality patterns using only monthly data (Balan, Jaba & others, 2016; Cypryjański, 2019), but did not study numerological superstitions. To the best of our knowledge, among European countries daily numbers of births and marriages are publicly disclosed only for Denmark.

Our study is one of the first that uses European data to shed light on how the willingness of people to avoid certain dates associated with numerological superstitions and symbolism is reflected in birth and marriage statistics from a European country – Denmark. The triad "7–9–13" corresponds in Denmark to English "knock on wood" (Russel, 2013). Interestingly, numbers 7 and 9 are considered lucky, while 13 alone – unlucky, but the combination of 7, 9 and 13 is considered to bring luck. However, whether and how Danish numerological superstitions are reflected in important choices such as those related to birth and wedding planning have not been studied in academic literature before. In Section 2 we describe our dataset and methods. In Section 3 we present the results of our statistical analysis. Section 4 concludes and outlines some directions for future research.

2 Materials and methods

The dataset of daily marriages and births in Denmark in 2007–2019 was obtained from "*Statistics Denmark*" – a web-interface to Denmark's official statistical data.[1] In Danish, like many other European languages, the written date format is "dd.mm.yyyy", which is important to account for when looking for special dates. As all dates are from the same century we will sometimes use a shortened "dd.mm.yy" format.

Our initial data exploration has shown that Danes really believe in good luck associated with the combination "7–9–

[1] https://www.statbank.dk/statbank5a/default.asp?w=1366

13”, even more than in the power of an internationally recognized “lucky” combination “7–7–7” (Figure 1). The largest number of marriages was on 07.09.13 (3136 marriages), followed by 07.07.07 (1967 marriages), and 18.08.18 (1948 marriages) with the third one being merely a beautiful date rather than a superstition-related date. At the same time on 13.09.07 the number of marriages was lower than average (42 marriages), suggesting the importance of the sequential order of the numbers comprising the “lucky” triad. Other numerically special dates that were in the top-10 most popular marriage dates were 12.12.12 (1382 marriages), 11.11.11 (1379 marriages), and 08.08.08 (1072 marriages). Birth dates can naturally be targeted to a smaller extent, which is why the top list of most popular dates is not so insightful: 06.08.08, 31.03.10, and 28.07.08 (Figure 2).

Key variables recorded in our daily dataset, containing data for 4748 consecutive days are presented in Table 1.

Using the data on daily number of marriages and live births we tested the hypothesis that Danes favor the 7th and the 9th and avoid the 13th and tested the effects of some other special days. Following most previous studies (Almond et al., 2015; Huang et al., 2020; Kabátek & Ribar, 2018) dependent variables were log-transformed so that regression estimates are interpreted in ratio rather than in interval terms. In the case of *marriages,* the transformation was especially useful as it decreased its skewness and made the distribution closer to normal (Figure 3).

Categorical variables *d7*, *d9*, *d13*, *valentines*, *halloween*, *apr1*, and *feb29* were constructed in such a way that they have 3 levels instead of 2 levels commonly used in the case of special event indicators. With this coding scheme the coefficient of the second level (corresponding to the date of the event) will show the difference between the number of marriages or births on the day of interest compared to the average of one day before and one day after the event. This prevents a situation when a researcher uses a single binary variable to account, for instance, for the Halloween’s effect, but then it turns out that the estimate would be the same if instead of a dummy variable for October 31 a dummy variable for October 30 was used. In such a situation the Halloween’s effect could have been attributed not to the Halloween, but to the lower attractiveness of this part of the year, which is otherwise not captured by main effects of months and days of the week.

For each of the dependent variables (*log(marriages)* and *log(births)*) we estimated a multivariate regression model, which included the following explanatory variables: fixed effects of *year*, *weekday*, *holiday*, *valentines*, *halloween*, *apr1*, *feb29*, and *special*. Factor variables *d7*, *d9*, and *d13* were included to allow for testing differences between days 7, 9 and 13 against the days right before and right after them.

Table 1: Key variables included in the dataset. The first level of all categorical variables is the reference level.

Variable	**Definition**
year	Year (from 2007 to 2019)
month	Month from 1 (January) to 12 (December)
day	Day of the month from 1 to 31
date	Date in *yyyy-mm-dd* format
marriages	Number of marriages
births	Number of births
weekday	1[2] – Monday, 2 – Tuesday, 3 – Wednesday, 4 – Thursday, 5 – Friday, 6 – Saturday, 7 – Sunday
holiday	1 – Not a public holiday, 2 – Boxing Day, 3 – Christ’s Ascension, 4 – Christmas Day, 5 – Easter Monday, 6 – Easter Sunday, 7 – Good Friday, 8 – Great prayer day, 9 – Maundy Thursday, 10 – New Year’s Day, 11 – Pentecost, 12 – Whit Monday
dt	1 – if day=t, 0 – otherwise, one variable for each t from {6,7,8,9,10,12,13,14}
fri13	=1 if Friday the 13th, 0 - otherwise
valentines	1 –February 13 or February 15, 2 – Valentine’s Day, 3 – not Valentine’s Day ±1 day
halloween	1 – October 30 or November 1, 2 – October 31, 3 – not Halloween±1 day
apr1	1 – March 31 or April 2, 2 – April 1, 3 – not April 1±1 day
feb29	1 – February 28 or March 1, 2 – February 29, 3 – not February 29±1 day
special	1 – Not a special date, 2 – mirror date (e.g., 20.12.2012), 3 – sequence date (e.g., 07.08.2009), 4 – 07.09.13, 5 – day=month (e.g., 12.12.2018), 6 – day=month=year (e.g., 12.12.2012), 7 – day=year and month=day-10 (e.g. 18.08.2018)

Variable *fri13*, which is essentially the interaction between a binary indicator of weekday=5 and day=13, has been included as well to test the hypothesis that the 13th is avoided more when it is a Friday.

Even though our dataset allows inferring the effects of official public holidays as well, we prefer to use them merely as control (nuisance) variables and focus on the effects of irrational beliefs, as there are objective reasons for lower number of births on such days. For example, few doctors are ready to work on holidays, which decreases the number of cesarian or induced vaginal labors scheduled to such days.

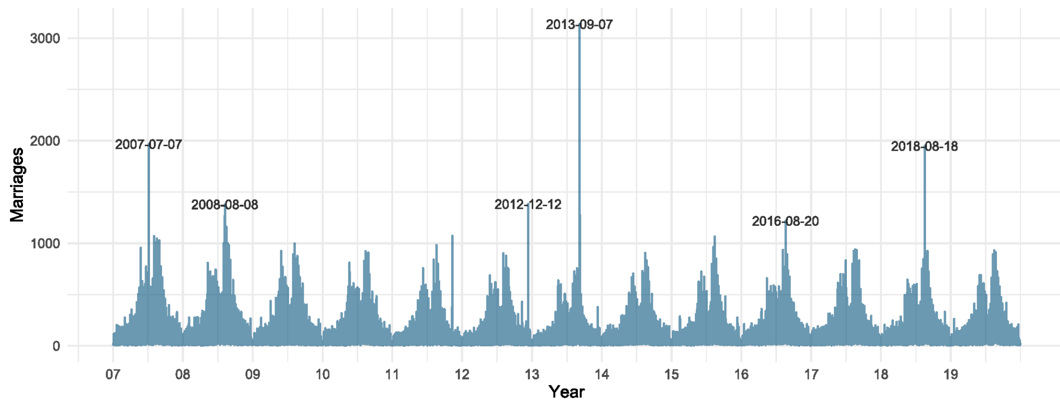

FIGURE 1: The dynamics of the daily number of marriages in Denmark (2007–2019)

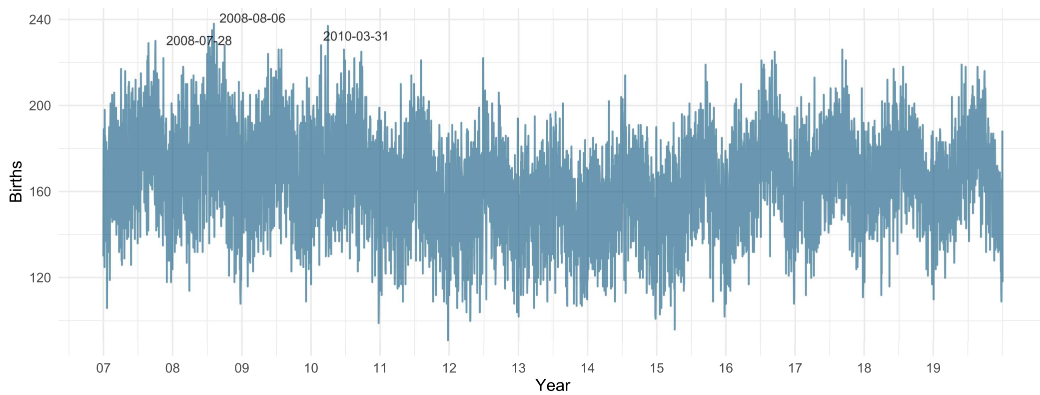

FIGURE 2: The dynamics of the daily number of live births in Denmark (2007–2019).

3 Results

The explanatory power of various date-related predictors is naturally higher for the case of marriages (R^2=0.895) than for the case of births (R^2=0.645), as the exact date of birth can be planned only to a limited extent (Table 2). Danish couples tend to avoid getting married on the 13th even if it is not on Friday. Other things equal, 25% fewer marriages occur on the 13th (other than Friday) than on the 14th. This negative effect is comparable to the effect of the Halloween (−27%). However, the difference reaches 39% for Friday the 13th.

There are no extra marriages on the 7th compared to the 6th and the 8th, and the 9th is, on average, less popular than nearby dates. By estimating an additional regression not presented here, we have checked that there is a premium for some round numbers – the 10th compared to the 9th and the 11th and to the 20th compared to the 19th and the 21st, but have not identified the same pattern for the 30th vs. the 29th and the 31st.

On average, 2% fewer children are born on the 13th than on days before and after the 13th ($p<0.001$). Unlike in the case of marriages, no additional fear associated with the 13th being Friday was identified for the case of childbirths. Contrary to our expectations, the 9th is also systematically around 2% less popular than the nearby dates (p=0.025), but the neighborhood of the round number 10 explains this.

Halloween is avoided both as a wedding date (around 27% fewer people married) and a childbirth date (7.5% fewer newborns). Controlling for other factors, significantly more marriages occurred on April Fool's day and on February 29 (by 81% and 139% compared to an average nearby day). However, people avoid giving birth to their children on February 29 and are reluctant to April 1. The effect of February 29 (-15%, $p<0.001$) is stronger than the effect of the 13th. The favorite numerically special dates both for the marriage and for the birth giving were those when the day, the month and the year coincided, as well as the unique date of 07.09.13 associated with the "7–9–13" superstition. Such dates were associated with more than 10 times more marriages and 6–8% more childbirths than we would have expected on such days if they had not been numerically special. Interestingly, in the case of childbirth St. Valentine's day had about the same positive premium, while Halloween – about the same negative premium as the above mentioned special dates.

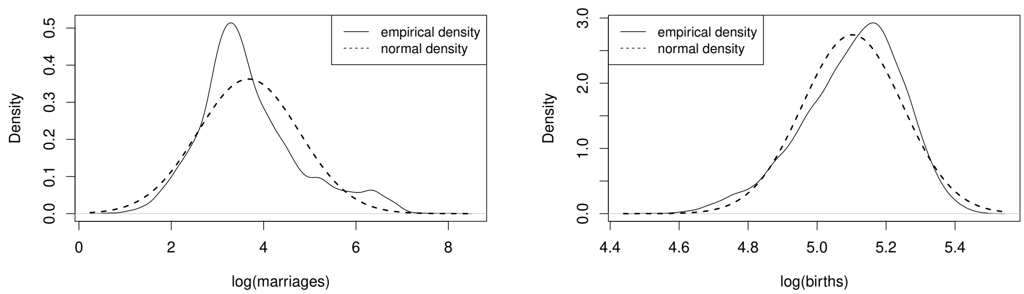

FIGURE 3: Density plots: empirical distribution of the log-transformed daily numbers of marriages and live births.

TABLE 2: Parameter estimates of the OLS regressions (with heteroscedasticity-robust standard errors).

	Dependent variable: *log(marriages)*				Dependent variable: *log(births)*			
	Estimate	SE	t	p-value	Estimate	SE	t	p-value
(Intercept)	3.497***	0.142	24.543	0.000	5.210***	0.035	148.997	0.000
7th	0.008	0.034	0.236	0.813	−0.013	0.008	−1.647	0.100
not 7^{th}±1 day	0.088***	0.022	4.014	0.000	−0.005	0.005	−1.084	0.278
9th	−0.143***	0.032	−4.535	0.000	−0.019*	0.008	−2.237	0.025
not 9th ±1 day	−0.098***	0.022	−4.535	0.000	−0.009	0.005	−1.702	0.089
13th	−0.287***	0.036	−8.026	0.000	−0.020*	0.009	−2.319	0.020
not 13th ±1 day	−0.069***	0.019	−3.576	0.000	0.001	0.005	0.280	0.779
fri13	−0.211***	0.053	−4.011	0.000	−0.008	0.016	−0.513	0.608
special: 07.09.13	2.549***	0.041	62.847	0.000	0.086***	0.009	9.055	0.000
special: day=month,	0.425***	0.029	14.461	0.000	0.004	0.006	0.595	0.552
special: day=month=year	2.952***	0.341	8.665	0.000	0.065*	0.029	2.250	0.025
special: day=year	0.983***	0.118	8.341	0.000	−0.023	0.036	−0.657	0.511
special: mirror	0.966***	0.223	4.336	0.000	−0.043	0.041	−1.052	0.293
special: sequence	0.896**	0.319	2.814	0.005	0.035	0.033	1.039	0.299
Valentines's Day	0.836***	0.124	6.740	0.000	−0.071*	0.032	−2.183	0.029
not Valentine's Day±1 day	−0.091	0.064	−1.432	0.152	−0.021	0.017	−1.230	0.219
Halloween	−0.317**	0.105	−3.010	0.003	−0.075***	0.019	−3.846	0.000
not Halloween ±1 day	−0.120	0.078	−1.539	0.124	−0.021	0.015	−1.375	0.169
April 1	0.596***	0.104	5.736	0.000	−0.031	0.029	−1.039	0.299
Not April 1±1 day	−0.063	0.063	−1.003	0.316	0.013	0.018	0.744	0.457
February 29	0.871***	0.181	4.810	0.000	−0.163***	0.022	−7.424	0.000
Not February 29±1 day	−0.202***	0.058	−3.499	0.000	0.005	0.015	0.360	0.719
Year-fixed effects	*Included*							
Month-fixed effects	*Included*							
Holiday-fixed effects	*Included*							
Weekday-fixed effects	*Included*							
R^2	*0.893*				*0.645*			
Adjusted R^2	*0.892*				*0.641*			
N	*4748*				*4748*			

***** - *p<0.001*, ** - *p<0.01*, * - *p<0.05*

4 Conclusion and directions for future research

The research contributes new evidence that Danes tend to be superstitious when choosing their wedding day. They avoid the 13th, especially if it is a Friday. Other things equal, they also prefer to move the birth date from the 13th. We have not found a positive premium neither for the 7th nor for the 9th. In the case of birth timing, the 7th and the 9th are even significantly less popular than the nearby dates, but the effect's magnitude is small. This can be explained by the importance of the "7–9–13" combination in Danish culture with less emphasis on 7 and 9 being lucky numbers on their own. When put in the context, the effects of numerological superstitions associated with numbers "7", "9" and "13" individually are small compared to many other effects of salient holidays and special dates. Somewhat surprisingly, February 29 and April 1 are favored as wedding dates, while February 29 is avoided as the birth date and April 1 is neither avoided nor favored, implying that cultural stereotypes are context-dependent. The unique date 07.09.13 and dates where day, month, and year equal one another were associated with dramatic increase in marriages and 6–8% increase in childbirths. Halloween's negative effect on childbirths was about the same as the Valentine's Day's positive effect (around 7%).

Preference towards particular dates of marriage and — to some extent — births (when mothers insist on shifting in birth timing despite medical recommendations) revealed in our study can potentially be monetized through price differentiation to decrease pressure on medical staff on especially popular dates. In a recent discrete choice experiment the average marginal willingness to pay for a spring birth was 877 USD among married US women aged 20–45, which also implied a willingness to trade-off 560 grams of birth weight in the normal range to achieve a spring birth (Clarke, Oreffice & Quintana-Domeque, 2019). Policy makers should be alert to cultural beliefs associated with delivery to enable informed delivery choices by mothers. Disincentivizing the scheduling of births for non-medical reasons can also decrease adverse health outcomes associated with elective caesarian sections and inductions.

The fact that it was confirmed that people were especially willing to get married and give birth to children on "special" dates makes it interesting to assess long-lasting consequences of such decisions. In addition, in the absence of more detailed statistics, excess childbirths on special dates implies that indicators of being born on such special dates can potentially serve as proxy or instrumental variables correlated with the likelihood that the person was born with the help of a cesarian section or induced labor.

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