Relationship-Specific Intergenerational Family Ties: An Evolutionary Approach to the Structure of Cultural Transmission

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Abstract

Affectional ties between cultural model and recipient facilitate intergenerational cultural transmission. A theory of cultural transmission must therefore account for how and why affectional ties vary between different dyadic relationships. Findings on the tie strengths of several intergenerational kin dyads (grandparent-grandchild, grandparent-parent, aunt/uncle-niece/nephew) as rated by recipients of kin investment (adult grandchildren or nieces/nephews) are presented, based on several studies involving more than 3000 participants between 16 and 80 years. The relationship structures were dyad specific, asymmetrical with a tilt to the maternal side, robust, and predictable from reproductively relevant variables of the kinpersons involved, namely, sex-specific reproductive strategy, paternity uncertainty, and genetic closeness. Implications for the study of intrafamilial cultural transmission are discussed with an emphasis on the importance of evolutionary theory for this research field.
Cultural transmission encompasses those processes which transmit and modify beliefs, attitudes, and values in a population. To understand these processes it might not be satisfactory just to know how the existing structures of cultural transmission give rise to cultural change. Rather, we also need to understand why cultural transmission has the structures it reveals (Boyd & Richerson, 1985; Richerson & Boyd, 2003). Evolutionary theories of human behavior are indispensable for finding satisfactory answers to this "why"-question. Such theories address the question why the human mind (or that of other animals) has its particular design features rather than other non existent but conceivable ones (Pinker, 1997; Tooby & Cosmides, 1992). Because culture is a product of the mind, mind features can explain cultural phenomena to some extent (Dawkins, 1982; Miller, 2000), cultural transmission included. Evolutionary theories may facilitate understanding by guiding us to see the relevant aspects of natural phenomena, or, as Socrates suggested and Plato wrote, to "carve nature at its joints" (Gangestad & Snyder, 1985, p. 317). The guidance may help to steer away from suboptimal concepts like those inspired by changing zeitgeist or individual predilections. With this guidance we avoid to get entangled in an overabundance of unconnected middle-level theories, a state which characterizes several disciplines of human behavior and impedes scientific progress. The newly emerging science of evolutionary psychology (Barret, Dunbar, & Lycett, 2002; Bridgeman, 2003; Buss, 2004; Cartwright, 2000; Gaulin & McBurney, 2001; Tooby & Cosmides, 1992) integrates concepts and findings from diverse disciplines such as behavioral ecology, genetics, cognitive sciences, and sociology.

A variety of a person's features can be transmitted socially from one generation to the next within the family. In this paper, we will address two interrelated aspects of intergenerational dyads which can be considered conducive to all or most social (non-genetic)
vertical transmissions: investment in progeny and emotional closeness of intergenerational dyads. Investment in progeny can express itself in many ways, such as time invested, acceptance of risks, emotional and material costs, feelings of obligations, and grief intensity upon death of a descendant. In non-economic terms, it is the extent of solicitude. We shall show that investment in progeny and emotional closeness of intergenerational dyads is highly and robustly structured, and that this structure is parsimoniously and to a considerable extent accounted for by a few basic reproductively relevant variables which in principle apply to all species with biparental care. Because investment and emotional closeness are instrumental, albeit not sufficient, conditions for social transmission, we shall argue that intergenerational social transmission in families is similarly structured. After all, the adoption of cultural norms and values presupposes specific motivations and requires interpersonal contact, both of which depend on interpersonal closeness and investment.

Researchers from various disciplines have repeatedly noted that kinship systems have an obvious tilt to the maternal side of the family. This asymmetry is reflected in a variety of measures, be it social interactions, feelings of closeness and obligations (Rossi & Rossi, 1990), or importance of family ties (Salmon & Daly, 1996). Women, in short, are the kin keepers. Most obvious is the asymmetry in parental care: in general mothers care more for their offspring than fathers do (reviewed in Geary, 1998), and it is not even always clear just how much of the fathering is due to paternal and how much to mating efforts (Anderson, Kaplan, Lam, & Lancaster, 1999; Anderson, Kaplan, & Lancaster, 1999a; Hawkes, 1991; Marlowe, 1999).

The proximate causes for lower paternal than maternal investment in humans do not seem to reside in men's lower ability to care for infants nor in father absence (Geary, 1998), but rather in a lower threshold of mothers to respond to an infant's needs and the ensuing development of the infant's preference for the breast-feeding caretaker (Hrdy, 1999). Minor initial sex differences thus develop into marked gender differences, exaggerated and solidified
by social norms and customs. The ultimate causes of why the maternal threshold in responding to an infant’s needs is lower than that of the father can be found in sex differences pertaining to relative costs and benefits of parental investment (Trivers, 1972). The minimum investment required for producing offspring is higher for female mammals than for males, mainly due to gestation and lactation. As a result of this, the potential reproductive rate is lower for females than for males (Clutton-Brock & Vincent, 1991).

During our ancestral past, human females had to find an optimal mate and invest in offspring in order to reproduce successfully. Men could do the same, but, in contrast to women, they could also improve their reproductive outcome by maximizing the number of mates. The mating opportunity costs of parenting (Alcock, 1998) are therefore higher for males than for females, because time and energy spent in parenting cannot be invested in finding additional mates. These sex-specific reproductive strategies led to corresponding sex-dimorphic psychological adaptations such as preferences, desires, and motivations, which are still present today, despite the introduction of contraceptives, baby bottles, supermarkets, pediatricians, and maternity leave (Geary, 1998; Mealey, 2000).

A second possible ultimate cause of the less paternal than maternal willingness to invest in offspring is paternity uncertainty. Because ancestral women sometimes engaged in extra-pair copulations (Baker & Bellis, 1995; Birkhead, 2000), the men recurrently encountered the risk of investing in another male’s offspring, which led to male adaptations such as partner surveillance, male forms of jealousy, and the sexual double standard across cultures (Buss, 2003). Accordingly, paternal investment has been shown to correlate with paternity confidence across cultures (Gaulin & Schlegel, 1980) and among human males (Anderson, Kaplan, & Lancaster, 1999b).

Both of these ultimate causes, sex-specific reproductive strategy and paternity uncertainty, contribute to the obvious matrilateral bias in human family structures. Now we shall demonstrate how asymmetry between the sexes not just evident in human but also in
other intergenerational investment, namely, in grandparental investment (Euler & Weitzel, 1996), in grandparent-parent relations (Euler, Hoier, & Rohde, 2001, expanded with new data), and in investment of aunts and uncles (Hoier, Euler, & Hänze, 2000). To present properly the ramifications of sex-specific parental investment for cultural transmission would require a chapter of its own and will not be attempted here.

Grandparental Solicitude

In eusocial species, reproductive endeavor is not restricted to mating and parenting. Alexander (1987) regards lifetimes as being composed of efforts (caloric expenditure and risk-taking) which can be differentiated into somatic effort and reproductive efforts. Somatic effort (e.g. eating, health care, growing, learning, cultivating relations with nonkin) amasses resources, while reproductive efforts reduce them. Aside from mating and parenting, reproductive effort can be carried on as extraparental nepotistic effort, the investment in descendants with whom one shares a high proportion of alleles. These are mainly the young relatives which in Italy are called nipote, namely grandchildren, nephews, and nieces.

By assisting their adult daughter or son in her or his parental effort, grandparents can continue to contribute to their own genetic inclusive fitness. Because the average amount of parental care differs between the sexes (Geary, 1998), grandparents differentiate in whether a daughter's or a son's parental effort is to be assisted. At the proximate level and as perceived by the recipient of grandparental help, a mother needs more assistance in direct child care than a father does. Therefore, Euler and Weitzel (1996) predicted that maternal grandparents care more for their grandchildren than paternal grandparents do, in both implicit meanings of the verb 'care'.

A second factor that may account for discriminative grandparental care is paternity uncertainty. Because two generations of descendants are involved in grandparental solicitude, grandparents have a double possible parental uncertainty. The most uncertain grandparent is the paternal grandfather, who can be certain neither of his own nor of his son's paternity. The
absolutely certain grandparent is the maternal grandmother, being certain of her own as well as of her daughter's maternity. In comparison, the paternal grandmother and the maternal grandfather have intermediate levels of grandparental uncertainty.

If both factors, assistance in sex-specific reproductive strategy and paternity uncertainty, are combined, we obtain an ordered prediction about discriminative grandparental investment. From the grandchild's perspective, the mother of the mother presumably invests the most and the father of the father the least. Even though both have one link of paternal uncertainty, the maternal grandfather is expected to invest more than the paternal grandmother, because the former helps a daughter and the latter a son.

Euler and Weitzel (1996) examined grandparental solicitude as perceived retrospectively by adult grandchildren, on the assumption that ratings by recipients of care are a better indicator of grandparental solicitude than ratings given by grandparents themselves, because norms of impartiality prevent grandparents from making self-descriptive statements about favored grandchildren. Participants (720 male, 1,125 female, 12 unspecified; ages 16 to 80 years) were asked on a 7-point rating scale how much each grandparent had cared for them (gekümmert) up to the age of seven years, from 1 (not at all) to 7 (very much). The German verb kümmern has both a behavioral and a cognitive-emotional meaning, namely (1) to care for, to look after, and (2) to be emotionally and/or cognitively concerned about. From the total sample of 1,857 respondents, only those 603 cases were selected for the analysis whose four (putative) genetic grandparents were all still alive when the participant was seven years old.

The results confirmed their prediction about the discriminativeness of grandparental solicitude. The maternal grandmother was rated as having been the most caring ($M = 5.16$), followed by the maternal grandfather ($M = 4.52$), the paternal grandmother ($M = 4.09$), and the paternal grandfather ($M = 3.70$). Maternal grandparents were significantly more caring than paternal grandparents, and grandmothers significantly more than grandfathers. The
effect sizes, given as the partial $\eta^2$ (Tabachnik & Fidell, 1996) which denotes the variance attributable to the effect of interest divided by this variance plus error variance, were .11 for the lineage effect (maternal vs. paternal) and .17 for the effect of sex of grandparent. Both effects together account for a sizable proportion of the variance.

Of special interest is the finding that the maternal grandfather cared more than the paternal grandmother. If grandparental care giving were solely determined by a social role and child care traditionally ascribed to women, then grandmothers should provide more care than grandfathers. Accordingly, this argument should apply particularly to the older grandchildren in the sample, whose grandparents presumably were more influenced by traditional gender roles than those of the younger participants. However, the difference was in the opposite direction, significantly so, and even more pronounced for the older (40 years or more) than the younger participants.

The grandchild's gender mattered little. Female grandchildren rated their grandparental solicitude just slightly higher than male grandchildren (partial $\eta^2 = .01, p = .046$) which might be explained by a rater effect, namely the higher family sentiment of women compared to men (Salmon & Daly, 1996), rather than a sex-specific allocation of grandparental solicitude. As expected, residential proximity had a large influence on grandparental care, but because the four grandparents did not differ in mean residential distances, this factor was of no importance. Unexpectedly, neither age of grandparent nor availability of any other grandparents had a significant effect on the solicitude of the grandparent. In the total sample, grandparental care was unaffected by whether one, two or three other grandparents were alive. Discriminative grandparental solicitude was a robust phenomenon under various conditions, with one exception. When comparing separated (divorced and estranged) with non-separated grandparents, separated grandfathers showed significantly less solicitude than grandfathers still living with their spouse, i.e. the grandmother of the child in question. This reduction was most pronounced in separated paternal grandfathers, whose solicitude dropped to a low mean
of 1.77. The same drop was not observed in widowed grandfathers. The low level of care provided by separated grandfathers may be taken as evidence that grandpaternal care, like paternal care (Hawkes, 1991), is to a considerable extent post-mating effort directed at their spouses.

This same pattern of discriminative grandparental solicitude has been found in comparable studies in various countries, namely, in the U.S. (DeKay, 1995), France (Steinbach & Henke, 1998), Sweden (Å. Nilsonne, personal communication, July 2002), England (R. Banse, personal communication, February 2004), and Greece (Pashos, 2000). Among urban Greeks, the pattern of grandparental solicitude was essentially the same as in the other studies cited, but among rural Greeks it differed, especially for male respondents, who rated the care given by paternal grandparents higher than by maternal grandparents. This paternal bias is only partially explained by prevailing patrilocality in rural Greece and a possible reduced paternity discrepancy. Rather, patrilinearity with preferred investment in paternal grandchildren, especially paternal grandsons, is the explanation that best fits Pashos' (2000) data from rural Greek grandparents.

Various studies in which aspects of grandparental investment other than grandchild-rated solicitude were investigated have confirmed the general pattern of discriminative grandparental investment: perception of closeness to (Fischer, 1983) and time spent with grandchildren (Smith, 1988), interaction frequencies (Eisenberg, 1988; Hartshorne & Manaster, 1982; Hoffman, 1978/1979; Salmon, 1999), perceived emotional closeness to grandparents (Eisenberg, 1988; Hoffman, 1978/1979; Kennedy, 1990; Matthews & Sprey, 1985; Rossi & Rossi, 1990; Russell & Wells, 1987), naming favorite grandparents (Kahana & Kahana, 1970; Steinbach & Henke, 1998), gifts received from grandparents (DeKay, 1995), grandparental mourning after a grandchild's death (Littlefield & Rushton, 1986), and adoption of grandchildren (Daly & Wilson, 1980; Berger & Schiefenhoevel, 1994).
Above we have argued that sex-specific reproductive strategy and paternity uncertainty explain discriminative grandparental care giving. Rossi and Rossi (1990) give another reason for the grandparents' preference to invest more in their daughters' children rather than in their sons' children. With the sharp rise in divorce rate and custody typically being vested in the hands of mothers, investment in daughters' children assures steadier and less risky relations than investment in sons' children. If this risk difference were operating, then the solicitude difference between maternal and paternal grandparents should vary with divorce rates across countries and cohorts, that is, it should be higher in the American sample (DeKay, 1995) than in the German (Euler & Weitzel, 1996) or French (Steinbach & Henke, 1998) sample, and higher among the younger grandparents in the German sample than among the older grandparents. However, none of these predictions is supported by the available data.

Another variable which influences grandparental care giving, aside from the two main reproductive variables considered so far, was detected by Salmon (1999) who found that grandparents have significantly less contact with grandchildren of their middleborn daughters or sons than with grandchildren of firstborn and lastborn children, a finding explained by the fact that middleborns show less attachment to their parents than do firstborns or lastborns (e.g. Rohde et al., 2003; Salmon & Daly, 1998). Salmon (1999) had asked Canadian students about the frequency of visits and had obtained large effects: visits with both maternal and paternal grandparents were about twice as frequent for grandchildren of firstborn and lastborn parents than for grandchildren of middleborn parents. We replicated the study with our procedure in a sample of 464 female and 172 male students, that is, asking about the amount of grandparental solicitude received in childhood, and did find the same effects, albeit very small ones. For all eight possible comparisons (parent middleborn vs parent firstborn and parent middleborn vs parent lastborn, both for each of the four grandparents; subsample sizes between N=73 and N=229; functional birth rank, i.e. requiring an age difference of successively ranked siblings of no more than seven years), solicitude was lower for
grandchildren of middleborn mothers or fathers than for a firstborn parents in all four comparisons, and in three of the four comparisons lower for grandchildren of middleborn than of lastborn mothers or fathers. Thus, the hypothesis was numerically confirmed for seven of eight comparisons, one of which turned out significant (The maternal grandmother cared more for grandchildren of last-born daughters than of middle-born daughters). The median effect size for all eight comparisons, however, was a mere $d=.11$. Apparently, there is indeed some effect of parental birth order, but it is doubtful whether the effect is as sizeable as suggested in the Salmon study.

While we were investigating potential parental birth rank effects of grandparental solicitude, we serendipitously came across another effect of grandparental care unknown so far. We examined the amount of grandparental care as a function of number of siblings a parent has and expected a straight solicitude diffusion effect. The more children a grandparent couple has, the more grandchildren there are on average, and, therefore, the less solicitude is available for each individual grandchild. Because we assessed grandparental solicitude by ratings of adult grandchildren, we expected the ratings from grandchildren to be lower the more siblings the parent has or had. This solicitude diffusion effect is clearly seen in Fig. 1, but unexpectedly only for the maternal grandparents (open data points in Fig. 1). Here the solicitude ratings are highest for grandparents who have only a daughter, lower for grandparents if the daughter has only one brother or sister, and lowest if the daughter has more than one sibling. As expected, the curve is lower for the maternal grandfather than for the maternal grandmother. For the paternal grandparents, however, this solicitude diffusion effect is countered by some other effect. Surprisingly, paternal grandparents care less for the children of their son if that son is the only child, and care more for the son's children if the son has a sibling. It makes no difference whether this sibling is a brother or a sister. In our first sample we considered this unusual finding a chance effect, but it turned up consistently in the two successive samples collected the following two years. In a sample of 1112 participants,
which yielded valid and complete entries for 840 participants, we obtained the expected very significant main effects for lineage (matriline vs patriline), grandparent sex, and number of siblings of parent, but also a significant interaction between lineage by number of siblings of parent ($F[2, 840] = 3.23, df = 2, p = .04$). Because there was no significant higher order interaction between this interaction and sex of grandparent, we pooled the data for both grandparental sexes which lowered the p-value for the interaction ($F[2, 1010] = 4.39, df = 2, p = .013$). Whatever unknown effect is working here to reduce the care for grandchildren if the son is a single child, or increase the care for grandchildren if the son has a sibling, or both, it must be strong enough to counter the solicitude diffusion effect. A fair significance test for this only-child-son effect should therefore correct for the solicitude diffusion effect. If we did this by taking as the null hypothesis not a horizontal line but the decline in the maternal solicitude ratings, paternal grandparents cared significantly more for grandchildren from only-child sons than for grandchildren of sons with a sibling ($t=3.28, df=456, p=.001, d=.34$).

How can this small but obviously real effect accounted for theoretically? If a counterintuitive finding is explained post hoc, there are usually explanations quickly at hand, and sometimes in abundance. The search for explanations could be focused if we knew whether the effect to be expounded came about because grandparents decreased their solicitude if their son was a single child, or increased their solicitude if their son had a sibling but only one, or both, but our current data is insufficient to answer this question. Out of several possible solutions we have considered, here are two for which we have some data: (1) The Sibling Equity Hypothesis would entail the following argument: If the son has a sister, the sister's children get more grandparental care than her brother's children, and to counter this effect, grandparents make certain that the son's children are not disadvantaged. If the son has more siblings, the effect gets diluted. The explanation assumes that the effect of increased grandparental solicitude for offspring of sons with one sibling is due to increased solicitude
for those cases where the son has a sister, and thus can be tested easily. If the son has a sister, grandmaternal solicitude rates 4.75 and grandpaternal solicitude 4.53; if the son has a brother, the values are 4.64 and 4.20, respectively. The differences are in the expected direction, but not significant. (2) The Mother-in-Law/Daughter-in-Law Conflict Hypothesis draws on the observation that this relationship is generally the most problematic in-law relationship (see next subchapter) whereas the relationship with the son-in-law is considerably better. If the son has a sister, there is a daughter as the family female to allow for grandparental solicitude transmission to grandchildren. If the son has a brother, there is a choice of daughters-in-law, and the grandparents are less prone to attribute relationship problems to the personality of the granddaughters but to the relationship constellation instead. If, however, the son is an only child, there is only one female in the next generation, and that is a daughter-in-law. Grandparental abstention might then help to alleviate the problem. A variant of this hypothesis would be to reason that in case of an only male child, grandparents are impelled to support their son more in his potential strategy to maximize mates rather than in his strategy to be a good father (see next subchapter). This goal can be achieved by rejecting the daughter-in-law. In any case, this hypothesis predicts that the relationships to the daughters-in-law are worse if the son is a single child than if he has one or more siblings. The evidence for this hypothesis is ambivalent. The relationship between mother-in-law and daughter-in-law is indeed worse if the son is an only child compared to sons with one or several siblings (M = 3.79, N = 111, vs. M = 4.29, N = 799; t = 2.98, p = .003; relationship rated on a 7-point scale, with 1 = very bad relationship, 7 = very good relationship). However, for fathers-in-law the difference is not significant (M = 4.34 vs M = 4.44). For mothers-in-law, the significance of the difference is mostly due to relatively good relationships to the daughter-in-law in those cases where the son has more than one sibling.

A third possible explanation is not primarily an evolutionary one, but resorts instead to son-and-heir. German parents in the past century still preferred the first child to be a son
rather than a daughter, and the question to have a second child or not was more often affirmed if the first one was a girl and not a boy. Maybe grandparents tend to get overly possessive about grandchildren of a single-child son, with counterreactions by the daughter-in-law and consequent alienation.

Because the reduced investment of grandparents with a single child is clearly restricted to children of sons, the idea suggests itself that the reason might be found in some sex-related asymmetry. Reproductive strategies are asymmetric, and from an evolutionary viewpoint this asymmetry is reflected in a pervasive pattern of consequent asymmetries, one of which is the difference in relationship quality between parents-in-law and sons-in-law on the one hand and daughters-in-law on the other. This asymmetry is investigated in the next subchapter.

Effective investment in progeny requires an ability to recognize kin in paternal descendants. It can, therefore, be predicted that fathers rely more on child resemblance for their investment than mothers (Porter, 1987). Indeed, mothers and their relatives seem to comment, even insist on resemblance to the father more often than to the mother, seemingly to ascertain his paternity and thus promote his willingness to invest in the infant (Daly & Wilson, 1982; McLain, Setters, Moulton, & Pratt, 2000; Regalski & Gaulin, 1993). Results on whether infants actually resemble the father or the mother more are conflicting (Brédart & French, 1999; Christenfeld & Hill, 1995; McLain, Setters, Moulton, & Pratt, 2000), probably due to methodological differences. Most recent findings suggest that infants vary in their parental resemblance, with some looking more like their father, some more like their mother, and some like both parents (Bressan & Grassi, 2004). It might be in the reproductive interest of fathers to sire infants that do not resemble them too much, or else his children sired in another women's extra-pair copulation might be too easily detected as cuckoo children. Correspondingly, it is in the best genetic interest of mothers to decrease their mates' paternity uncertainty and thereby promote paternal investment (Bressan, 2002).
Euler and Weitzel (1996) found that in retrospect the participants rated their physical and behavioral resemblance to their father during childhood higher than to their mother. However, resemblance to paternal grandparents was not rated higher than to maternal grandparents, nor to grandfathers higher than to grandmothers. What did come to light, however, was a correlation between resemblance and grandparental solicitude which tended to systematically vary with the number of links of paternity uncertainty. For the maternal grandmother (no link of paternity uncertainty) the correlation was $r = .37$, for the maternal grandfather and the paternal grandmother (one link each) $r = .39$ and $r = .42$, and for the paternal grandfather (two links) $r = .47$ ($N = 458$ for each coefficient). Apparently, the higher general paternity uncertainty is, the more grandparental solicitude is being made dependent on resemblance to the grandchild.

Relationships Between Grandparents and Parents

The relationships between grandparents and grandchildren have been shown to be systematically structured by a few reproductively relevant variables (Euler & Weitzel, 1996). A comparable structure can be expected to reveal itself in the relationships between grandparents and parents. If grandparental investment is to be transmitted to grandchildren, parents are usually the mediators. Grandparental investment is thus facilitated by good relationships between parents and grandparents and obstructed by poor ones.

With four grandparents and two parents, there are eight different grandparent-parent dyads, four of them in-law dyads. Among the in-laws, the mother-in-law seems to play a salient role. In many cultures, she is the target of scorn and derision in jokes and songs. The relation between the mother-in-law and the daughter-in-law is a source of particularly intense conflict (Duvall, 1954). Why is the image of the mother-in-law so negative? The most popular explanation, nourished by psychoanalytic theory, is rivalry between the two over the son's/husband's love and attention. This is a proximate explanation which asks for an ultimate explanation, namely why such a rivalry appears in the first place and why there no equal
rivalry between the father-in-law and son-in-law over the daughter/wife? There may be rivalry between the father-in-law and son-in-law, but if so, it is not invoked to explain long-lasting in-law relations.

Evolutionary psychological theory might give a more satisfying answer. First, a key reproductive variable that differentiates the eight grandparent-parent dyads is consanguinity. The son or daughter is genetically closer than his or her spouse, and therefore the four parent-child dyads are expected to be more positive relationships than the four in-law dyads.

Secondly, parental support of the adult child’s reproductive strategy is another factor to consider. It is in the reproductive interest of grandparents to support their adult child in his or her sex-specific reproductive strategy. An adult daughter, more restricted than a son to the reproductive strategy of parental care, is best aided by her parents within the context of a good parent-daughter relationship. A poor parent-son relationship is comparatively less detrimental for a son’s opportunistic reproductive strategy of maximizing mates. Therefore, grandparents can be expected to have generally better relationships with daughters than with sons. Thirdly, due to uncertainty of paternity, a better relationship is predicted between mother and children than between father and children. These last two factors, daughter support and paternity uncertainty, yield predictions about the differential quality of the four relationships between grandparents and their adult children. The best relationship is expected to exist between the grandmother and her adult daughter, the worst of these four between the grandfather and his adult son. Depending on the relative strengths of the two factors mentioned, i.e. daughter support and paternity uncertainty, the grandfather-daughter or the grandmother-son relationship are expected to be second best.

Let us now examine in-law relationships. How do evolutionary considerations differentiate these four dyads? The factor of daughter support again plays a role here. A daughter needs a more stable partner support in her child care than a son needs in his strategy of maximizing mates. A daughter is best aided by her parents if they welcome and relate well
to the husband she has chosen. A son, insofar as he is inclined towards polygyny, is comparatively less impeded by poor relations between his wife and his parents. Rejection of their son's partner may even be strategically appropriate and unconsciously in the grandparents' own reproductive interest. Therefore, the relations to the son-in-law are expected to be better than relations to the daughter-in-law. Again considering paternity uncertainty as a factor, the mother-in-law is expected to have a better relationship than the father-in-law to the spouse of the adult child. (However, as we realized later and as explained below, here we must again take into account an asymmetry between the sexes).

Taken together, these considerations predict a relatively good relationship between the mother-in-law and the son-in-law and a relatively poor one between the father-in-law and the daughter-in-law, with the other dyads—again depending on the relative strengths of both factors—somewhere in between. However, folklore, and perhaps our own experiences, object. Is not the relationship between the mother-in-law and the daughter-in-law said to be the most problematic of the eight relationships?

From 2,319 persons, we obtained a rating on a 7-point scale of how good each one of their eight grandparent-parent relationships was when the participants were children (1 = very bad relationship, 7 = very good relationship). The participants (888 male, 1,426 female, 11 unspecified) were between 12 and 67 years old with a median of 21 years and 11 months. Of these participants, 962 gave us complete ratings (337 males, 619 females, 6 unspecified; age 16 to 62 years, median 21 years and 7 months), that is, a rating for all eight grandparent-parent dyads.

(insert Table 1 about here)

Table 1 shows the predictions on the basis of consanguinity, daughter support, and paternity uncertainty, and the means and standard deviations of the relationship ratings. The plus or minus sign denotes whether the column condition leads to a prediction of a better or a worse relationship for that particular grandparent-parent dyad relative to the other dyads. A
MANOVA showed a large significant main effect for consanguinity, $F(1, 961) = 788.55$, $p < .001$, partial $\eta^2 = .45$. Relationships between grandparents and their own sons or daughters were rated as better than relationships with spouses of sons or daughters. Sex of parent yielded a significant main effect, $F(1, 961) = 99.12$, $p < .001$, partial $\eta^2 = .09$. Relationships with daughters and their husbands were better than with sons and their wives. Sex of grandparent yielded a significant main effect, $F(1, 961) = 15.32$, $p < .001$, partial $\eta^2 = .02$. Relationships between grandmothers and parents were better than between grandfathers and parents. Same-sex grandparent-parent dyads were rated as having had slightly better relationships than cross-sex dyads, as shown by the 'Sex of Parent' by 'Sex of Grandparent' interaction, $F(1, 961) = 9.12$, $p = .003$, partial $\eta^2 = .01$. Sex of participant (grandchild) showed no effect.

How well do siblings agree in their retrospective ratings of their grandparent-parent relationships during their childhood? We obtained ratings from the siblings of the participants and calculated for the families with two children ($N = 87$) the intra-class correlations within sibling pairs. The average correlation over all eight grandparent-parent dyads was $r = .64$. This correlation varied negatively with the age difference of the sibling pair, which can be expected because the quality of relationships can vary with time and because the age gap between siblings is one determinant of a child's family niche (Sulloway, 1996). There is considerable agreement between siblings about the quality of grandparent-parent relations.

Two other studies which investigated the various parent-child relationships delivered comparable results. Rossi and Rossi (1990) found that affinal kin, those acquired through marriage or remarriage, evoke lower feelings of obligation than do consanguineal kin in comparable positions, and sons-in-law evoke higher feelings of obligation than do daughters-in-law. The bond between mothers and children was stronger than between fathers and children, the strongest between mothers and daughters and the weakest between fathers and
sons. Szydlik (1995) obtained results which at one point differed from the ones presented above. When adults were asked how close their relationship was to their various relatives, including their parents and their children, but not their in-laws, he found that mothers and daughters had the closest of the four parent-child relationships (percentage of persons answering "close" or "very close") and fathers and sons the least close relationship, as did we and Rossi and Rossi (1990). However, the relationship between mother and son was, on average, somewhat better than the one between father and daughter. Whether this difference is due to differences in the samples, survey questions, or data presentation cannot be answered here.

The three reproductive determinants listed in Table 1 predicted the poorest relationship for the father-in-law/daughter-in-law dyad and the second poorest for the mother-in-law/daughter-in-law dyad. However, it is the latter relationship which is actually the worst. The mean difference between the two dyads is significant, $t(1, 961) = 4.772$, $p < .001$, as are all adjacent mean differences in Table 1 with the exception of the one between father/daughter and mother/son, $t(1, 961) = 1.850$, $p = .065$. This reversal of the bottom two dyads, unpredicted by our original reproductive conditions, but suggested by folklore, is also reflected in a significant 'Consanguinity' by 'Sex of Grandparent' interaction, MANOVA, $F(1, 961) = 124.98$, $p < .001$, partial $\eta^2 = .12$. Daughters-in-law are obviously less of a problem for grandfathers than for grandmothers. Can this be explained, at least post hoc?

The father-in-law/daughter-in-law relationship is, in one respect, a special relationship. This dyad has a direct reproductive potential, which no other grandparent-parent-dyad has, that is, it involves two unrelated reproductive individuals of both sexes with the man usually being older than the woman. The other seven dyads are mismatches with respect to direct reproduction because of incest barrier, same sex, or age relation in the case of mother-in-law/son-in-law. We hypothesize in hindsight that the reproductive potential of the father-in-law/daughter-in-law dyad contributes to a positive relationship. If this hypothesis were valid,
the goodness (quality) of this relationship should covary with the mate value of the daughter-in-law.

The hypothesis was tested in a subsample of 370 participants (232 female, 138 male), where the mate value was a composite score of the z-transformed 7-point ratings of the mother's and father's physical attractiveness, intelligence, chances to find another mate, prudence, job prospects, agreeableness/warmth, and self-confidence (the latter for father only) during the participant's childhood. Because mate value also depends on age, especially for females (Symons, 1979), each parent's age at the time of the participant's birth was also collected. However, the results did not support our hypothesis that the reproductive potential of the father-in-law/daughter-in-law dyad causes the relationship between the daughter-in-law and her father-in-law to be better than her relationship to her mother-in-law. Grandparents cherish high mate value in both their descendants and their descendants' mates. This makes evolutionary sense, because the affiliate kin will become part of the parents' genetic lineage.

The riddle of the comparatively good father-in-law/daughter-in-law relationship was recently solved, or so we think, by our colleague Paola Bressan (personal communication, May 2003) who brought an obvious, indeed embarrassing, error in our theoretical deductions to our attention. The last two relationships in Table 1, those to the daughter-in-law, differ in one important aspect from the other six relationships: Whereas the other six relationships, from mother/daughter to father-in-law/son-in-law, are receptive, supportive relationships, the last two are rejective relationships. Parental certainty is not a primary factor, but a secondary one: If the relationship is a supportive one, as is usually the case among close relatives, paternity uncertainty detracts from emotional closeness and all kin supports it entails. If, however, the relationship is repudiative, as we indicated above the one to the daughter-in-law is, paternity uncertainty detracts from the rejection. The father-in-law, being generally less certain about his paternity than his spouse is about her maternity, has comparatively less
reasons to reject his daughter-in-law than his spouse has. Therefore, the corresponding
plus/minus-signs in Table 1 (marked with an asterisk) should actually be reversed.

Investments of Aunts and Uncles

Evolutionary theory predicts differential investment of consanguineal aunts and uncles. Because of paternity uncertainty and sex-specific reproductive strategy, matrilateral aunts and uncles can be expected to show more concern for their nieces and nephews than patrilateral aunts and uncles, and aunts more concern than uncles. Of all four types of consanguineal aunts and uncles, matrilateral aunts are expected to be the most caring and patrilateral uncles the least caring. These hypotheses were tested in a sample of 302 participants (109 male, 193 female; age 19 to 40 years) whose genetic parents were cohabiting (Hoier et al., 2000). Those participants who either had both matrilateral and patrilateral uncles, or both types of aunts, were asked whether the matrilateral or the patrilateral uncle or aunt showed more concern for the participant's welfare. A significant matrilateral bias was revealed with respect to both aunts and uncles: Matrilateral aunts and uncles were chosen more often as showing more concern than were their patrilateral equivalents.

Each aunt and uncle's level of concern was rated by the participants on a 7-point scale. Repeated measures ANCOVA, corrected for the relative's age and residential distance to the participant, again showed a significant matrilateral effect (larger investment in descendants of sister than in those of brother) and a significant sex effect (more care by aunts than by uncles). Finally, the interaction between both effects was significant: The matrilateral bias was larger in aunts than in uncles. Studies from the United States (Gaulin, McBurney, & Brakeman-Wartell, 1997; McBurney, Simon, Gaulin, & Geliebter, 2001; Rossi & Rossi, 1990) provided the same results with the exception of no interaction effect. This difference could be due to a floor effect in the German data: German uncles were rated as showing considerably less concern than American uncles (Gaulin et al., 1997).

Discussion
We have shown that investment in progeny and emotional closeness of cross-generation dyads is highly structured. This structure is only modestly affected by circumstances that do not tap reproductive conditions (Rossi & Rossi, 1990). The predictor variables addressed in our research account for a sizable share of the variance in the quality of intergenerational relations. Nepotistic investment was sex-specific with respect to the investor and the linking kinperson for distant kin, but less so with respect to the sex of the beneficiary.

We looked at intergenerational nepotistic investment and relations from an evolutionary perspective. From this angle, one asks for what purpose a phenotypic trait, in this case a relationship-specific investment, was designed. The answer to such a question does not conflict with proximate explanations. For example, Rossi and Rossi (1990) note correctly that the pervasive matrilateral bias in family relations, that is, the fact that women are kin keepers, is due to the close mother-daughter bond. We were not satisfied with this explanation and asked why the mother-daughter bond is so close.

If cultural norms and values are familially transmitted, then the transmissions belts, i.e. the conditions or factors which enhance transmission (Schönpflug, 2001), can be expected to be structured like the intergenerational investment patterns, notwithstanding the possibility that social transmission structures also may vary with transmission content. Giving technical advice, providing financial resources, and teaching technical skills might be areas where male kinpersons are more involved than in emotional investment. However, reproductive conditions are nonetheless equally relevant for various transmission contents, as can be seen in the transmission structures of testaments where the decisions of who inherits how much have been shown to be strongly influenced by genetic closeness and other factors which affect genetic replication (Bossong, 2001; Judge, 1995; Smith, Kish, & Crawford, 1987).

This paper was not written to illuminate the how-question, that is, the processes of cultural transmission. Its purpose was to not only empirically demonstrate that the various familial relationships do indeed differ in measures of solicitude and closeness, but also to
explain why this is the case in the first place. We believe that this and other studies of kin relations guided by an evolutionary perspective can contribute to understand the processes of cultural transmission within the family. Although it has long been suggested that the affectional ties between the cultural model and the recipient influence the ease and reliability of transmission, a finely structured theoretical framework to explain **why** some family relations are more affectionate than others is only now emerging with the introduction of evolutionary concepts to social psychology. Daly, Salmon, and Wilson (1997) argued that from an evolutionary perspective the qualities of the various kin relations are expected to be highly specific. We agree and suggest that this specificity of relationships contributes to the shaping of transmission pathways.

Theorists seem to agree that cultural transmission, or "cultural adoption" (Tooby & Cosmides, 1992), involves learning by observation. But imitation is highly selective, as is readily revealed in a situation of high cultural variability. It would indeed be surprising if this selectivity in the choice of models and traits was not influenced by the quality of the relationship between recipient and model.

Cultural transmission is an interesting problem only in as much as it implies the possibility of failed transmission. Cultural traits can get lost, either because they are not adopted or because they are actively exchanged for newly introduced ones. Only when there is competition between several cultural traits to be adopted by the next generation will the significance of specific kin relationships and other possible transmission pathways reveal itself. The question of intergenerational cultural transmission thus has to be posed this way: What structures and processes determine whether a cultural trait is being conservatively passed along from one generation to the next? What structures and processes, on the other hand, promote cultural change?

There are reasons to question the assumption that familial social transmission of norms and values is the sole or most important process of cultural transmission. On the one hand,
repeated findings in the field of behavioral genetics (Plomin, DeFries, McClearn, & Rutter, 1997; Rowe; 1994; Tesser, 1993) point to genetic transmission which, due to conventional genetics-insensitive socialization research designs, has frequently been erroneously interpreted as social transmission. Harris (1995, 1998), on the other hand, points to the peer group, and not the parents, as the main agent responsible for social transmission of norms and values. It makes good evolutionary sense that children should extract as much investment as possible from their family of origin, especially in their first years of life, while at the same time adopt the culture of their own generation within which they will encounter most of their potential competitors, allies, and mates. The empirical evidence for the presumed superior role of peer group influence provided by Harris, however, is restricted largely to language acquisition and is otherwise more anecdotal than systematic.

The transmission pathways between parents and children are the most frequently studied ones, although it has been suggested that the significance of parents as models is overestimated (Harris, 1995; Plomin, Ashbury, & Dunn, 2001). With respect to our own studies, it is interesting to note that the quality of the parent-child relationship correlates positively with the child's acceptance of her or his parents as cultural models (e.g. Hood, Spilka, Hunsberger, & Gorsuch, 1996). We suggest that the results from our own participants' ranking of their relationships with grandparents, parents-in-law, and aunts and uncles imply that future research will find a similar ranking pattern when the same family members are studied as potential cultural models.

A similar prediction can be made with respect to the specific family niche of the focal child recipient. Several studies have shown that university students' closeness to their parents is influenced by birth order (Kennedy, 1989; Kidwell, 1981; Rohde et al., 2003; Salmon & Daly, 1998), which is considered the strongest proxy of a child's family niche (Sulloway, 1996). Firstborns were the birth rank most often naming their parents as the persons to whom they felt closest, followed by lastborns and only then middleborns. Not only does the quality
of family relationships determine cultural adoption when we act within these relationships; to some degree, these relationships also may mould the personality in such a way that they influence the choice of model outside the family, at least in some realms, even if the influence of birth order outside of the family of origin appears not to be strong or at least not pervasive (Pinker, 2002). Sulloway (1996) provides impressive evidence for the paramount importance family relations have played in the history of scientific and other cultural revolutions in Western history. The author interprets his findings within the general evolutionary framework of parent-offspring conflict (Trivers 1974), which is driven by sibling competition for parental care. Sulloway's (1996, 2001) results serve as a warning to not restrict the study of intrafamilial cultural transmission to just different model-recipient dyads. In the long run, we ought to identify the individual family niche in a network of relationships that seems to shape the recipient's personality and thereby his or her inclination to adopt, reject, or actively exchange a cultural trait for a new one.
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References


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Figure 1. Grandparental solicitude as a function of kind of grandparent and number of siblings of parent.
Table 1

Predictions About Grandparent-Parent Relationships and Results

<table>
<thead>
<tr>
<th>Grandparent-Parent Dyad</th>
<th>Predictions on the Basis of</th>
<th>Relationship Rating</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>Consanguinity</td>
<td>Daughter Support</td>
</tr>
<tr>
<td>Mother/Daughter</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Father/Daughter</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Mother/Son</td>
<td>+</td>
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</tr>
<tr>
<td>Father/Son</td>
<td>+</td>
<td>-</td>
</tr>
<tr>
<td>Mother-in-law/Son-in-law</td>
<td>-</td>
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<tr>
<td>Father-in-law/Son-in-law</td>
<td>-</td>
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</tr>
<tr>
<td>Mother-in-law/Daughter-in-law</td>
<td>-</td>
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<tr>
<td>Father-in-law/Daughter-in-law</td>
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</tbody>
</table>

NOTE: plus or minus sign denotes better or worse relationship predicted; N = 962. *: see text (p. xx) for reinterpretation of direction of effect.