

# Social Networks and Parental Behavior in the Intergenerational Transmission of Religion\*

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## Abstract

We analyze the intergenerational transmission of the strength of religion focusing on the interplay between family and peer effects. We develop a theoretical model suggesting that both peer quality and parental effort are of importance for the religious behavior of the children. We then bring the model to the data by using a very detailed dataset of adolescent friendship networks in the United States. We find that, for religious parents, the higher is the fraction of religious peers, the more parents put effort in transmitting their religiosity, indicating cultural complementarity. For non-religious parents, we obtain the reverse, indicating cultural substitutability. Concerning the success in transmitting the religious trait, we find that, for religious parents, the fraction of religious peers has only an indirect effect (through parental effort) while, for non-religious parents, there is a lower indirect effect and a statistically significant and sizeable direct effect of peers on the transmission of the non-religious trait.

**Key words:** Religion, cultural transmission, peer effects, network fixed effects.

**JEL Classification:** A14, D85, Z12.

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# 1 Introduction

The past few years have witnessed substantial progress in our understanding of how religious factors influence economic and demographic factors including education, female employment, fertility, and union formation and dissolution (Lehrer, 2008). The economics of religion applies socio-economic theory and methods to explain the religious behavioral patterns of individuals, groups or cultures and the social consequences of such behavior.<sup>1</sup> One particular interesting topic is the study of the transmission of religion across generations. Parents are passing on religious knowledge and attitudes to their children (Clark and Worthington, 1987; Hayes and Pittelkow, 1993; Hoge et al., 1982; Ozorak, 1989; Thomson et al., 1992). The more intensive is the parents' practice (for example, church attendance), the more they expose their kids to religious practice and hence invest in the children's "religious capital" and transmit religious attitudes to the next generation.

The aim of the present paper is to study the transmission of religious intensity by highlighting the trade off faced by parents between the time they devote in religious activities and the religious exposure of their children, i.e. peer effects.

To be more precise, we develop a theoretical framework in which parents' involvement in religious activities as well as the peers' influence on the children are the key ingredients in explaining religious outcomes. Indeed, based on some works on anthropology and sociology (see, in particular, Boyd and Richerson, 1985 and Cavalli-Sforza and Feldman, 1981), there is a recent literature initiated by Bisin and Verdier (2000, 2001) arguing that the transmission of a particular trait (religion, ethnicity, social status, etc.) is the outcome of a socialization *inside* and *outside* the family (like e.g. peers and role models). These two types of socialization are cultural substitutes (complements) if parents have less (more) incentive to socialize their children, the more widely dominant are their values in the population. We use this idea to explain children's religious attainment. Altruistic parents, who can either be religious or not, have to decide how much time they spend in religious activities with their children. There are two different traits: religious and non-religious. The transmission of one of these traits is costly since parents have to give up leisure, but also rewarding since it positively

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<sup>1</sup>A comprehensive review of the literature is presented in Iannaccone (1998).

influences the chances for their children of being like them (religious for religious parents and non-religious for non-religious parents).

There are two main differences with the standard approach of cultural transmission a la Bisin and Verdier (2000, 2001) and Bisin et al. (2004). First, because of our dataset (AddHealth) of adolescents where nearly none of these teenagers change religion over time, we do not consider two types of religion (say Protestant and Catholic) and thus the transmission of a particular religion but two types of intensity of religion and thus the transmission of this intensity within the same religious group. In other words, we analyze if religious parents have religious kids and non-religious parents don't. As a result, we model trait  $r = a$ , as the religious trait, and trait  $r = b$  as the non-religious one. Second, and this is one of our main contributions, contrary to Bisin and Verdier (and the subsequent literature of cultural transmission; see our discussion below) where peer effects are conceived as an average intra-group externality that affects identically all the members of a given group and where the group boundaries for such an homogeneous effect are often arbitrary and at a quite aggregate level,<sup>2</sup> here peers will be defined by the smallest unit of analysis for peer effects, that is the dyad, a two-person group. The collection of active bilateral influences or dyads will constitute a *social network*.

In the theoretical model, we show that the choice of parents' socialization effort (i.e., how much time they spend transmitting their trait) involves a trade off between direct costs of socialization and the long-run expected benefits, which consist of a better chance of having a child with the same religion intensity. If the cost of socialization is convex, then *cultural substitution* prevails, i.e. the higher is the percentage of the child's religious friends, the less (more) the religious (non-religious) parents put effort in transmitting their trait. On the other hand, if it is concave, then *cultural complementarity* is at work, meaning that the higher is the percentage of the child's religious friends, the more (less) the religious (non-religious) parents put effort in transmitting their trait. We then study the probabilities that a trait is successfully transmitted and those for which it is non-transmitted. We show that

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<sup>2</sup>For instance, peer effects in crime are often measured at the neighborhood level using local crime rates (see e.g. Glaeser et al, 1996), peer effects in school at the classroom or school level using average school achievements (see e.g. Hoxby, 2000), etc.

there is a direct effect of parental effort on these probabilities and an indirect effect through peer effects.

We then test these predictions using data from the National Longitudinal Survey of Adolescent Health (AddHealth). The special feature of AddHealth is that it has detailed information on adolescents' behavior in the United States by collecting data on students in grades 7-12 from a nationally representative sample of roughly 130 private and public schools in years 1994-95 (wave I). A subset of these students are interviewed again in 1995-96 (wave II), in 2001-2 (wave III), and again in 2007-2008 (wave IV). One of the most interesting aspects of the AddHealth data is the information on friendship networks, which is based upon actual friends nominations during the school years (wave I). Indeed, pupils were asked to identify their best friends from a school roster (up to five males and five females). As a result, one can reconstruct the whole geometric structure of the friendship networks.

The successful transmission of religion is tested when the child is an adult while we evaluate the importance of parents and peers during the teenage years. For this purpose, we exploit the longitudinal structure of the AddHealth data, which allows a time lag between when friendship choices are made (wave I in 1995-1996) and when outcome (in terms of religion) is realized (wave IV in 2007-2008). A major econometric issue arises when we test the impact of friends' religion on parental religious effort during the teenage years since the choice of friends may be not exogenous. We address this issue as follows. First, we exploit the network structure of our data to include the characteristics of the peers and network fixed effects, together with individual (parent and child) level controls. Second, we use an IV approach. The idea is to treat the composition of students in a given grade within a school as quasi-random and to isolate this quasi-random variation in the friendship network formation process. We use the fraction of religious students by grade, gender, religious affiliation and ethnic group as an instrument for the individual (children) fraction of religious friends.

We find that, for religious parents, the higher is the fraction of religious peers, the more parents put effort in transmitting their religiosity, indicating cultural complementarity. For non-religious parents, we obtain the reverse, indicating cultural substitutability. Concerning the success in transmitting the religious trait, we find that, for religious parents, the fraction of religious peers has only an indirect effect (through parental effort) while, for non-religious

parents, there is a lower indirect effect and a statistically significant and sizeable direct effect of peers on the transmission of the non-religious trait.

## 2 Related literature

As stated in the Introduction, there is an important literature on cultural transmission initiated by the seminal papers of Bisin and Verdier (2000, 2001).<sup>3</sup> In this literature, cultural transmission is conceptualized as the result of interactions between purposeful socialization decisions inside the family (*direct vertical socialization*) and other socialization processes like social imitation and learning which govern identity formation (*oblique and horizontal socialization*). Cultural traits are endogenous in this context. Allowing for interesting socio-economic effects interacting with the socialization choices of parents, the basic cultural transmission model of Bisin and Verdier has been applied to several different environments and cultural traits and social norms of behavior, from preferences for social status (Bisin and Verdier, 1998), to corruption (Hauk and Sáez-Martí, 2002), hold up problems (Olcina and Penarubbia, 2004), development and social capital (Francois, 2002), intergenerational altruism (Jellal and Wolf, 2002), labor market discrimination and work ethics (Sáez-Martí and Zenou, 2010), globalization and cultural identities (Olivier et al., 2008), education (Botticini and Eckstein, 2004, 2007; Patacchini and Zenou, 2011), and identity (Bisin et al, 2011).

As in the present paper, there are some studies that have analyzed the transmission of religion. Azzi and Ehrenberg (1975), Neuman (1986) and Iannaccone (1990) have suggested to follow the human capital approach to study the accumulation of an individual's religious capital. The accumulation of an individual's religious capital starts at childhood when the parents pass on religious knowledge and attitudes to their children and then continues with religious practices at school, at church and at the neighborhood where the child lives. A positive empirical relationship between the intensity of exposure to religious conduct during childhood and the individual's current religiosity has been documented in the literature (e.g., Brañas-Garza and Neuman, 2006; Hayes and Pittelkow, 1993; Hoge et al., 1982; Ozorak, 1989; Thomson et al., 1992). There are also studies using the Bisin-Verdier framework to

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<sup>3</sup>For an overview, see Bisin and Verdier (2011).

study the transmission of religion traits from parents to children. Cohen-Zada (2006) finds for the U.S. that the demand for private religious schooling decreases with the share of the religious minority in the population, accordingly with cultural substitution. Bisin et al. (2004), using the GSS survey data for the US over the period 1972-1996, estimate for religious traits the structural parameters of the model of marriage and child socialization in Bisin and Verdier (2000). They find that observed intermarriage and socialization rates are consistent with Protestants, Catholics and Jews having a strong preference for children who identify with their own religious beliefs, and taking costly decisions to influence their children's religious beliefs. The estimated 'relative intolerance' parameters are high and asymmetric across religious traits, suggesting an interestingly rich representation of cultural distance. More recently, using data from 32 countries (included in the International Social Survey Program: Religion II – ISSP, 1998), Bar-El et al. (2010) study the transmission of religious norms and, in particular, on the religious taste for children. They find that (i) direct religious socialization efforts of one generation have a negative effect on secularization within the next generation; (ii) oblique socialization by the community has a parabolic effect on secularization; and (iii) the two types of socialization are complements in producing religiosity of the next generation.

Compared to all these papers, our main innovation is to use a network approach in order to study the intergenerational transmission of religion. This allows us to define in a much more precise and satisfying way the quality of the “neighborhood” where the child lives. Instead of using very aggregate measures of neighborhoods, which in some papers are at the state or even country levels, we use the friends each student has nominated. In other words, the fraction of religious friends each individual has will be our measure of oblique and horizontal socialization. We are also able to address the issue of endogeneity of “neighborhoods”, here peer effects, by using network fixed effects and instrumental variables. Finally, because of the longitudinal aspect of our dataset, we can study the socialization inside and outside the family when the child and his/her peers are students at school and the outcome of the socialization when the child is an adult.

### 3 Theoretical model

As in Bisin and Verdier (2000, 2001), the transmission of religion is modeled as a mechanism interacting socialization *inside* the family (*vertical* socialization) with socialization *outside* the family (*oblique* socialization) via imitation and learning from peers. As stated above, the peers are defined by friends of each individual in a given network. Let us explain the latter.

**The network**  $N = \{1, \dots, n\}$  is a finite set of children/students. As stated above, there are two types of students: those with trait  $r = a$  (religious students) and those with  $r = b$  (non-religious or seculars). Let  $n^a$  and  $n^b$  denote the number of type- $a$  and type- $b$  individuals in the population. We have that  $n = n^a + n^b$ . We denote each student by  $i(r)$  so that, for example,  $i(a)$  means a religious student  $i$ .

Students will be connected through a social network structure. A network is represented by a graph, where each node represents an individual and a connection among nodes represents a friendship relationship between the two individuals involved. The  $n$ -square adjacency matrix  $\mathbf{G}$  of a network  $g$  keeps track of the direct connections in this network. Two students  $i(r)$  and  $j(r)$  are directly connected (i.e. best friends) in  $g$  if and only if  $g_{i(r)j(r)} = 1$ , and  $g_{i(r)j(r)} = 0$ , otherwise. Given that friendship is a reciprocal relationship, we set  $g_{i(r)j(r)} = g_{j(r)i(r)}$ . We also set  $g_{i(r)i(r)} = 0$ .

The set of student  $i(r)$ 's best friends (direct connections) having religious intensity  $r$  is:

$$N^{i(r)j(r)}(g) = \{j(r) \neq i(r) \mid g_{i(r)j(r)} = 1\},$$

which is of size  $n^{i(r)j(r)}(g)$ . The total number of friends (having both religious traits) of individual  $i(r)$  is

$$N^{i(r)j(a,b)}(g) = \{j(r) \neq i(r) \mid g_{i(r)j(a)} = 1 \text{ and } g_{i(r)j(b)} = 1\},$$

which is of size  $n^{i(r)j(a,b)}(g)$ . By definition,

$$n^{i(r)j(a,b)}(g) = n^{i(r)j(a)}(g) + n^{i(r)j(b)}(g)$$

**Reference group** We would like to define the reference group of each student  $i$ . We denote by  $q_i(g)$  the fraction of “religious” friends (type  $a$ ) of individual  $i$  in network  $g$  and  $1 - q_i(g)$ , the fraction of those who are not religious (type  $b$ ). We have:

$$q_i(g) = \frac{n^{i(r)j(a)}(g)}{n^{i(r)j(a,b)}(g)} \quad (1)$$

where  $q_i(g)$  is the number of type- $a$  friends of  $i(r)$  over his/her total number of friends.

Because

$$n^{i(r)j(a,b)}(g) = n^{i(r)j(a)}(g) + n^{i(r)j(b)}(g)$$

$1 - q_i(g)$  is the fraction of non-religious friends (i.e. type  $b$ ) of individual  $i(r)$  in network  $g$ .

**Intergenerational transmission of religion** Let us now explain how the religion transmission works. We denote by  $\pi^{p(r)i(r)}$  the probability that a child  $i(r)$  with a parent  $p(r)$ , i.e. parent  $p$  with religious strength  $r \in \{a, b\}$ , adopts religious strength  $r \in \{a, b\}$ . As in Bisin and Verdier (2000, 2001), we assume that for both parents, transmission of own religious strength will be successful with a probability equal to the parents’ effort  $e^{p(r)}$  in transmitting the trait.<sup>4</sup> This is the *vertical transmission* of religion (i.e. from the parent to the child). If transmission is not successful, then the *horizontal transmission* (i.e. from individuals in the network to the child) will play a major role and, in that case, the child will adopt the religious strength of the average friends in his/her network. We obtain the following transition probabilities:

$$\pi^{p(a)i(a)} = e^{p(a)} + [1 - e^{p(a)}] q_i(g) \quad (2)$$

$$\pi^{p(a)i(b)} = [1 - e^{p(a)}] [1 - q_i(g)] \quad (3)$$

$$\pi^{p(b)i(b)} = e^{p(b)} + [1 - e^{p(b)}] [1 - q_i(g)] \quad (4)$$

$$\pi^{p(b)i(a)} = [1 - e^{p(b)}] q_i(g) \quad (5)$$

Let us interpret equation (2). The child of a type- $a$  parent will also adopt religious strength  $a$  if either his/her parents’ religion transmission is successful (probability  $e^{p(a)}$ ) or

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<sup>4</sup>We could have assumed a more general function so that the transmission of religious strength would be successful with a probability which a function of effort  $e^{p(r)}$ . We would have to impose some conditions on this function but no analytical solution would be obtained in that case.

the parent fails to transmit his/her trait (probability  $1 - e^{p(a)}$ ) and the child picks up the religious trait from his/her direct friends (probability  $q_i(g)$ ). In other words, if 10 percent of  $i$ 's friends are very religious (type  $a$ ), then, if  $i$ 's parent fails in transmitting religion  $a$ ,  $i$  has 10 percent of becoming of type  $a$ . Equation (3) gives the probability that a child of type- $a$  parents adopts religion  $b$ : it is because both the parents and the friends were unsuccessful in transmitting religion  $a$  to the child. For type- $b$  parents (equations (4) and (5)), we have a similar interpretation.

What we assume in this model is that, when the parent  $p(r)$  decides his/her effort  $e^{p(r)}$ , the child (who is an adolescent in the data) has not yet decided yet his/her religion intensity. In the data, we will measure  $e^{p(r)}$  and  $q_i(g)$  when the child is still an adolescent in school and the outcome  $\pi^{p(r)i(r)}$  when the child is adult.

**Parents' expected utility** Let  $V^{p(r)i(r)}$  denote the utility a type- $r$  parent derives from a type- $r$  child,  $r \in \{a, b\}$ . We assume that  $V^{p(r)i(r)} > V^{p(r)i(r')}$ , if  $r \neq r'$ . Indeed, we assume that *altruism* motivates parents to exert effort to socialize their children. As in Bisin and Verdier (2000, 2001), this altruism, however, is assumed to be "paternalistic" in the sense that parents wish to transmit their own trait, and do not just internalize their children's preferences or some measure of their success. More precisely, parents are altruistic toward their children and want to socialize them to their own specific cultural model.

As a result, the expected utility of a parent of type  $p(r)$ ,  $r \in \{a, b\}$ ,  $r' \in \{a, b\}$ ,  $r \neq r'$ , is given by:

$$W^{p(r)} = \alpha^{p(r)} e^{p(r)} + \pi^{p(r)i(r)} V^{p(r)i(r)} + \pi^{p(r)i(r')} V^{p(r)i(r')} - C(e^{p(r)})$$

where  $\alpha^{p(r)}$  are the observable characteristics of parent  $p(r)$  (i.e. gender, race, education, etc.) and  $C(e^{p(r)})$  is the cost of this socialization effort. We assume that  $C(0) = 0$ ,  $C'(e^{p(r)}) > 0$ . For a parent of type  $a$ , we have:

$$\begin{aligned} W^{p(a)} = & \alpha^{p(a)} e^{p(a)} + \{e^{p(a)} + [1 - e^{p(a)}] q_i(g)\} V^{p(a)i(a)} + \\ & \{[1 - e^{p(a)}] [1 - q_i(g)]\} V^{p(a)i(b)} - C(e^{p(a)}) \end{aligned}$$

while, for a parent of type  $b$ ,

$$W^{p(b)} = \alpha^{p(b)} e^{p(b)} + \{e^{p(b)} + [1 - e^{p(b)}] [1 - q_i(g)]\} V^{p(b)i(b)} \\ + \{[1 - e^{p(b)}] q_i(g)\} V^{p(b)i(a)} - C(e^{p(b)})$$

**Parents' optimal socialization effort** Let us now determine  $e^{p(r)}$ , the effort choice of parents  $p(r)$ . Denote by  $\Delta V^{p(a)} \equiv V^{p(a)i(a)} - V^{p(a)i(b)} > 0$  and  $\Delta V^{p(b)} \equiv V^{p(b)i(b)} - V^{p(b)i(a)} > 0$ . The first-order condition for parent of type  $p(a)$  is:

$$C'(e^{p(a)}) = \alpha^{p(a)} + [1 - q_i(g)] \Delta V^{p(a)} \quad (6)$$

Similarly, for type- $b$  parents, we have:

$$C'(e^{p(b)}) = \alpha^{p(b)} + q_i(g) \Delta V^{p(b)} \quad (7)$$

We can denote these optimal efforts as:  $e^{p(r)*} \equiv e^{p(r)*}(q_i(g))$ , for  $r \in \{a, b\}$ . We have the following proposition:

**Proposition 1** *For both parents, the relationship between optimal parents' effort and the fraction of their child's religious friends is ambiguous and depends on the sign of the second derivative of the cost function, i.e.*

$$\frac{\partial e^{p(a)*}}{\partial q_i(g)} \begin{matrix} \geq \\ \leq \end{matrix} 0 \Leftrightarrow C''(e^{p(a)}) \begin{matrix} \leq \\ \geq \end{matrix} 0 \\ \frac{\partial e^{p(b)*}}{\partial [1 - q_i(g)]} \begin{matrix} \geq \\ \leq \end{matrix} 0 \Leftrightarrow C''(e^{p(b)}) \begin{matrix} \leq \\ \geq \end{matrix} 0$$

where  $\frac{\partial e^{p(r)}}{\partial q_i(g)} < 0$  refers to as *cultural substitution* while  $\frac{\partial e^{p(r)}}{\partial q_i(g)} > 0$  refers to as *cultural complementary*.

The first-order conditions (6) and (7) show that the choice of socialization effort involves a trade off between the direct cost  $C(e^{p(r)})$  and the long-run expected benefits, which consist of a better chance of having a child with the same religion intensity  $r$ . If  $C''(e^{p(a)}) \geq 0$ , *cultural substitution* prevails, i.e. the higher is the percentage of the child's religious friends, the less (more) the religious (non-religious) parents put effort in transmitting their trait.

On the other hand, if  $C''(e^{p(a)}) \leq 0$ , then *cultural complementarity* is at work, meaning that the higher is the percentage of the child's religious friends, the more (less) the religious (non-religious) parents put effort in transmitting their trait.

We can now calculate the expected school achievement of each individual by focusing on the different transition probabilities.

**Proposition 2**

(i) For type-a parents whose effort is  $e^{p(a)}(q_i(g))$  and given by (6), the probability that their child will adopt the same religion is:

$$\pi^{p(a)i(a)} = e^{p(a)}(q_i(g)) + [1 - e^{p(a)}(q_i(g))] q_i(g),$$

while the probability that their child will not adopt their religion is:

$$\pi^{p(a)i(b)} = [1 - e^{p(a)}(q_i(g))] [1 - q_i(g)].$$

(ii) For type-b parents whose effort is  $e^{p(b)}(q_i(g))$  and given by (7), the probabilities that their child will adopt the same religion and will not adopt the same religion are respectively given by:

$$\pi^{p(b)i(b)} = e^{p(b)}(q_i(g)) + [1 - e^{p(b)}(q_i(g))] [1 - q_i(g)].$$

$$\pi^{p(b)i(a)} = [1 - e^{p(b)}(q_i(g))] q_i(g).$$

(iii) For parents of both types, the effect of  $q_i(g)$  on these four transition probabilities is undetermined and depend whether there is cultural substitutability or cultural complementarity.

Results (i) and (ii) just express the transition probabilities (2)-(5) in terms of optimal parents' effort. The interesting result is (iii) since it shows the impact of the "quality" (i.e. the percentage of friends having the same religion) of the "neighborhood" of the child (i.e. the network) on religion attainment. There are two effects: a *direct* one, where  $e^{p(r)}$  depends on  $q_i(g)$ , and a *indirect* one, because if  $e^{p(r)}$  fails, then only  $q_i(g)$  affects children's religion attainment.

## 4 Empirical model

The aim of our empirical analysis is to test Propositions 1 and 2, that is the influence of local environment (quality of the peers) on the parents' decision of spending time with their children transmitting religion values and the impact of both parents' effort and local environment quality on the religion behavior of the children.

Assuming  $n_\kappa$  individuals in each of the  $K$  networks in the economy, for  $i = 1, \dots, n_\kappa$ ,  $\kappa = 1, \dots, K$  (denoting for simplicity  $g_\kappa = g_1, \dots, g_K$ ), the empirical counterparts of (6) and (7) are given by:

$$e_{i,k,t}^{p(a)} = \alpha_1 q_{i,k,t} + \sum_{m=1}^M \beta_m^{p(a)} x_{m,i,k,t} + \eta_k + \varepsilon_{i,k,t}, \quad (8)$$

$$e_{i,k,t}^{p(b)} = \alpha_2 (1 - q_{i,k,t}) + \sum_{m=1}^M \beta_m^{p(b)} x_{m,i,k,t} + \eta_k + \varepsilon_{i,k,t}, \quad (9)$$

where

$$q_{i,k,t} = \frac{1}{g_{i,\kappa}} \sum_{j=1}^{n_\kappa} g_{ij,\kappa} h_{j,\kappa}$$

and  $h_{j,\kappa}$  is a dummy variable taking value 1 if the friend  $j$  of individual  $i$  is religious and 0 otherwise. Furthermore,  $e_{i,k,t}^{p(r)}$  denotes the time spent by parents  $p(r)$  of child  $i$  in network  $k$  transmitting their religion trait to the child at time  $t$ ;  $x_{m,i,k,t}^{p(r)}$  (for  $m = 1, \dots, M$ ) is a set of  $M$  control variables at the parent, child, household and area level at time  $t$ , accounting for differences in socio-economic characteristics between parents, children, families and neighborhoods (listed in Table A1 in Appendix 1), also including the average characteristics of  $i$ 's friends;  $\eta_k$  denotes network fixed effects and  $\varepsilon_{i,t}$  is a white noise error term.

A test of this equation will allow us to evaluate the prediction of the theoretical model. A  $\alpha_1$  significantly different from zero will indicate either cultural substitution (if negative) or cultural complementarity (if positive). A  $\alpha_2$  significantly different from zero will indicate either cultural substitution (if positive) or cultural complementarity (if negative). Indeed, the signs of  $\alpha_1$  and  $\alpha_2$  will provide information on the form of the trade-off between neighborhood composition and parental investment in terms of religion.

Turning now our attention to the test of Proposition 2, we model the likelihood of a

successful or unsuccessful intergenerational transmission of religion as follows:

$$\pi_{t+1}^{p(r)i(r)} = \phi^{i(r)} q_{i(r),k,t} + \gamma^{i(r)} e_{i(r),k,t}^{p(r)} + \rho^{i(r)} (q_{i(r),k,t} \times e_{k,t}^{p(r)}) + \sum_{m=1}^M \beta_m^{p(r)i(r)} x_{m,t} + \eta_k + \varepsilon_{i(r),k,t+1} \quad (10)$$

where  $\pi_{t+1}^{p(r)i(r)}$  is the probability that an adult  $i$  at time  $t + 1$  (who was a child at  $t$ ) whose parents are of type  $r \in \{a, b\}$  attains the level of religion intensity  $r \in \{a, b\}$ ;  $q_{i(r),k,t}$  is the fraction of  $i(r)$ 's friends of type  $a$  (religious) in network  $k$  when the adult was a child at time  $t$ ;  $e_{i(r),k,t}^{p(r)}$  is parental involvement when the adult was a child at time  $t$ ;  $\eta_k$  denotes network fixed effects and  $\varepsilon_{i(r),k,t+1}$  is a white noise error term. The control variables included in the set  $x_{m,t}$  (for  $m = 1, \dots, M$ ) are allowed to have a different impact on  $\pi_{n,t+1}^{p(r)i(r)}$  than they had on  $e_{i,k,t}^{p(r)}$ . This is of particular interest for our target variable  $q_{i(r),k,t}$ , which has been separated from the set of control variables for ease of clarity.

## 5 Data and definition of variables

Our empirical analysis is based on data from the National Longitudinal Survey of Adolescent Health (AddHealth).<sup>5</sup>

The AddHealth survey has been designed to study the impact of the social environment (i.e. friends, family, neighborhood and school) on adolescents' behavior in the United States by collecting data on students in grades 7-12 from a nationally representative sample of roughly 130 private and public schools in years 1994-95 (wave I). Every pupil attending the sampled schools on the interview day is asked to compile a questionnaire (*in-school data*) containing questions on respondents' demographic and behavioral characteristics, education,

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<sup>5</sup>This research uses data from Add Health, a program project directed by Kathleen Mullan Harris and designed by J. Richard Udry, Peter S. Bearman, and Kathleen Mullan Harris at the University of North Carolina at Chapel Hill, and funded by grant P01-HD31921 from the Eunice Kennedy Shriver National Institute of Child Health and Human Development, with cooperative funding from 23 other federal agencies and foundations. Special acknowledgment is due Ronald R. Rindfuss and Barbara Entwisle for assistance in the original design. Information on how to obtain the Add Health data files is available on the Add Health website (<http://www.cpc.unc.edu/addhealth>). No direct support was received from grant P01-HD31921 for this analysis.

family background and friendship. This sample contains information on roughly 90,000 students. A subset of adolescents selected from the rosters of the sampled schools, about 20,000 individuals, is then asked to compile a longer questionnaire containing more sensitive individual and household information (*in-home* and *parental data*). A subset of these students are interviewed again in 1995-96 (wave II), in 2001-2 (wave III), and again in 2007-2008 (wave IV).<sup>6</sup> One of the most interesting aspects of the AddHealth data is the information on friendship networks, which is based upon actual friends nominations during the school years (wave I). Indeed, pupils were asked to identify their best friends from a school roster (up to five males and five females).<sup>7</sup> As a result, one can reconstruct the whole geometric structure of the friendship networks. Such a detailed information on social interaction patterns allows us to measure the relevant local community, i.e. the students who actually interact with each other, much more precisely than in previous studies. Given that friendship relationships are typically reciprocal, we consider that a link exists between two friends if at least one of the two individuals has identified the other as his/her best friend. For each school, we keep track of all the individuals who directly or indirectly interact with a given student. By matching the identification numbers of the friendship nominations to the respondents' identification numbers, one can also obtain information on the characteristics of nominated friends. In addition, the longitudinal structure of the survey provides information on both respondents and friends during the adulthood.

Let us now detail how we define the empirical counterparts of the variables used in our theoretical model.

The key variables in the theoretical model are parents' effort in transmitting religious values ( $e^{p(r)}$ ), the local community religious strength ( $q_i(g)$ ) and the transition probabilities ( $\pi^{p(r)i(r)}$ ).

The AddHealth questionnaire contains different religious related questions. In particular, in wave I (1995-96), both students and parents are asked about their religious affiliation, how important is religion for them, and, more importantly, each student is asked whether she/he

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<sup>6</sup>The AddHealth website describes survey design and data in details. <http://www.cpc.unc.edu/projects/addhealth>

<sup>7</sup>The limit in the number of nominations is not binding (even by gender). Less than 0.1% of the students in our sample show a list of ten best friends.

has gone to a religious service or a church-related event in the last four weeks with his/her mother and with his/her father (separately). As it usually the case, we have divided our sample into seven groups: Catholics, Protestants, other Christians, Jews, Asian religion (i.e. Buddhist, Hindu), Muslims and a residual category: “other religions”. Table A.1 in Appendix 1 describes what we include in each of these groups.

As in the model, we distinguish between religious parents  $p(r) = p(a)$  and non-religious parents or seculars  $p(r) = p(b)$ . This distinction is derived using the response to the question in wave I: “How important is religion to you?”, coded as 1 = unimportant; 2 = fairly unimportant; 3 = fairly important; 4 = very important and as 0 if the respondent has no religion (i.e. response “none” to the question: “What is your religion?”). We define as *religious parents*, i.e.  $p(r) = p(a)$ , those who have answered 3 or 4 to the question above while *non-religious parents* (or seculars), i.e.  $p(r) = p(b)$ , are those who have answered 0 or 1 to the question above. We exclude those for which religion is “fairly important” to better distinguish between the two categories.<sup>8</sup>

Within each group of parents ( $p(r) = p(a)$  and  $p(r) = p(b)$ ), we measure parental effort in transmitting their religion trait,  $e^{p(r)}$ , using a dichotomous variable (labeled as “parental effort”) that takes a value of one if the child declares having/not having gone to a religious service or a church-related event in the last four weeks with at least one parent and zero otherwise. Specifically, for religious parents,  $p(r) = p(a)$ , the intensity of religion  $e^{p(a)}$  is measured using a dummy variable that takes a value of 1 if the child declares having gone to a religious service or a church-related event in the last four weeks with at least one parent and takes a value of zero otherwise. For non religious parents, the parental effort in transmitting their trait,  $e^{p(b)}$  is measured by using a dummy variable that takes a value of 1 if the child declares *not* having gone to a religious service or a church-related event in the last four weeks with at least one parent and take a value of zero otherwise. In other words,  $e^{p(a)} = 1 - e^{p(b)}$ .

The intensity of religion of the local community (friends) of each individual  $i$ ,  $q_i(g)$ , is derived from the religious-related information on nominated friends in network  $g$ . We calculate the fraction of religious friends (labeled as “religious peers”) of each individual  $i$  by

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<sup>8</sup>This religion-related question is asked in the (in home) parental questionnaire where only one parent is interviewed.

considering the percentage of friends of  $i$  who have answered 3 or 4 to the question: “How important is religion to you?”. Observe that this measure is independent of the religion of the friends of  $i$  since a very religious Jew can obviously affect a Catholic student if they are friends. What matters is strength of religion of the friends of each student  $i$ .

We need now to determine the transition probabilities  $\pi^{p(r)i(r)}$ . The questionnaire in wave IV, i.e. when the child is an adult, asks again the same religion-related questions, in a slightly different formulation. Specifically, in wave IV, it is asked: “How important (if at all) is your religious faith to you?”, coded as 1 = not important; 2 = somewhat important; 3 = very important; 4 = more important than anything else.

Consistently with the other definitions, we define religious individuals as those having (in wave IV) responded 3 or 4 to this question. So, for example,  $\pi_{t+1}^{p(a)i(a)}$  is the probability that a child  $i$  in wave I is religious in wave IV (when he/she is an adult) given that his/her parents declared that they were religious in wave I.

To summarize, we evaluate parents’ effort when the child is at school (wave I in 1995-1996), the quality of the social context and parents’ strength of religion when the child is at school (wave I in 1995-1996) and the child’s religious outcome when he/she is an adult (wave IV in 2007-2008).

Let us describe our data by documenting the parent-child associations in terms of religious affiliation. Table 1 shows that the intergenerational correlation in terms of religious affiliation is roughly 1. Indeed, children belong to the same religious group as their parents and they maintain this affiliation over time.<sup>9</sup> This is why, in this paper, we analyze the transmission of the intensity of religion *within* the same religious group.

[Insert Table 1 here]

Our final sample of in-home wave I students (and friends) that are followed over time and can be tracked into networks consists of slightly less than 5,000 individuals distributed over 279 networks. This large reduction in sample size with respect to the original sample is due

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<sup>9</sup>Some transitions appear for the Protestant group. The large majority of these individuals go to the “other” religious group. This group very likely collects other minority protestant religious denominations that are not listed in the Add Health questionnaire.

to the fact that the information on religion behavior is only asked to a sub-sample of students (in the in-home questionnaire) and to the network construction procedure. Indeed, roughly 20% of the students do not nominate any friends and another 20% cannot be correctly linked (for example because the identification code is missing or misreported). In addition, we also exclude networks composed by 2-3 individuals only and individuals who are not followed in wave IV. In our data, there is a large variation in network size, ranging from cohesive groups of 4 students to larger communities of more than 700 students directly or indirectly linked to each others.<sup>10</sup> In our empirical analysis, we will use *network fixed effects* to account for unobserved differences between small and large communities. We will thus exploit variations in peer groups *within networks* to identify the effect of the local community (peer group) as distinct from the effects of the global community (the network), as well as from those stemming from family and neighborhood background. Observe that because networks are within schools, network fixed effects also account for school inputs. Our identification strategy is detailed in the next section.

Table A.1 in Appendix 1 provides precise definitions and descriptive statistics of the variables used in our study, distinguishing between religious and non-religious parents. Among the individuals selected in our sample, roughly 82% have religious parents and 18% have non-religious parents. About 60% of children of religious parents declare to have been to a religious service or church-related event in the past 4 weeks with the mother or the father ( $e^{p(a)}$  in our analysis) and this percentage is about 16% for children of non-religious parents ( $e^{p(b)}$  in our analysis). The average fraction of friends who are religious ( $q_i(g)$ ) is 52% for children coming from religious families and 29% for children of non religious parents, with considerable dispersion around these mean values. The remaining control variables do not show noticeable differences between children having religious and non-religious parents. Roughly, one fourth of our adolescents are highly performing individuals at school, i.e. had the highest mark in mathematics. The average parental education is higher than high school graduate. About 70% of our individuals come from household with two married parents,

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<sup>10</sup>In the empirical analysis, we define a network as a connected network, which needs to satisfy the two following conditions. First, two agents in a network  $g_\kappa$  are either directly linked, or are indirectly linked through a sequence of agents in  $g_\kappa$  (this is the requirement of connectedness). Second, two agents in different network components  $g_\kappa$  and  $g_{\kappa'}$  cannot be connected through any such sequence (this is maximality).

from a neighborhood of good quality. Protestants are the dominant religious group, followed by the Catholic group. Less than 2% of our individuals are of various other Christian denominations, and small percentages (smaller than 1%) belong to minority religion affiliations (Jewish, Muslim, Buddhist, Hindu). In the remainder of our analysis we will focus on the determinants of the strength of religious faith, under the guidance of our theoretical model. Unfortunately, the small sample sizes by religious affiliations (in particular for Jewish, Muslim and Asian religions) prevent us from running our analysis on the different religious groups separately. We do, however, control for religious affiliation including (child) religious affiliation dummies.

Table 2 reports on the evolution of the strength of religion over time (transition probabilities).

*[Insert Table 2 here]*

Contrary to religion affiliation (Table 1), the individual intensity of religion varies between teenage years (wave I in 1995-1996) and adulthood (wave IV in 2007-2008). Table 2 shows that, in wave I, roughly 57% of children having religious parents has the same intensity of religion as their parents. This percentage is about 85% for children having non-religious parents (i.e. reporting that they not care much about religion). When the child grows up, however, those percentages change. Indeed, more children having religious parents acquire the same trait as their parents whereas there are less children having non-religious parents that keep this trait, meaning that there is a tendency for being more religious over time. The aim of our study is to shed some light on the relative importance of family inputs and social context in shaping those transitions, while uncovering the mechanisms underlying those influences.

## 6 Estimation issues

While most of the existing studies on the impact of the social context on individual outcomes measure the social context at a quite aggregate level (neighborhood, classroom, city),<sup>11</sup> we adopt here a *social network* approach. As mentioned in the Introduction, contrary to the standard approach where peer effects are conceived as an average intra-group externality that affects identically all the members of a given group (often arbitrary, and at a quite aggregate level), in a network approach this problem does not arise because peers are defined by the smallest unit of analysis, which is the dyad, a two-person group. It does not solve, however, the problem of the endogenous formation of the group. This is a key endogeneity problem when assessing the impact of the behavior of a (narrowly defined) reference group on individual decisions.

In this paper, we combine the richness of information of the AddHealth data with various estimation strategies to provide a credible identification of the behavioral mechanism proposed by our theoretical model.

Firstly, the test of Proposition 2 (model (10)) does not raise severe concerns as the social network structure is predetermined in the adulthood. We exploit the longitudinal structure of the AddHealth data, which allows a time lag between when friendship choices are made (wave I in 1995-1996) and when outcome is realized (wave IV in 2007-2008). Possible unobserved student's characteristics driving friends' choice at school (i.e. common interests in sports or other activities) are unlikely to remain important determinants of individual decisions later on in life.

The test of Proposition 1, instead, implies to estimate a contemporaneous effect. Although the individual decision being modelled here is the one of the parents (not of the children who choose friends), if the variables that drive the process of selection of children into groups are not fully observable, potential correlations between (unobserved) network-specific factors and the target regressors may still be major sources of bias. Indeed, there may be some unobserved child characteristics correlated with the choice of peers who are religious that also influence the parental effort in transmitting religion intensity.

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<sup>11</sup>See e.g., Bisin et al. (2010), Oreopolous (2003), Patacchini and Zenou (2011), Solon et al. (2000). For an overview of this literature, see Durlauf (2004), Ioannides and Topa (2010), and Ioannides (2011).

We address this issue as follows.

Firstly, we exploit the network structure of our data to include the characteristics of the peers and network fixed effects, together with individual (parent and child) level controls. The inclusion of peer characteristics helps in explaining the process of selection into groups whereas network fixed effects helps in capturing any remaining source of selection on unobservables. This implies that we allow link formation (as captured by our adjacency matrix  $\mathbf{G}$ ) to be correlated with observed individual characteristics, contextual effects (observed peer characteristics) and unobserved network characteristics (captured by the network fixed effects). Under the assumption that any troubling source of heterogeneity, which is left unexplained, can be captured at the network level, a pseudo-panel data (OLS) fixed effects estimator delivers consistent estimates.<sup>12</sup> However, if the correlated unobserved factors are rather individual-specific, OLS estimators will be biased (upward or downward according to the signs of the correlations between these factors, our peer-level variable and parental effort).

We address this problem by using an IV approach, which is similar in spirit to the strategy proposed by Mihaly (2009) who addresses endogenous network formation using the same AddHealth data. The idea is to treat the composition of students in a given grade within a school as quasi-random and to isolate this quasi-random variation in the friendship network formation process.<sup>13</sup> We use the fraction of religious students by grade, gender, religious affiliation and ethnic group as an instrument for the individual (children) fraction of religious friends. The underlying network formation process that supports this strategy is an assortative matching behavioral mechanism where contacts are within individuals who are similar along observable characteristics (most notably grade, gender, religious affiliation and ethnic group). Then the individual contacts with a given trait are chosen from this population of possible links. They will thus partly depend on the share of individuals with this trait in the population, which is supposed to be exogenous. Indeed, a student of a

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<sup>12</sup>This approach for the identification of peer effects, i.e. the use of network fixed effects in combination with high quality data on social contacts has been first proposed by Bramoullé et al. (2009) and then used in a number of recent studies based on the AddHealth data ( e.g. Lin, 2010; Liu et al. 2011; Patacchini and Zenou, 2012).

<sup>13</sup>Similar assumptions about cohort variation are frequently made in the literature, see e.g. Hoxby (2000).

given grade, gender, religious affiliation and ethnic group may be simply more likely to form friendships with religious friends if there are many other students of the same grade, gender, religious affiliation and ethnic group around who are religious. For example, if we consider a student who is a male, Catholic, white and in grade 7, we will take as instrument for the fraction of his friends who are religious, the fraction of religious Catholic white seventh grader males in the school he attends.

We will thus estimate models (8) and (9) using both OLS and IV estimators.

## 7 Estimation results

Tables 3 and 4 report the estimation results of model (8) and (9), respectively, which are obtained by using a linear probability model with network fixed effects and adopting an OLS estimator or an IV estimator. Both sets of results are presented using an increasing set of controls. We start by including a set of individual and peer characteristics that should reasonably explain the sorting of children into peer groups (peers' choice), such as parental education, sex, grade, mathematics score, neighborhood quality and religious affiliation dummies (specification (1)) and then gradually introduce other possibly relevant factors affecting parental effort in transmitting religious. We add indicators of the social structures of families, namely number of components and whether the parents are married (specification (3)), and finally parental occupation dummies (specification (4)).

Our results show a significant impact of the social context on parental effort, which is positive for religious parents (Table 3) and negative for non-religious parents (Table 4). Going back to our theoretical model (Proposition 1), this suggests *cultural complementarity for religious parents*, i.e.  $\frac{\partial e^{p(a)}}{\partial q_i(g)} > 0$  (indicating that  $C'''(e^{p(a)}) \leq 0$ ) since the more the child's friends are religious, the more they invest in transmitting religion to their child (i.e. the more the child has declared having gone to a religious service or a church-related event in the last four weeks with at least one parent). On the contrary, for non-religious parents, we find *cultural substitutability*, i.e.  $\frac{\partial e^{p(b)}}{\partial [1-q_i(g)]} < 0$  (indicating that  $C'''(e^{p(b)}) \geq 0$ ) since the more the child's friends are non-religious, the lower they invest in non transmitting religion to their child (i.e. the less the child has declared *not* having gone to a religious service or a

church-related event in the last four weeks with at least one parent).

Observe that both Tables 3 and 4 show that the estimated coefficient of our target variable “religious peers” ( $q_i(g)$  in the model) remains roughly unchanged across columns within each panel (i.e. for each type of estimator). Looking at the results across panels (i.e. at the difference between OLS and IV estimators), we find that the IV estimates are substantially higher in magnitude (in absolute value) than the OLS estimates and that they have opposite sign for religious and non-religious parents. These findings are consistent with the presence of individual unobserved factors differently correlated with the fraction of religious friends and with parental effort for different types of parents. For example, if religious parents “trust” the religious behavior of their child because lower levels of a given unobserved characteristic (such as a propensity towards risky behavior) induces them to choose more friends who are religious, they may then decrease their effort in transmitting religion. These types of unobserved child characteristics negatively correlated with the fraction of religious peers (hence positively correlated with the fraction of non-religious peers) can instead show a positive correlation with parental effort in transmitting religion for non-religious parents, i.e. can show higher levels if parents do not put effort in transmitting religion.

An OLS estimator that fails to take into account these effects will be downward biased for religious parents and upward biased for non-religious parents. The IV estimator will instead show the true impact of the local environment on parental effort.

Regarding the magnitude of the effects, according to the IV estimates, we find that for religious parents, a 1% increase in the fraction of religious peers increases the average probability that the parents devote more effort in transmitting religion values to their children by about 0.15 (roughly 0.24%). For non-religious parents, a 1% increase in the fraction of non-religious peers translates into a decrease of the average probability that the parents do not devote effort in transmitting religion of about 0.12 (roughly 0.14%).

The evidence collected so far shows that, *ceteris paribus*, (i) the quality of the social context (friends) in terms of religion is an important factor in influencing parental effort in transmitting religion; (ii) the effect is different for religious and non-religious parents; (iii) the extent of the effect is also different for different parental type and stronger for religious parents.

[Insert Tables 3 and 4 here]

Let us now turn our attention to the test of Proposition 2. The key feature of our model of intergenerational transmission of religion strength is that both socialization *inside* the family (the role of parents) and socialization *outside* the family (the role of peers) play an important role in shaping the intensity of religion strength of children, predicting that parental effort in transmitting religion values is an important channel mediating social context influences. We test the empirical salience of such a model by estimating model (10). In this model, the friendship network was formed when students were at school (wave I in 1995-1996) whereas the decisions of the intensity of religion are observed when the individual is an adult (wave IV in 2007-2008).

The probabilities  $\pi_{t+1}^{p(r)i(r)}$  are analyzed using linear probability models with network fixed effects, each of them having the dependent variable equal to one if the (observed) child's religion intensity is achieved when adult (i.e. in wave VI the individual has answered 3 or 4 to the question: "How important (if at all) is your religious faith to you?", coded as 1 = not important; 2 = somewhat important; 3 = very important; 4 = more important than anything else) and zero otherwise. Clearly, conditionally on parental religion type, the probabilities that a child will be religious and that he/she will not, sum to one. Thus, we only report the results for  $\pi^{p(a)i(a)}$  and  $\pi^{p(b)i(b)}$  (since  $\pi^{p(a)i(b)} = 1 - \pi^{p(a)i(a)}$  and  $\pi^{p(b)i(a)} = 1 - \pi^{p(b)i(b)}$ ), focussing the analysis on the successful transmission of the parent religious trait.

Table 5 displays the estimation results for religious (dependent variable  $\pi^{p(a)i(a)}$ ) and non religious parents (dependent variable  $\pi^{p(b)i(b)}$ ).

We find that, for religious parents, the quality of the social context ("religious peers") does not seem to have a direct impact on a successful transmission of religion  $\pi^{p(a)i(a)}$  nor it shapes the impact of parental effort (i.e. the estimated interaction parameter  $q_i(g)e^{p(a)}$  is not statistically significant). Parental effort  $e^{p(a)}$  appears to be the only crucial factor in a successful transmission of the religious trait  $r = a$ . In terms of magnitude, having parents devoting time in transmitting religion raises the average probability of having a religious child by about 0.07 (roughly 0.11%). This seemingly surprising result has a natural interpretation in light of our theoretical model, which predicts not only a direct effect but also an indirect

effect via parental effort. It reveals that, for religious parents, the effect of the social context (peer effects) on a successful transmission of religion  $\pi^{p(a)i(a)}$  only acts *indirectly* through parental effort, as shown in Table 1, but not directly.

For non-religious parents, instead, we find that the quality of the social context has both a *direct* and *indirect* effect on  $\pi^{p(b)i(b)}$  and that the impact of parental effort also varies with the quality of the social context (cross effect). Indeed, we find that the higher is the fraction of non-religious peers, the more successful is the transmission of the non-religious trait, i.e.,  $\frac{\partial \pi^{p(b)i(b)}}{\partial (1-q_i)} > 0$ , and the higher is parental effort in transmitting the non-religious trait, the more successful is the transmission of the non-religious trait, i.e.,  $\frac{\partial \pi^{p(b)i(b)}}{\partial e^{p(b)}} > 0$ . Moreover, we also find that the higher is the fraction of non-religious peers, the lower is the effect of parental effort on the transmission of the non-religious trait, i.e.,  $\frac{\partial^2 \pi^{p(b)i(b)}}{\partial e^{p(b)} \partial (1-q_i)} < 0$ . If the fraction of non-religious peers is extremely high (1 in the extreme case), the direct impact of parental effort is close to zero. In terms of magnitude, having parents devoting effort in transmitting the non-religious (secular) trait increases the average probability of a successful transmission by just 0.0052 (which translates into a 0.008% only). Consistently with the results in Table 2, for non-religious parents, the quality of peers and parental effort appear to be substitutes. If the fraction of non religious peers is extremely high, the parents will leave to the peers the task of transmitting their non-religious traits. As a result, the quality of the social context (peers) is the crucial factor for a successful transmission of non-religious (i.e. secular) traits. On the other hand, if the fraction of non-religious peers is low, the (non) transmission of religious is successful only if the parents put effort in transmitting their trait (no religion), otherwise the child will become religious with a high probability. The direct effect of the quality of the social context remains sizeable even if parents put effort in transmitting the non-religious trait. In terms of magnitude, a 1% increase in the fraction of non-religious peers raises the average probability of a successful (non) transmission of religion by roughly 0.05 (about 0.09%). This finding implies that children of non-religious parents can increase their religious faith if they have religious peers, regardless of the effort of their parents in transmitting their trait.

[Insert Table 5]

Our findings can thus be summarized as follows: *(i)* The impact of both parents' effort and local environment quality (quality of peers) on the intergenerational transmission of religion are different for religious and non-religious parents, *(ii)* for religious parents, the quality of peers has a large indirect effect (through parental effort) and a non-significant direct impact, *(iii)* for non-religious parents, there is a lower indirect effect and a statistically significant and sizeable direct effect, *(iv)* the mechanisms driving these effects are different for different types of parents.

## 8 Conclusion

Using a network approach, this paper has proposed a mechanism of transmission of religion strength based on parents' involvement in religious activities and peer effects. Peers, here measured as the fraction of religious friends each student nominates, have both a direct and an indirect effect on children's religious outcomes as it affects parents' effort in transmitting their religious trait which, in turn, plays an important role in determining the child's religious outcome. These potential interactions depend on the parents' religious strength. Using detailed data on friendships between adolescents in American schools, our empirical evidence supports these predictions. We find that, for religious parents, the higher is the fraction of religious peers, the more parents put effort in transmitting their religiosity, indicating cultural complementarity. For non-religious parents, we obtain the reverse, indicating cultural substitutability. Concerning the success in transmitting the religious trait, we find that, for religious parents, the fraction of religious peers has only an indirect effect (through parental effort) while, for non-religious parents, there is a lower indirect effect and a statistically significant and sizeable direct effect of peers on the transmission of the non-religious trait.

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**Appendix 1: Data appendix**  
**Table A.1: Description of Data**

	Variable definition	Religious parents 82.07%			Non Religious parents 17.93%		
		n.obs.	mean	std.dev	n.obs.	mean	std.dev
<b>WAVE I</b>							
Parental effort $e^{p(r)}$	Dummy variable taking value one if the respondent has gone to a religious service or church-related event in the past 4 weeks with the mother or the father.	4,088	0.61	0.49	893	0.16	0.23
Religious friends $q_i(g)$	Fraction of friend answering 3 or 4 to the question: "How important is religion to you?" coded as 1=unimportant; 2 = fairly unimportant; 3 = fairly important; 4 = very important and 0 if the respondent answers "none" to the question: "What is your religion?"	4,086	0.52	0.38	892	0.29	0.33
<b>Individual socio-demographic variables</b>							
Female	Dummy variable taking value one if the respondent is female.	4,058	0.55	0.50	885	0.58	0.49
Grade	Grade of student in the current year, range 7 to 12	4,004	9.67	1.63	875	9.61	1.57
Mathematics score a	Mathematics score dummies, derived from the score in mathematics at the most recent grading period, coded as A (the highest score) , B , C , D or lower and missing. "D or lower" is the reference category.	4,006	0.27	0.44	874	0.24	0.43
Mathematics score b	"	4,006	0.30	0.46	874	0.31	0.46
Mathematics score c	"	4,006	0.24	0.43	874	0.21	0.41
Mathematics score missing	"	4,006	0.05	0.22	874	0.07	0.26
Catholic	Religion affiliation dummies. Response to the question: What is your religion? " No religion" is the reference category.	4,057	0.27	0.44	872	0.17	0.38
Protestant	" . Baptist, Methodist, Lutheran, Presbyterian, Pentecostal, Episcopal, Other Protestant, Adventist, AME, AME Zion, CME, Assemblies of God, Adventist Christian Church (Disciples of Christ), Christian Science, Congregational, Friends/Quake, Holiness	4,057	0.62	0.48	872	0.44	0.50
Other Christian	" . Jehovah's Witness, Latter Day Saints (Mormon), Unitarian, Eastern Orthodox,	4,057	0.02	0.16	872	0.007	0.08
Jewish	" . Jewish Conservative, Jewish Reformed, Jewish Orthodox, Jewish Reconstructionist	4,057	0.004	0.06	872	0.006	0.07
Asian religion	" . Buddhist, Hindu	4,057	0.005	0.07	872	0.004	0.06
Muslim	" . Islam, Moslem, Muslim	4,057	0.002	0.04	872	0.003	0.06
Other religion	" .Other religions	4,057	0.02	0.15	872	0.03	0.16
<b>Family background variables</b>							
Family size	Number of people living in the household, range 2 to 11	4,056	4.65	1.53	885	4.30	1.40
Married parents	Dummy variable taking value one if the respondent lives in a household with two parents (both biological and non biological) that are married.	4,056	0.72	0.45	885	0.68	0.47
Parent education	Schooling level of the (biological or non-biological) parent who is living with the child, coded as 1 = "never went to school", 2 = "some school", 3 = "less than high school", 4 = "a business, trade, or vocational school instead of high school or completed GED", 5 = "high school graduate", 6 = "business, trade, or vocational school after high school", 7 = "some college", 8 = "graduated from college or a university", 9 = "professional training beyond a four-year college". If both parents are in the household the education of the father is considered	3,975	5.97	2.031	866	5.51	1.98
Parent occupation manager	Parent occupation dummies. Closest description of the job of (biological or non-biological) parent that is living with the child . If both parents are in the household, the occupation of the father is considered. "none" is the reference group.	4,048	0.09	0.29	883	0.10	0.30

Parent occupation professional/technical	”	4,048	0.19	0.39	883	0.16	0.36
Parent occupation office or sales worker	”	4,048	0.11	0.31	883	0.09	0.29
Parent occupation manual	”	4,048	0.33	0.47	883	0.36	0.48
Parent occupation military or security	”	4,048	0.03	0.17	883	0.02	0.15
Parent occupation farm or fishery	”	4,048	0.02	0.14	883	0.01	0.12
Parent occupation other	”	4,048	0.13	0.34	883	0.15	0.36
<b>Residential neighborhood variables</b>							
Neighborhood quality	Interviewer response to the question "How well kept is the building in which the respondent lives", coded as 4= very poorly kept (needs major repairs), 3= poorly kept (needs minor repairs), 2= fairly well kept (needs cosmetic work), 1= very well kept.	4,012	1.54	0.77	875	1.67	0.89
<b>Contextual variables</b>	Average value of all the variable over the peer group						
<b>WAVE IV</b>							
<b>Individual socio-demographic variables</b>							
Age	Respondent's age in years	4,058	29.07	1.69	885	29.04	1.66
Earnings	Response to the question: Now think about your personal earnings. In {2006/2007/2008}, how much income did you receive from personal earnings before taxes, that is, wages or salaries, including tips, bonuses, and overtime pay, and income from self-employment? Range 0 (unemployed) to 100,000\$ (capturing also >100,000\$)	3,976	37,47	46,06	870	33,89	50,56
Job Satisfaction	Response to the question: How satisfied (are/were) you with this job, as a whole? 5 = extremely satisfied, 4 = satisfied, 3 = neither satisfied nor dissatisfied, 2 = dissatisfied, 1 = extremely dissatisfied.	4,057	3.87	0.99	883	3.83	1.01
Self-esteem	Response to the question: Compared to other people your age, how intelligent are you? 1 =moderately below average, 2 = slightly below average, 3 = about average, 4 = slightly above average, 5 = moderately above average, 6 = extremely above average.	4,058	3.98	1.01	885	3.93	0.98
Religion importance	Response to the question: "How important (if at all) is your religious faith to you?" 1 = not important; 2 = somewhat important; 3 = very important; 4 = more important than anything else.	4,075	2.75	0.83	889	2.168	0.88
<b>Family background variables</b>							
Married	Dummy variable taking value one if the respondent is married.	4,058	0.43	0.50	885	0.37	0.48
Children	Dummy variable taking value one if the respondent has children.	4,058	0.46	0.50	885	0.48	0.50
Family size	Number of people in the household.	4,057	3.32	1.94	885	3.26	2.04
<b>Residential neighborhood variables</b>							
Neighborhood quality_2	Interviewer response to the question: "How well kept is the building in which the respondent lives", coded as 4= very poorly kept (needs major repairs), 3= poorly kept (needs minor repairs), 2= fairly well kept (needs cosmetic work), 1= very well kept	3,730	1.35	0.59	827	1.33	0.57

**Table 1: Children with same religion affiliation of the parents by religious affiliation**

	Whole sample(%)		Religious parents (%)		Non religious parents (%)	
	WAVE I	WAVE IV	WAVE I	WAVE IV	WAVE I	WAVE IV
Catholic	91.73	87.02	94.48	90.41	85.85	82.49
Protestant	86.31	65.34	91.47	67.68	73.54	62.92
Other christian	99.04	77.53	99.19	76.06	98.78	79.40
Jewish	99.80	99.76	99.85	99.80	99.48	99.66
Asian religion	99.68	99.30	99.82	99.55	99.56	99.06
Muslim	99.91	99.85	99.92	99.90	99.82	99.66
Other	96.89	92.15	97.25	92.04	95.98	91.50

**Table 2: Children with same religion effort of the parents over time**

	Religious parents (%)		Non religious parents (%)	
	WAVE I	WAVE IV	WAVE IV	WAVE IV
Religious child	57.04	67.29	-	-
Non religious child	-	-	85.33	62.49

**Table 3: Parental effort in transmitting religion and peers' quality**

**-Model (8) estimation results-**

**Religious parents**

	Dep. Var. parental effort ( $e^{p(a)}$ )					
	OLS			IV		
	(1)	(2)	(3)	(1)	(2)	(3)
<b>Religious peers (<math>q</math>)</b>	<b>0.0782***</b> <b>(0.0252)</b>	<b>0.0815***</b> <b>(0.0251)</b>	<b>0.0798***</b> <b>(0.0252)</b>	<b>0.1495**</b> <b>(0.0667)</b>	<b>0.1493**</b> <b>(0.0665)</b>	<b>0.1493**</b> <b>(0.0667)</b>
Parental education	0.0197*** (0.0042)	0.0200*** (0.0042)	0.0208*** (0.0046)	0.0203*** (0.0043)	0.0205*** (0.0043)	0.0219*** (0.0047)
Female	-0.0011 (0.0154)	0.0001 (0.0154)	0.0013 (0.0154)	-0.0035 (0.0158)	-0.0021 (0.0157)	-0.0009 (0.0157)
Grade	-0.0094 (0.0115)	-0.0093 (0.0114)	-0.0101 (0.0114)	-0.0090 (0.0119)	-0.0093 (0.0118)	-0.0101 (0.0118)
Mathematics score a	0.0961*** (0.0264)	0.0903*** (0.0263)	0.0919*** (0.0264)	0.0860*** (0.0270)	0.0795*** (0.0269)	0.0810*** (0.0270)
Mathematics score b	0.0665*** (0.0253)	0.0612** (0.0252)	0.0628** (0.0252)	0.0677*** (0.0261)	0.0614** (0.0260)	0.0631** (0.0260)
Mathematics score c	0.0204 (0.0258)	0.0137 (0.0257)	0.0151 (0.0258)	0.0256 (0.0267)	0.0179 (0.0266)	0.0192 (0.0267)
Mathematics score missing	0.0448 (0.0406)	0.0457 (0.0404)	0.0470 (0.0404)	0.0445 (0.0421)	0.0444 (0.0419)	0.0447 (0.0419)
Catholic	0.4067*** (0.0410)	0.3909*** (0.0410)	0.3894*** (0.0410)	0.4381*** (0.0445)	0.4195*** (0.0444)	0.4178*** (0.0444)
Protestant	0.4335*** (0.0394)	0.4267*** (0.0393)	0.4259*** (0.0393)	0.4534*** (0.0425)	0.4444*** (0.0424)	0.4430*** (0.0424)
Other christian	0.6277*** (0.0604)	0.6105*** (0.0602)	0.6074*** (0.0603)	0.6356*** (0.0632)	0.6157*** (0.0630)	0.6118*** (0.0630)
Jewish	0.1507 (0.1395)	0.1353 (0.1389)	0.1297 (0.1389)	0.1740 (0.1524)	0.1485 (0.1517)	0.1425 (0.1517)
Asian religion	0.0472 (0.1225)	0.0317 (0.1220)	0.0182 (0.1229)	0.0760 (0.1273)	0.0592 (0.1267)	0.0476 (0.1278)
Muslim	0.6955*** (0.2097)	0.6497*** (0.2092)	0.6521*** (0.2093)	0.6765*** (0.2103)	0.6288*** (0.2097)	0.6283*** (0.2099)
Other	0.3538*** (0.0605)	0.3485*** (0.0603)	0.3550*** (0.0605)	0.3956*** (0.0636)	0.3871*** (0.0634)	0.3932*** (0.0636)
Neighborhood quality	-0.0733*** (0.0105)	-0.0667*** (0.0106)	-0.0667*** (0.0107)	-0.0713*** (0.0108)	-0.0645*** (0.0110)	-0.0647*** (0.0111)
Family size		0.0042 (0.0055)	0.0051 (0.0055)		0.0040 (0.0056)	0.0048 (0.0057)
Parents married		0.1008*** (0.0187)	0.0950*** (0.0195)		0.1037*** (0.0193)	0.0969*** (0.0201)
Peers characteristics	yes	yes	yes	yes	yes	yes
Parental occupation dummies	no	no	yes	no	no	yes
Network fixed effects	yes	yes	yes	yes	yes	yes
			First stage <i>F test</i>	1119.65	1108.38	1106.04
n.obs	3,816	3,816	3,810	3,659	3,659	3,653
n. networks	279	279	279	279	279	279

Notes: Precise list and definition of control variables are in Tables A1. "Peers characteristics" are averages among peers of the listed controls. Standard errors in parentheses. Coefficients marked with one (two) [three] asterisks are significant at 10 (5) [1] percent level.

**Table 4: Parental effort in transmitting religion and peers' quality  
-Model (9) estimation results-  
Non Religious parents**

	Dep. Var. parental effort ( $e^{(b)}$ )					
	OLS			IV		
	(1)	(2)	(3)	(1)	(2)	(3)
<b>Non religious peers (1- q)</b>	<b>-0.0665**</b>	<b>-0.0671**</b>	<b>-0.0694**</b>	<b>-0.1212**</b>	<b>-0.1204**</b>	<b>-0.1225**</b>
	<b>(0.0337)</b>	<b>(0.0337)</b>	<b>(0.0340)</b>	<b>(0.0542)</b>	<b>(0.0543)</b>	<b>(0.0551)</b>
Parental education	-0.0091*	-0.0086	-0.0053	-0.0056	-0.0052	-0.0042
	(0.0052)	(0.0052)	(0.0056)	(0.0051)	(0.0051)	(0.0054)
Female	0.0020	0.0018	-0.0006	0.0123	0.0123	0.0117
	(0.0184)	(0.0184)	(0.0186)	(0.0174)	(0.0174)	(0.0176)
Grade	-0.0293**	-0.0298**	-0.0298**	-0.0191	-0.0193	-0.0194
	(0.0145)	(0.0145)	(0.0146)	(0.0138)	(0.0138)	(0.0140)
Mathematics score a	-0.0119	-0.0139	-0.0125	-0.0096	-0.0106	-0.0091
	(0.0296)	(0.0296)	(0.0299)	(0.0283)	(0.0283)	(0.0286)
Mathematics score b	0.0002	-0.0010	0.0002	-0.0316	-0.0320	-0.0310
	(0.0279)	(0.0279)	(0.0282)	(0.0268)	(0.0268)	(0.0271)
Mathematics score c	0.0128	0.0130	0.0108	-0.0147	-0.0144	-0.0149
	(0.0297)	(0.0298)	(0.0303)	(0.0285)	(0.0286)	(0.0291)
Mathematics score missing	0.0308	0.0323	0.0374	-0.0029	-0.0023	0.0025
	(0.0422)	(0.0423)	(0.0428)	(0.0400)	(0.0401)	(0.0407)
Catholic	-0.0643**	-0.0633**	-0.0668**	-0.0608**	-0.0605**	-0.0637**
	(0.0273)	(0.0273)	(0.0276)	(0.0261)	(0.0261)	(0.0263)
Protestant	-0.0515**	-0.0512**	-0.0517**	-0.0404**	-0.0400*	-0.0412**
	(0.0210)	(0.0210)	(0.0212)	(0.0205)	(0.0205)	(0.0207)
Other christian	-0.0442	-0.0465	-0.0475	-0.0386	-0.0400	-0.0311
	(0.1060)	(0.1063)	(0.1069)	(0.1130)	(0.1132)	(0.1142)
Jewish	-0.0464	-0.0282	-0.0393	-0.0272	-0.0164	-0.0303
	(0.1356)	(0.1362)	(0.1372)	(0.1254)	(0.1261)	(0.1271)
Asian religion	0.0137	0.0095	0.0094	0.0176	0.0137	0.0046
	(0.1323)	(0.1325)	(0.1332)	(0.1508)	(0.1510)	(0.1519)
Muslim	-0.0481	-0.0895	-0.0774			
	(0.3125)	(0.3143)	(0.3156)			
Other	-0.0903	-0.0894	-0.0919	-0.0946*	-0.0946*	-0.1016*
	(0.0590)	(0.0590)	(0.0599)	(0.0566)	(0.0567)	(0.0577)
Neighborhood quality	-0.0056	-0.0046	-0.0066	-0.0079	-0.0075	-0.0094
	(0.0104)	(0.0106)	(0.0109)	(0.0098)	(0.0101)	(0.0102)
Family size		0.0042	0.0043		0.0030	0.0033
		(0.0073)	(0.0074)		(0.0070)	(0.0070)
Parents married		0.0217	0.0174		0.0112	0.0055
		(0.0209)	(0.0220)		(0.0200)	(0.0209)
Peers characteristics	yes	yes	yes	yes	yes	yes
Parental occupation dummies	no	no	yes	no	no	yes
Network fixed effects	yes	yes	yes	yes	yes	Yes
			First stage			
			<i>F test</i>	387.53	385.81	384.25
n.obs	813	813	811	768	768	767
n. networks	182	182	181	177	177	176

Notes: Precise list and definition of control variables are in Tables A1. "Peers characteristics" are averages among peers of the listed controls. Standard errors in parentheses. Coefficients marked with one (two) [three] asterisks are significant at 10 (5) [1] percent level.

**Table 5: Intergeneration transmission of education**  
**-Model (10) estimation results-**  
**Transition probabilities**

	Dep. Var. $\pi^{p(a) i(a)}$		Dep. Var. $\pi^{p(b) i(b)}$	
	(1)	(2)	(1)	(2)
<b>Religious peers (<math>q</math>)</b>	<b>0.0038</b>	<b>0.0080</b>		
	<b>(0.033)</b>	<b>(0.033)</b>		
<b>Parental effort (<math>e^{p(a)}</math>)</b>	<b>0.0737***</b>	<b>0.0750***</b>		
	<b>(0.025)</b>	<b>(0.025)</b>		
<b>Religious peers (<math>q</math>)* Parental effort (<math>e^{p(a)}</math>)</b>	<b>0.0406</b>	<b>0.0386</b>		
	<b>(0.039)</b>	<b>(0.039)</b>		
<b>Non-religious peers (<math>1-q</math>)</b>			<b>0.4887**</b>	<b>0.4792*</b>
			<b>(0.244)</b>	<b>(0.244)</b>
<b>Parental effort (<math>e^{p(b)}</math>)</b>			<b>0.4351**</b>	<b>0.4299**</b>
			<b>(0.202)</b>	<b>(0.202)</b>
<b>Non-religious peers (<math>1-q</math>)* Parental effort (<math>e^{p(b)}</math>)</b>			<b>-0.4227*</b>	<b>-0.4247*</b>
			<b>(0.251)</b>	<b>(0.251)</b>
Female	0.0648***	0.0669***	-0.0405	-0.0484
	(0.015)	(0.015)	(0.038)	(0.038)
Age	0.0393	0.0384	-0.0865	-0.0615
	(0.154)	(0.154)	(0.380)	(0.380)
Age squared	-0.0003	-0.0003	0.0013	0.0009
	(0.003)	(0.003)	(0.006)	(0.006)
Married	0.0591***	0.0571***	0.0143	0.0135
	(0.016)	(0.016)	(0.042)	(0.042)
Children	0.0082	0.0079	-0.1401***	-0.1401***
	(0.018)	(0.018)	(0.045)	(0.046)
Family size_2	0.0029	0.0040	0.0189*	0.0160
	(0.005)	(0.005)	(0.011)	(0.012)
Neighborhood quality_2	-0.0072	-0.0070	-0.0658*	-0.0661*
	(0.013)	(0.013)	(0.035)	(0.035)
Earnings	-0.0000	-0.0000	-0.0000	-0.0000
	(0.000)	(0.000)	(0.000)	(0.000)
Parental education	0.0050	0.0042	-0.0066	-0.0033
	(0.004)	(0.004)	(0.010)	(0.010)
Catholic_	0.3759***	0.3758***	-0.1720***	-0.1840***
	(0.027)	(0.027)	(0.055)	(0.055)
Protestant	0.5500***	0.5477***	-0.4051***	-0.4051***
	(0.027)	(0.027)	(0.051)	(0.051)
Other_christians	0.5583***	0.5566***	-0.3500***	-0.3473***
	(0.028)	(0.028)	(0.051)	(0.052)
Jewish	0.6962***	0.6901***	-0.8086*	-0.8474*
	(0.121)	(0.121)	(0.436)	(0.435)
Asian_religion	0.2633*	0.2656*	-0.3011	-0.2836
	(0.137)	(0.136)	(0.260)	(0.259)
Muslim	0.7954***	0.7774***	-0.7643***	-0.8238***
	(0.186)	(0.186)	(0.277)	(0.278)
Other	0.4813***	0.4808***	-0.3753***	-0.3841***
	(0.038)	(0.038)	(0.069)	(0.070)
Self_esteem		0.0122*		-0.0336*
		(0.007)		(0.019)
Job satisfaction		0.0174**		-0.0208
		(0.007)		(0.018)
Peers characteristics	yes	yes	yes	yes
Network fixed effects	yes	yes	yes	yes
n.obs	3,547	3,547	785	783
n. networks	277	277	180	180

Notes: Precise list and definition of control variables are in Tables A1. "Peers characteristics" are averages among peers of the listed controls. Standard errors in parentheses. Coefficients marked with one (two) [three] asterisks are significant at 10 (5) [1] percent level.