

(1998), and Pashos (2000). Specifically, evolutionary psychological research has introduced the notion that laterality effects are important in grandparental investment. There exist two distinct types of grandparents (matrilateral vs. patrilateral ones), which are distinguished by different degrees of paternity certainty, and thus, potentially different degrees of genetic relatedness (see target article, sect. 5.1.3.). Indeed, many studies conducted in modern industrialized nations (see target article, top of sect. 2. and Note 4) have obtained a specific pattern in the ranking of grandparental investment, as recalled by adults using rating scales, such that the maternal grandmother seemed to care the most, the maternal grandfather somewhat less, followed by the paternal grandmother, and then the paternal grandfather.

Elsewhere (Tran et al. 2009), we show that the well-known spousal age differences, combined with the equally pervasive sex differences in life expectancy, create noticeable differences in the expected exposure time grandchildren have to their four grandparents. That is, due to the fact that grooms are generally older and become parents later in life than do brides, grandchildren have a shorter overlap in the number of years they could interact with grandfathers than they do with grandmothers.

It is important to note that the ranking of expected exposure time to the four grandparents follows exactly the above-mentioned ranking of recalled grandparental solicitude. Clearly, total grandparental investment in grandchildren must be limited by (and thus partly dependent on) the available time that grandparents have for such investments in their grandchildren. Intriguingly, appropriate controls for exposure time, accounting for the two confounding variables noted earlier, significantly level the matrilateral bias in grandparental investment (Tran et al. 2009). We therefore conclude that the widely publicized matrilaterality effect of grandparental investment, as highlighted in current evolutionary psychological literature, may well be incorrect, or at least substantially overstated.

This finding has manifold ramifications and consequences. As for one example, some researchers (e.g., Gaulin et al. 1997; Russell & Wells 1987) have used such retrospective, obviously biased rating data of adults' recalled grandparental solicitude for estimating nonpaternity rates. Unsurprisingly, such calculations of putative nonpaternity rates have yielded grossly overstated and thus implausible values (10–20%) – which clearly indicates the inappropriateness of such rating data. In contrast, several recent systematic reviews of nonpaternity rates among modern human populations have convergently estimated these to be about 2–3% (Anderson 2006; Bellis et al. 2005; Voracek et al. 2008).

Of further importance in this context, in their systematic review of grandparental investment and physical and mental well-being of grandchildren (sect. 5.1.), C&H cite studies (sect. 5.1.2.) that found differential grandparental investment (i.e., the matrilateral bias therein) to be dissociated from the criterion variables under scrutiny. This constitutes more counterevidence to current evolutionary psychological reasoning about the existence, importance, and consequences of differential grandparental investment, as the allegedly differentiated pattern of grandparental caring showed a lack of association with important life outcomes in the grandchildren.

Having taken evolutionary psychological study findings as examples for illustration, we therefore would suggest that the opposed views of sociology, economics, and evolutionary psychology on grandparental investment appear hard to reconcile and to integrate, as intended and anticipated by C&H. There may well be no “Dodo Bird Phenomenon” in these lines of research, and we do not believe that “everyone has won and all must have prizes.” At the very least, some of these competing hypotheses have less plausibility and veridicality than others. Specifically, we surmise that some important explanations and assertions in this field based on current evolutionary psychology thinking might be confounded or misleading, as they could be more parsimoniously derived from quite simple facts of demography, as we have elaborated here.

## Authors' Response

### Toward an integrative framework of grandparental investment

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David A. Coall<sup>a</sup> and Ralph Hertwig<sup>b</sup>

<sup>a</sup>School of Psychiatry and Clinical Neurosciences, University of Western Australia, Fremantle, Western Australia 6160, Australia; <sup>b</sup>Department of Psychology, University of Basel, 4055 Basel, Switzerland.

david.coall@uwa.edu.au

http://www.uwa.edu.au/people/david.coall

ralph.hertwig@unibas.ch

http://www.psych.unibas.ch/hertwig

**Abstract:** This response outlines more reasons why we need the integrative framework of grandparental investments and intergenerational transfers that we advocated in the target article. We discuss obstacles – from misconceptions to poor measures – that stand in the way of such a framework and of a better understanding of the effects of grandparenting in the developed world. We highlight new research directions that have emerged from the commentaries, and we end by discussing some of the things in our target article about which we may have been wrong.

#### R1. Introduction

One main goal of our target article was to review the existing disparate accounts of grandparental investment and intergenerational transfers, and to make a case for an integrative framework that promotes concision among psychological, evolutionary, economic, and sociological accounts. Taking steps toward a multidisciplinary framework is not easy, because the involved disciplines have different goals, terminologies, assumptions, methods, and to some extent conflicting worldviews. Therefore, we are pleased that 18 commentators from the fields of anthropology, demography, economics, evolutionary biology, evolutionary and developmental psychology, and sociology responded to our article. We thank the authors for their generous comments, valuable insights, and helpful suggestions. We are especially grateful to those contributors who extended our understanding of research on grandparental investment in new directions (see sect. R6). In our response, we first turn to our commentators' views concerning our vision of an integrative and multidisciplinary framework. Throughout our reply, we also attend to our omissions, errors, and confusions, where appropriate, as an antidote to the risk of simplifying too much in our attempt to bring together disparate accounts. Unfortunately, some good points made by individual commentators – especially those with which we agree and therefore feel less impelled to comment on – must go unaddressed.

#### R2. Grandparental investment: Theory pluralism and theory integration

Many commentators appear to agree with theoretical pluralism and support our push for a multidisciplinary framework in research on grandparental investment; some say so explicitly (**Fantino & Stolarz-Fantino; Huber;**

**Voracek, Tran, & Fisher [Voracek et al.]**. Such an integrative framework, however, does not mean that we have to believe that each hypothesis has equal explanatory weight (a position that Voracek et al. appear to attribute to us). Of course, the evidence should be allowed to sort the wheat from the chaff. In this section, we clarify some reasons for the need of a multidisciplinary framework (R2.1), consider overlooked aspects that need to be included (R2.2), and address concerns regarding the practicality of a multidisciplinary framework (R2.3).

### **R2.1. Why we need a multidisciplinary framework**

A multidisciplinary framework is not *l'art pour l'art*. Grandparental investments in industrialized societies are part of multilayered intergenerational transfers, both private and public. Consequently, what happens within families cannot be divorced from public transfers via institutions created by the social welfare state. Therefore, we are convinced that economic and sociological analyses of, for example, public transfers need to be integrated with analyses of private transfers. Moreover, both kinds of transfers need to be combined with demographic analyses of fertility and mortality, and with psychological analyses of the health and well-being consequences for both the recipients and the donors. No single discipline can do it all by itself.

**Lee and Cox** bring up the topic of public intergenerational transfers. In his compelling analysis, Lee shows that in rich industrialized societies, consumption by older adults (age 60 and above) – for example, in terms of health care, long-term care, and pensions – is much higher than consumption by younger adults. In addition, older adults' consumption exceeds their production (measured as labor earnings), a condition that in hunter-gatherer societies is characteristic of childhood only. According to Lee, this represents a paradigm shift in human history, with the net flow of material (*in vivo*) resources being reversed from downward to upward and amounting to a relatively brief period of 30 years – during which adult Americans, for example, produce more than they consume (Lee et al. 2006). As Lee stresses, however, this reversal has occurred for public, but not private, material transfers (see also, Kohli 1999).

**Lee's** analysis raises the question of how public and private transfers relate to each other: Do they complement or antagonize each other? **Cox** touches upon a concept discussed by economists and sociologists that is key in answering this question: *crowding out*. Used in the context of intergenerational transfers, crowding out describes the displacement of private help within the family by public, institutionalized services. Various authors have suspected crowding out as the cause behind the weakening of intergenerational links within the family (see the discussion in Künemund & Rein 1999). With the expansion of the welfare state, crowding out may occur for a wide range of private transfers, downward and upward alike. Focusing on upward transfers, Brandt et al. (2009) analyzed the interaction of private and public aid in the context of support that children give to their elderly, ailing parents (an issue to which we return in sect. R6.2). Based on the SHARE (Survey of Health, Ageing and Retirement in Europe)

data set, they analyzed the level of care that adult children gave a parent during the previous 12 months in 11 European countries. Their main finding was a division of labor between private and public help: Specifically, professional services have taken over the medically more demanding and physical help of dependent recipients (thus crowding out private activities). The adult children, in turn, tend to provide voluntary, and less intensive support (e.g., help in the household or in dealing with authorities). On Brandt et al.'s interpretation, public support thus does not generally displace private support, but the services are divided, and the availability of a public support system might actually stimulate ("crowd in") private support. When social and health services, however, are less available – as is the case in the Mediterranean, relative to Scandinavian countries – children are more likely to provide the intensive care that ailing parents require. Such demanding care, however, appears to exact a cost: It has been suggested that simultaneous care for elderly parents and young children may overtax families and contribute to the low fertility rate in Mediterranean countries (Livi-Bacci 2001), which provide less public and institutional support for both the raising of children and the care for elderly, ailing parents.

To the best of our knowledge, such an analysis of the interplay between private and public transfers and their impact on the dimensions of interest, including classic fitness indicators (e.g., fertility, childhood mortality, age at first reproduction) and psychological and economic indicators of health and well-being, has not yet been conducted with regard to grandparental resources in the developed world. Does public support – in terms of child support, daycare facilities, and free education – crowd out private transfers from grandparents to grandchildren (and their parents)? Alternatively, has a division of labor evolved, with time-intensive and demanding services being provided by public institutions (if available), allowing grandparents to step up other investments? Relatedly, to what extent do private transfers from grandparents to grandchildren depend on public transfers such as institutionalized pension systems: In other words, what parts of the public transfers from employed adult children to retired grandparents are handed back to them via grandchildren (see also, Kohli 1999)?

At the risk of sounding repetitive: In modern societies, private grandparental investments are intertwined with other intergenerational transfers. Investigating the consequences of these transfers on psychological, economic, demographic, sociological, and medical dimensions and examining the motivations underlying private, non-institutionalized transfers requires, so we believe, theory pluralism and theory integration.

### **R2.2. Why we need lifespan developmental psychology**

**Hoppmann & Klumb** remind us gently of an additional perspective on grandparental investment that needs to be part of an integrative framework, namely, lifespan developmental psychology (see also, **Gurven & Schnitzer**). We wholeheartedly agree, and would also advocate a similar approach in sociology, the study of the life course. Key to the lifespan development perspective is the assumption that ontogenetic development extends

across all stages of the life course, from conception to death. One way to conceptualize development is in terms of demands and opportunities – or Havighurst's (1948/1972) notion of *developmental tasks* – that individuals face as they move through life. One developmental task associated with parenting and grandparenting is, couched in Erikson's (1966) classic (and somewhat rigid) stage model of psychosocial development, the solution of the conflict between *generativity* and *stagnation*. In our view, early and modern theories of lifespan development psychology – for instance, the selection, optimization, and compensation framework (Baltes 1997), or the socio-emotional-selectivity theory (Carstensen et al. 1999) – can bring three things to an integrative framework of grandparental altruism: First, they can broaden our understanding of why grandparents care for younger generations. Second, they can offer hypotheses as to why such activities can have tangible benefits for grandparents in terms of a sense of identity and accomplishments (an issue to which we return in sect. R6.1), and successful aging. Third, they will be indispensable in understanding how investments translate into psychological outcomes, in both grandchildren and grandparents. To this end, we hope that life-span development psychologists will discover that grandparenting – a topic they have largely neglected so far – is worth their attention.

### R2.3. Necessary scrutiny and unnecessary misconceptions

**Voracek et al.** criticize us for being too accommodating of the different theoretical perspectives and thus overlooking serious flaws in one or the other approach. According to them, one potential flaw in the evolutionary literature is the often-found pattern of grandparental investment according to which the maternal grandmother invests the most, followed by the maternal grandfather, the paternal grandmother, and the paternal grandfather (see sect. 2.3 in our target article). Voracek et al. criticize evolutionary investigations reporting this pattern for not adjusting for potential confounding factors such as grandparental age and residential distance. Both might account for the apparently robust association between grandparental type and grandparental investment. We do, of course, agree that establishing the independent effect of grandparent type by adjusting for potential confounders, such as grandparental age, health, wealth, and distance, is good practice. However, the seminal article reporting this pattern and cited by Voracek et al. as a culprit (Euler & Weitzel 1996) recognized, investigated, and found no evidence for a confounding role of grandparental age and distance (pp. 46–48).

Irrespective of the merits of the conjecture that evolutionary investigations fail to control for likely confounders – one can find examples of better (e.g., Coall et al. 2009; Pollet et al. 2009) and worse practice (Bishop et al. 2009) – we have not advocated an “anything goes” approach. Pursuing an integrative framework does not mean that we have to believe that each hypothesis has the same merit and should not be subjected to empirical scrutiny. In fact, having one's favorite hypothesis inspected by researchers from other disciplines, with different theoretical priors and methods, will make the hypothesis' merits, or lack thereof, more compelling.

Joining forces toward building a multidisciplinary framework sounds fine in theory, but can it work in practice? Some express doubts. The evolutionary psychologist **Euler** diagnoses among sociologists a “resistance to biological accounts of human behavior,” manifest in their lack of interest in lineage and gender effects. When read side-by-side, Euler's and **Friedman & Hechter's** commentaries show that the breakdown of communication across disciplines in research on grandparental investment is most palpable between evolutionary psychology and sociology. This breakdown makes it possible that to one degree or another we all hold outdated misunderstandings of the other discipline. Take the conjecture that sociologists rarely examine grandparental sex and lineage in their analyses. Although it may have been accurate in the past, things are changing (e.g., Chan & Elder 2000; Dubas 2001; Monserud 2008).

Change would be ushered in even faster if we began to read and cite the other discipline's work in earnest. In a recent citation analysis, we (Coall & Hertwig, submitted) found mostly mutual neglect. Analyzing the reception of three seminal articles authored by evolutionary researchers (Daly & Wilson 1980; Euler & Weitzel 1996; Hawkes et al. 1998) and sociological researchers (Bengtson 2001; Bengtson & Roberts 1991; Szinovacz 1998a), respectively, all of which explored intergenerational transfers and relationships, we found that although they had been cited a total of 644 times, only on 22 occasions (3.4%) were they cited by the other discipline. This disinterest in each other is most striking because the methodologies of each discipline, specifically in the areas of discriminative grandparental solicitude (Euler & Weitzel 1996; Michalski & Shackelford 2005) and intergenerational solidarity (e.g., Mangen et al. 1988), are becoming more similar. Moreover, the methodological rigor of sociology is likely to benefit evolutionary investigations, and the theoretical framework of evolutionary theory may widen the scope of hypotheses examined by sociologists. It is time to stop pointing fingers, and to start benefiting from each other.

Not surprisingly, the commentators most critical of our target article were those of whose theory of grandparental investment (Friedman et al. 2008) we were quite skeptical (see sect. 3.2 in our target article). We appreciate **Friedman & Hechter's** commentary in which they put a number of misconceptions of the evolutionary view of grandparental investment out into the open. We cannot address all of these but focus on a few, and hope that their discussion can help in moving beyond them. Contrary to Friedman & Hechter's implication that massive investments into post-pubertal children in developed societies cannot be explained within an evolutionary framework, let us point out that a quantity–quality tradeoff is a key concept within evolutionary, demographic, and economic accounts (see e.g., Kaptijn et al. 2010; Van Bavel 2006). Specifically, in post-demographic transition societies, ensuring that descendants are competitive in employment and mating markets means that investment extends way beyond puberty and often into the children's own parenthood. Such investments in the high within-population competitiveness of modern societies exact opportunity costs and consequences for the investor's inclusive fitness, and, therefore, conform to Trivers' (1972) definition of *parental investment*.

Relatedly, **Friedman & Hechter** also conjecture that there is no satisfactory evolutionary explanation for the declining fertility in developed countries. Indeed, sociologists have previously identified the demographic transition as a challenge to evolutionary perspectives (e.g., Vining 1986). In our view, this challenge has been met by theoretical reviews detailing evolutionary hypotheses (e.g., Borgerhoff Mulder 1998) and by combining evolutionary and demographic expertise (e.g., Clarke & Low 2001). Currently, a combination of hypotheses gives the strongest evolutionary account of the demographic transition (see **Sear & Dickins**). This is not surprising because the demographic transition takes different forms in response to the complexity of different ecological and social conditions (e.g., Kaptijn et al. 2010). We concede that even though a combination of hypotheses may give a more realistic representation of the complex social changes taking place, it may simultaneously leave the unfortunate impression that no satisfactory evolutionary explanation exists.

Finally, **Friedman & Hechter** ask why grandparents do not limit their investment into their children and simply assume that their children will do the same, given that their objective, according to Friedman & Hechter's reading of the "evolutionary model," is to maximize the well-being of their children. There are different answers to this question. Let us give two. First, an important basic distinction is that between classic and inclusive fitness. Introduced by Hamilton (1964), inclusive fitness emphasizes that an evolutionary perspective is not purely about ensuring your own reproduction. Inclusive fitness is calculated from an individual's own reproductive success (classic fitness) in combination with his effects on the reproductive success of his relatives, each one weighted by the coefficient of relatedness. That is, individuals can get proportions of their genes into future generations by ensuring individuals who share some of their genes by common descent survive and reproduce. This can include children and grandchildren, but also nieces, nephews, and more distant relatives. Maximizing inclusive fitness is thus one possible explanation for why grandparents invest in kin other than their children (as detailed in terms of the grandmother hypothesis in sect. 1.2 of our target article). Another explanation for grandparental altruism that is also consistent with an evolutionary framework is in terms of evolutionary continuity and the empathy mechanism (see sect 3.3 in our target article).

**Pashos** also harbors some misconceptions, in this case of his own field: evolutionary psychology. We are puzzled by his pronouncement that "most behaviors are irrational," leaving it open as to what notion of rationality he may have in mind. He also draws a strict distinction between evolutionary and economic accounts of human behavior, suggesting that evolutionary biologists discover human regularities devoid of economic conditions. We disagree. Of course, economic and evolutionary concerns are related, and in contrast to Pashos' view, yes, evolutionary theorists do talk about economic and, more generally, ecological factors. Life history theory, a branch of evolutionary ecology, is effectively evolutionary economics: the allocation of limited resources among competing demands during a finite lifetime for the greatest utility (in this case, reproductive success). Examples of evolutionary-minded researchers describing regularities of human behavior in response to economic conditions are

endless (see, e.g., Clarke & Lowe 2001). To name a few such regularities: In traditional and historical societies, marriage rates and fertility patterns have been found to correlate with resource fluctuations. In most societies, men have been demonstrated to use resources such as wealth and status to gain reproductive advantages. Child survival varies with socioeconomic status of the family, and child abandonment is related, among other factors, to economic conditions. Biased investment favoring daughters over sons has been found to be dependent on economic conditions. Indeed, the link between evolutionary and economic concepts may be *the* single existing bridge in the integrative framework that we envision.

Trying to integrate disparate fields sounds easy in theory, but is hard in practice. Each field has different cultures, conventions, and journals, and one is typically not familiar with the theoretical developments in the other disciplines. But exchange of ideas between anthropology, demography, economics, psychology, sociology, and evolutionary theorizing also promises substantial payoffs: It can guide research and theory more effectively. We agree with **Friedman & Hechter, Hames, Michalski, and Pashos** that we need more and better data to test theories of grandparental investment. Ideally, future investigations will be longitudinal, involve myriad process and outcome measures, and encompass several generations. In persuading grant institutions to fund such expensive studies, designing them as interdisciplinary in nature may give them a decisive edge in the scientific marketplace.

### R3. What do grandparents do, what should they do, and what are the effects?

Grandparental investments need not be invariably good. **Hoppmann & Klumb** make this point, thus reinforcing the differentiated evidence from traditional societies. Although the maternal grandmother has been suggested as the second most helpful adult family member behind the mother in traditional societies, under some circumstances this help can be detrimental (Sear & Mace 2008). For example, whereas in the patrilineal Oromo of southern Ethiopia having a maternal grandmother present increased survival of boys to three years of age (Gibson & Mace 2005), in the matrilineal Chewa of Malawi, the presence of a maternal grandmother reduced the probability of her granddaughter surviving to five years of age (Sear 2008). Likewise, in industrialized nations, the utility that grandparental investments have is highly variable, as numerous commentators emphasized, and, again, it changes across cultures, even within industrialized societies (Rosman & Yoshikawa 2001). It is patent that not all grandparents invest in their grandchildren or are caring (**Fantino & Stolarz-Fantino**); that some grandparents are in competition for the same limited resources as their grandchildren (**Fawcett, van den Berg, Weissing, Park, & Buunk [Fawcett et al.]; Lee**), and that when some grandparents help out, it may be seen as interfering or implying parental incompetence (Hoppmann & Klumb). In order to better understand and predict which investments are beneficial and which are detrimental, respectively, we agree with **Michalski** that we need to better understand what contemporary grandparents do with and for their grandchildren.

### R3.1. What do grandparents do with and for their grandchildren?

Grandparents can adopt many beneficial roles from storytellers, family historians, conciliators, and advisors to being sources of encouragement, skill, knowledge, and even wisdom (Michalski and Gurven & Schniter). Yet, activities that grandparents share with their grandchildren can also represent a mixed blessing. A paradigmatic example is one of the most common behaviors that grandparents and grandchildren share: watching television (Höppflinger et al. 2006). In the best of all worlds, TV consumption can be educational and foster intergenerational dialogue. At the same time, it can foster a sedentary lifestyle. In a study of 84 Native American and African American three-generation families, Polley et al. (2005) found that a grandchild's body mass index (BMI) was positively associated with grandparental BMI. Moreover, a higher grandparental BMI was related to lower activity levels in the grandchild and a lower grandparental activity level was associated with more hours of television watching in the grandchild. Although no attempt was made to establish the independent contribution of these relationships (and they are not surprising, considering the family clustering of BMI across three generations; Guillaume et al. 1995), the study by Polley et al. highlights that researchers must monitor carefully the activities in which grandparents and grandchildren engage. As Michalski points out, summative measures – such as time spent with grandchild – may hide the sophisticated things that grandparents can do, and, we would add, also the potentially detrimental activities.

Consequently, both Michalski and Hames demand more detailed information and more detailed measures representing the perspective of both donor and recipient – only then can progress be made in understanding the evolved psychological mechanisms by which the donations exert their influence. Relatedly, Euler emphasizes that outcome measures should be broadened to include such measures as grandparental and grandchild happiness. Friedman & Hechter take the issue of insufficient measures a step further and argue that the current lack of quality longitudinal data thwarts robust empirical tests of the competing predictions from different theories. They appear to believe that sophisticated longitudinal investigations are unlikely in the near future. We are less pessimistic. There are recent longitudinal studies that promise to provide us with richer data, for example, the *Millennium Cohort Study* ([www.cls.ioe.ac.uk/studies.asp?section=000100020001](http://www.cls.ioe.ac.uk/studies.asp?section=000100020001)) or the *Longitudinal Study of Australian Children* ([www.aifs.gov.au/growingup/](http://www.aifs.gov.au/growingup/)). Moreover, longitudinal studies are beginning to collect daily activity diaries that detail information on specific behaviors at regular intervals throughout the day (Baxter & Smith 2009). We are currently on the brink of a data explosion that, if shared across disciplines, will enable the grandparental investment field of research to advance immeasurably.

### R3.2. How can we measure the effects?

Gurven & Schniter argue that research on grandparental investment implies causality but in reality often demonstrates phenotypic correlations. They call for the explication and investigation of the proximate mechanisms that convert grandparents' behavior into kin welfare consequences, thus

rendering it possible to understand the impact of contemporary grandparents' behaviors. We completely agree and also stress that researchers need to be aware of and consider *reverse* causality. For illustration, consider the following possible causalities: (a) Do grandparents' investments improve grandchildren's cognitive, social, and academic outcomes, or are grandparents more attracted to and responsive to clever, friendlier grandchildren? (b) Do healthier grandparents invest more resources in their grandchildren, or do grandparents who invest more in their grandchildren (within reason) stay healthier? (c) Is living with grandparents bad for grandchildren (Chin & Xihua 2008; Marks 2006), or do grandparents begin living with grandchildren (e.g., as custodial parents) because of a poor pre-existing environment that impacts grandchild development?

Unfortunately, to make matters more complex, the mechanisms that broker the consequences of grandparental behavior and kin welfare will depend on myriad conditions such as pre-existing family environment. For example, *custodial* grandparenting is commonly seen as detrimental for both the grandchild's and the grandparent's well-being. How much of this association occurs because of what a grandparent actually does and how much arises because of the pre-existing family environment that precipitated the grandparent taking up this role? In a longitudinal study of American adolescents, Pittman (2007) examined the influence of a grandmother's childcare responsibility and whether she co-resided with her grandchild, and the impact that had on the grandchild's psychological adjustment. Crucially, Pittman adjusted for the grandchild's psychological adjustment at an earlier time point. Co-residing with a grandmother improved psychological adjustment, but it decreased this if the grandparent was custodial. In a more detailed analysis, however, Pittman and Boswell (2007) demonstrated that after moving into a custodial grandparent household grandchildren actually showed improvement and exhibited lower levels of internalizing behaviors (e.g., withdrawal, depression, anxiety) as measured by the Child Behavior Checklist. One evident interpretation is that grandparents become custodial grandparents under the most difficult of conditions, which in themselves are associated with poor childhood outcomes; nevertheless, they still make a difference to their grandchildren's psychological development. From this follows the possibility that custodial grandparents could in reality provide valuable resources that buffer grandchildren against these stressors or moderate their impact. Similarly, Hughes et al. (2007) showed that the negative health effects of being custodial grandparents were largely attributable to grandparents' pre-existing health and socioeconomic characteristics. Clearly, to reveal the authentic effects of grandparental behavior, we need – as Gurven & Schniter stress – a better understanding of the proximate mechanisms, and in addition, the inclusion of pre-existing environment and grandparent and grandchild characteristics in longitudinal study design.

### R3.3. What is optimal grandparental investment?

Coming from different angles, Cox and Fawcett et al. and Gurven & Schniter raise the question of how grandparents should *optimally* invest their typically limited resources. Taking an economic perspective, Cox points

out that grandparental help, like other economic goods or services, is subject to the law of diminishing marginal utility. That is, the better off the grandchild, the smaller the impact of an additional unit of grandparental help. From this follows that utility-maximizing grandparents should distribute their resources such that they get the most bang for their buck. In referring to our review of the beneficial effects of grandparental resources in *low-risk* and *high-risk* conditions, Cox suggests that diminishing marginal utility explains why grandparenting confers less pronounced benefits in the former circumstances, relative to the latter. Advocating a combination of evolutionary and rational actor perspectives into one framework (contrary to **Pashos**), Gurven & Schniter explicitly suggest that grandparents should choose to allocate their behavior optimally, such that it can have the highest marginal benefit (at lowest personal costs). As Cox suggests, high-risk contexts could represent circumstances under which the cost–benefit tradeoff of grandparental resources are best, and, consistent with this possibility, Gurven & Schniter report evidence that in a forager-horticulturalist society that they have studied, grandparents often become primary caretakers when parents die.

We entirely agree with the important role of marginal diminishing utility. But in contrast to **Cox**'s suggestion, we believe it is too early to tell whether the relative lack of evidence for benefits of grandparental investment in low-risk conditions is indeed a consequence of the fact that grandchildren who do well simply derive less marginal utility from additional units of grandparental resources than grandchildren who are worse off. There are just too few published studies on the potential benefits of grandparental resources in low-risk contexts. And their rarity may reflect the reality of researchers and grant institutions “investing” in the study of high-risk conditions because they hope for larger effect sizes and more impact in domains with sociopolitical relevance (e.g., teenage pregnancy). It could well be, however, that in industrialized societies where enormous investments into children are required in order to foster their success, investments under low-risk conditions yield high returns on dimensions such as level of education and future income. The issue, then, is to figure out on which dimensions to look for such high returns.

Like **Cox**, **Fawcett et al.** also pick up on the theme of nonlinear returns of grandparental investment, and the question of how optimizing grandparents should distribute their resources. In their analysis, Fawcett et al. assume an evolutionary rather than an economic currency (i.e., “lifetime reproductive success of the grandchild”; see their Figure 1) that is to be optimized. They argue that Trivers' (1974) theory of parent–offspring conflicts over the allocation of parental resources can and should be extended to grandparental resources. Because a child is more related to itself than to its siblings, it seeks a more skewed distribution of resources than parents, being equally related to all their children, are willing to grant. Giving each child some but not all resources also means that parents invest their resources such that the investment yields relatively large marginal utilities. By extension, because a grandchild is more related to itself than to its siblings or cousins, it desires to secure a larger piece of the pie than the grandparents, being equally related to all of their children's children, are willing to give.

Extending Trivers' (1974) framework to grandparental resources is an excellent idea. It will likely yield a set of novel research questions (e.g., how do parents and grandchildren attract and negotiate the allocation of grandparents' resources?), and challenge a perhaps too rosy picture of the grandparent–grandchild relationship (see **Friedman & Hechter**). However, a simple one-to-one mapping of Trivers' theory onto grandparental resources and their allocation is difficult, and the picture may be even more complicated than suggested by **Fawcett et al.** for at least the following reasons: First, the conflict over how to distribute grandparental resources implicates three generations, and parents are likely to act as agents on behalf of their children. **Michalski** points out that there is not a single study exploring how parents attempt to “encourage” their parents to invest into their grandchildren. Moreover, parents' intermediate roles are complicated by the fact that one of the parents is biologically related to his or her siblings' offspring but the other is not. In other words, parents themselves may operate on the basis of different biases or preferences, depending on the lineage. Finally, the conflict over allocations between parents and offspring occurs in a context of *relative* transparency and information symmetry; that is, all parties tend to know all relevant information (e.g., a child experiences how a parent treats its siblings). That is less likely to be the case for grandparental resources, with a grandchild being less aware of how much time or resources grandpa and grandma spend on her cousins.

Let us conclude by pointing out that we completely agree with **Hames**' important point – which carries even more weight in the context of a Triversian analysis of grandparent–parent–grandchild conflicts – that research on grandparental resources needs to better monitor not only what grandparents do with grandchildren, but also what and how much grandparents invest beyond the focal grandchild.

#### R4. Why do helpers help?

Several of the commentaries – **Broadfield, Kramer, Fantino & Stolarz-Fantino, Gurven & Schniter**, and **Strassmann & Kurapati** – address the question of why grandparents help. One explanation that has attracted wide attention is the *grandmother hypothesis*, according to which female grandparental investment and reproductive senescence evolved because the intergenerational transfer of affection, help, care, food, and wisdom increases grandmothers' inclusive fitness. Broadfield argues against this ultimate mechanism and suggests that even though grandparental investment is beneficial in modern societies, grandparental altruism is not an adaptation, but an epiphenomenon of an extended lifespan. Specifically, he argues that if menopause was selected for to provide time for grandparental investment, one would expect to see evidence of menopause in our closest animal relatives. But there is none. Moreover, he suggests that life expectancy into post-reproductive years is a recent phenomenon of the twentieth century.

First and foremost, we agree with **Broadfield** that the existence of benefits of grandparental care does not necessitate grandparental investment to represent an evolved adaptation (see sect. 2.3 of our target article). Nevertheless, we are not as convinced that the

grandmother hypothesis can be refuted on the grounds outlined in Broadfield's arguments. The evidence that human, chimpanzee, and gorilla follicle depletion rates are similar (Atsalis & Margulis 2008; Jones et al. 2007) suggests that menopause in humans does have a phylogenetic legacy. Moreover, low life expectancy in historical and traditional societies obviously represents an aggregate measure, and is strongly skewed by those societies' high infant mortality. That is, life expectancy at birth is simply not the same as lifespan. True, life expectancy at birth was less than 50 years in national populations until the twentieth century (Oeppen & Vaupel 2002), but that does not mean that few lived beyond 50. As Oeppen and Vaupel pointed out, increases in life expectancy until the middle of the twentieth century were due to large reductions in death rates at younger ages. So, what is the mortality signature of human adulthood (i.e., among those who survived childhood)? According to Hawkes (2004; see also, Paine & Boldsen 2006), first, most girls in hunter-gatherer and historical societies who survived childhood continued to live past their child-bearing years. Second, a third or more of women (of those who are over 15 years of age) usually live beyond the age of 45. Broadfield's arguments are not compelling enough to put the grandmother hypothesis to rest – in particular, when taking into account that **Gurven & Schniter's** findings indirectly address Broadfield's argument.

**Gurven & Schniter** show (see their Table 1) that two hunter-gatherer societies and two modern societies differ in "age at first grandparenting," namely, 38 years (hunter-gatherers and acculturated hunter-gatherers) versus 58.6 years (Spain) and 50 years (United States). What these numbers imply is that a long life expectancy is not necessary for grandparenting, and that our ancestors – the only great ape simultaneously to raise more than one dependent offspring (see **Kramer**) – possibly had to decide simultaneously, all before their reproductive years ended, in which of their offspring to invest their scarce resources (Kaplan et al. 2000) and whether to invest in their grandchildren.

How are we to deal with this reproductive overlap and the inescapable competition for resources necessary for reproduction? Overt competition for such resources has been demonstrated in other cooperatively breeding mammals (Clutton-Brock et al. 2006). For humans, Cant and Johnstone (2008) proposed that ceasing reproduction early (menopause) might have been a way to minimize the reproductive overlap between generations, and thus, resource competition. Indeed, despite humans' high generational overlap (see **Gurven & Schniter**), they show an extremely low level of reproductive overlap compared to other primates (Cant & Johnstone). By ceasing reproduction early, grandmothers-to-be would reduce the reproductive conflict between generations, free up resources for younger reproducers, and boost their own inclusive fitness.

Consistent with this hypothesis, overlap between a mother's reproductive period and that of her daughter is uncommon in humans (e.g., Flinn 1989). Should it occur, it has negative consequences for the growth and survival of grandchildren, as demonstrated in a study of nutritional status and mortality in rural Ethiopia. Sear and colleagues (2000) showed that the presence of maternal grandmothers improved their grandchildren's

nutritional status (weight and height) up to five years of age. The benefits of a maternal grandmother on height, however, was compromised in children whose maternal grandmothers were still reproducing, with them being significantly shorter relative to those with a post-reproductive maternal grandmother. In fact, their disadvantage was similar to that of children whose maternal grandmother had died. The nutritional benefit translated into improved survival throughout childhood, an effect that was again compromised (but did not reach statistical significance) in children whose grandmothers were still reproducing. In section R7.3, we return to the grandmother hypothesis and to **Strassmann & Kurapati's** challenge to its empirical foundation.

Stressing the economic reality of the relationship between generations, **Kramer** offers an alternative to the grandmother and good-mother hypotheses and suggests economic interdependency across generations as an explanation for grandparental investment. Specifically, she proposes that in traditional societies dietary resources and labor are pooled and transferred from old to young, *and vice versa*. Moreover, children require fewer resources than previously thought, because they produce some portion of what they need, and even over-produce at some tasks. Consequently, the production conditions of traditional forager and agricultural societies enforce a more equitable and directly reciprocal relationship across generations than is typically assumed, thus reducing the costs of grandparental investment.

By depicting grandparental investment as part of an economic exchange, **Kramer** builds a bridge to the economic accounts of intergenerational transfers. To consolidate this bridge and to make the notion of a semi-equitable relationship compelling, however, more data on the human economic life cycle are needed. According to **Lee**, for example, hunter-gatherers are estimated to become net producers of calories as late as age 21, and continue to be net producers of calories until near their time of death. If grandparental investment were primarily explained in terms of the mutual benefits of reciprocated equitable favors, then would one not expect a more balanced allocation of resources between young and elderly?

**Fantino & Stolarz-Fantino** offer still another route toward grandparental altruism, learning, and reinforcement principles. In doing so, they provide a bridge to the economic literature that deserves to be explored. In the economic literature on intergenerational transfers, learning principles have, for example, been invoked in the *demonstration-effect* hypothesis (Cox & Stark 2005), according to which, parents who expect to require care and support in old age have an incentive to demonstrate such behavior toward their own parents. The target audience is their children. By observing this model of behavior and the consequences, so the argument goes, the children will be inclined to follow suit and imitate these transfers in the future.

**Fantino & Stolarz-Fantino** also suggest that many of us operate on the basis of a generalized social belief that "what goes around, comes around." Such a domain-general belief suggests that not every act of altruism, grandparental or otherwise, needs to be directly reciprocated for such behavior to be maintained. Postulating this belief, of course, raises the question of how and why it was learned. Moreover, is it, for instance, a function of

“payoff to cooperation in everyday life” or “market integration” – two cultural dimensions that have been shown to affect the level of prosociality expressed in experimental games (Henrich et al. 2005)?

## R5. Grandparental investment in industrialized societies and reproductive success

Our starting premise was that in industrialized societies, characterized by a postmodern regime of low fertility and mortality, the effects of grandparental investments will most likely not be observed on classic fitness indicators. Instead, we suspected that they may be found in terms of less tangible dimensions, such as the grandchildren’s cognitive and verbal ability, mental health, and well-being. Notwithstanding this population-wide regularity, in section 7.3 of our article, we speculated and presented initial data that within subgroups of a population there may be links between grandparental care and fertility. Specifically, parents of working mothers may be key to their daughters’ decision to have children, in particular in countries with modest state-financed infrastructure for childcare (e.g., daycare). Several commentators – **Hoppmann & Klumb** and **Kaptijn & Thomese** (but see **Pashos**) – support this thesis. According to Hoppmann & Klumb, grandparents can help their children to orchestrate the conflicting demands of production and reproduction, and avoid the frustrating choice between motherhood and career. Kaptijn & Thomese report having found a link between the availability of grandparental childcare and their children’s fertility in a Dutch sample. They also emphasize the role of parents’ preferences concerning childcare: Even with state-subsidized infrastructure for childcare in place, prevailing cultural norms may, for example, value private (e.g., grandparental care) over public childcare, thus causing a positive link between grandparental resources and fertility.

**Kaptijn & Thomese** also gently remind us that fertility and child mortality are not the be-all-and-end-all of reproductive success, and indicators such as age at first reproduction may, on a population level, still be associated with grandparental investment in industrialized societies. We agree. In fact, we believe that it is helpful to conceptualize grandparental investment not purely as post-reproductive investment, but also as part of the grandparents’ lifetime reproductive strategy. A life history perspective suggests that for individuals who develop in a harsh environment, it may be adaptive to reproduce earlier, have more descendants, and invest fewer resources in each descendant (see **Sear & Dickins**; Coall & Chisholm 2010). Consistent with this, we found that grandparents who had their first child and first grandchild at a younger age invested fewer resources in a focal grandchild. Moreover, this association was partially mediated by the higher number of children and grandchildren that these early reproducing grandparents’ had (Coall et al. 2009). This initial evidence indicates that examining grandparental investment as the final stage of grandparents’ own reproductive strategies could be a fruitful research heuristic.

On a practical level, age of first reproduction is important because, as **Sear & Dickins** point out, *timing of*

*reproduction* is of great concern for policy-makers in the developed world, with the two opposite poles, namely, teenage pregnancy and delaying reproduction to a point when declining fecundity requires the help of the booming fertility industry. On a theoretical level, age of reproduction is challenging because its association with grandparental investment may not be as linear as it has been observed to be in historical and traditional societies (see **Kramer**). For example, in their classic study of the influence that grandmothers had in two historical populations, Lahdenperä et al. (2004) found that having a grandmother present at the time her offspring (son or daughter) began to reproduce was associated with a 2.4-year earlier age at first reproduction. Grandmothers thus, so the interpretation goes, provide additional resources that improve the parents’ condition and increase the probability of earlier reproduction. In contrast, in industrialized societies, as **Sear & Dickins** suggest, the influence of grandparental investment could be two-fold: It could delay age of first reproduction if affluent parents and grandparents-to-be were to invest in the quality of their grandchildren by supporting delayed, post-higher-education family planning of their children. Conversely, grandparental investment could bring forward the age of first reproduction if, in contexts of low socioeconomic status, the presence of grandparents were to signal to women that early reproduction is feasible. Currently, there is little direct evidence in support of the latter “kin” hypothesis, which appears to be partially in conflict with the finding that a *lack* of paternal investment markedly increases the likelihood of teenage pregnancy.

To conclude, whether or not grandparental investment in industrialized societies still impacts fertility and other classic fitness variables such as age of first reproduction is an exciting research question (see **Sear & Dickins**). Moreover, unlike **Pashos**, we see grandparental childcare as a crucial measure of grandparental investment. Dependent on the availability of state-subsidized childcare and cultural norms concerning private and public childcare, there are indications that grandparental care has fitness consequences even in industrialized societies. This association is likely to become more pronounced during difficult times. The current global economic crisis – draining state coffers and imposing financial sacrifices on many with jobs as well as those out of work – may make it more likely that parents turn to family for childcare assistance. How extensive the effect of grandparental childcare is on fertility decisions will depend on the myriad interactions of public policy, availability of institutionalized childcare, rates of women’s participation in the workforce, flexible working hours, and fertility. This is exactly the basket of variables that requires – no, demands – a multidisciplinary framework.

## R6. Key questions for future research

Reading the commentaries provided a unique opportunity to recognize some new and exciting research directions. Because of space limitations, we must be selective, and some new research questions that we have already touched upon will not be repeated here (e.g., the relationship of private and public transfers, and the issue of

crowding in and out; the relationship between life-history indicators and grandparental investment in the modern world).

### **R6.1. Being a helping grandparent pays**

Our focus and that of most research on grandparental investment has been weighted towards the effects of grandparental investment on grandchildren; however, it is clear that grandparental investment is not a one-way street (see sect. 7.2 in our target article). Several commentators elaborate on the potential benefits that grandparents may gain from their good deeds and the relationship with their children and grandchildren. **Euler** points out a valuable finding that we missed in Tinsley and Parke (1987), namely, that grandparents reported significantly greater satisfaction with their contact with children and grandchildren than the parents did (p. 270). Taking an evolutionary perspective, Euler suggests that “nepotistic effort” reflects an important “life effort” during the sunset years, and therefore, that such behavior is inherently rewarding. What is striking to us is that Euler’s thesis could also have been couched in terms of a lifespan developmental approach, which **Hoppmann & Klumb** advocate.

To this end, grandparenting has been recognized as an effective activity that can meet the generative needs of older people (Fisher 1995). In an Australian study of grandparent satisfaction, it was the psychological aspects of grandparenting – including generative concerns, the centrality of the grandparenting role to the individual, and being valued as an elder by their grandchildren – that predicted satisfaction (Thiele & Whelan 2008). In contrast, the number of hours per week that the grandparent provided childcare was not predictive of satisfaction. Apparently, contact alone is not enough for grandparents to be satisfied with their role; rather, it is the meaning and generativity surrounding this contact that matters. One reason could be that older people, faced with the prospect of a limited future, seek emotionally meaningful experiences (Carstensen et al. 1999), and prioritize generative and emotionally meaningful goals (Lang & Carstensen 2002).

These and related results suggest that grandparenting – provided that people still enjoy the physical and mental resources necessary – represents the conduit for emotionally gratifying experiences that older people, attempting to regulate their emotions via meaningful activities, seek out. Clearly, the exact psychological and neural mechanisms need to be worked out. However, if even mandatory, tax-like transfers to a charity elicit neural activity in areas linked to reward processing (Harbaugh et al. 2007), we would be surprised if grandparents, voluntarily donating their resources to their kin, did not also receive payback in terms of some neural reward currency.

### **R6.2. How can one explain young kin’s altruism towards elders?**

**Cox** points out that younger generations’ investments into ailing grandparents pose a conceptual difficulty for kin selection theory, and, perhaps because of this, have attracted little attention in the evolutionary literature.

We agree that the evolutionary logic favors downward intergenerational transfers because the reproductive value of younger individuals is generally higher than that of older members in a society (Frank 1998). Consequently, understanding why individuals help older people may not be best achieved from a “gene’s-eye view.” Economists, for example, have proposed accounts such as the demonstration-effect hypothesis (Cox & Stark 2005) and the strategic-bequest hypothesis (Bernheim et al. 1985), which predict that resources flow from young (even if the young are selfish) to older generations. Another potentially fruitful direction in which one may find partial answers is the mechanism of empathy (see sect. 4.3 of our target article).

Perhaps one of the greatest achievements of modernization is that societies have built institutions that implement public transfers to the elderly, thus sparing them poverty, neglect, and possibly geronticide (which according to **Gurven & Schniter** is commonly practiced in pre-industrial societies). As a result, the economic role of the elderly has been radically changed, with, as **Lee** points out, a long and healthy old age of extensive consumption and little labor. One topic that repeatedly emerges in public discourse is whether the enormous public resource flow to the older generations is sustainable in light of the large changes in the frequency of old and very old in the developed world (Oeppen & Vaupel 2002). In this context, one may also ask to what extent the very existence of the substantial private transfers from the old to the young persuades the younger generations to support and accept what Lee identifies as the changed economic role of the elderly.

### **R6.3. How does what grandparents offer change over time?**

**Hames** suggests that the grandparental resources being transferred are need-sensitive; that is, initial investments are likely to be in the form of direct grandparental care, such as babysitting. When grandchildren grow older, monetary resources, such as assistance in higher education, may become more pertinent. What is interesting about this plausible hypothesis is that such need- and age-dependent changes in resources may also reflect the capabilities of the aging grandparents. They babysit when they are still relatively young, and transfer monetary resources when their ailing health makes it increasingly impossible to be directly involved. Age of grandparents and grandchildren, of course, is a variable associated with a number of changes worth studying. For example, contact, but not necessarily closeness, in the grandparent–grandchild relationship decreases as children grow up (Dench & Ogg 2002; but see also, Bridges et al. 2007). With both generations getting older, their views of each other change (Kahana & Kahana 1970), which, in turn, is likely to affect how grandchildren try to elicit investment, and what type of investment grandparents offer.

### **R6.4. Beyond classic fitness indicators in investigations of traditional societies**

In order to find the effects of grandparental investments in industrialized societies, we recommended focusing on dimensions such as the grandchildren’s cognitive and verbal ability, mental health, and well-being. This is in

contrast to evolutionary psychologists' and anthropologists' focus on classic fitness indicators in traditional societies. **Curven & Schniter** rightly point out that dimensions beyond fitness indicators (e.g., transfer of knowledge) also deserve to be studied in traditional societies, even more so because such societies epitomize high-risk contexts, in which the most important grandparental resource – in particular, later in the child's life – may not be calories but, for example, skills.

## R7. Things we got wrong, or did we?

Our target article was admittedly ambitious, trying to bring together evidence and explanations of grandparental investment stemming from different disciplines. In doing so, we entered territory new to us, and therefore omissions and errors may have been inevitable. In previous sections, we have addressed oversights as the opportunity arose. Now we turn to three broader challenges to some generalizations we proposed.

### R7.1. Do grandparents have more or less opportunity to care in industrialized societies?

**Curven & Schniter** argue that grandparental *opportunity* was higher in hunter-gatherer societies than in modern industrialized societies, contrary to our conclusion. We appreciate their analysis of demographic parameters across different societies. At the same time, however, we also caution against overrating the parameters' value, as they fail to recognize several important properties of grandparents and of grandparents' environments in industrial societies that are likely to increase the opportunity to invest. First, today's grandparents are likely to be healthier than their predecessors and invest over a longer period. Second, they have more resources (in particular, through the enormous institutional upward transfers that they receive; see **Lee**). Third, they have substantially fewer grandchildren in whom to invest (see the total fertility rate in **Curven & Schniter's** Table 1), and therefore, there is less competition for grandparental resources within generations. Fourth, the wider-spaced generations are likely to reduce competition for grandparental resources between generations (see **Fawcett et al.**). Based on these differences between grandparenting in the past and today, we believe that our conclusion – that the opportunity for grandparents to care is higher than ever – still holds.

### R7.2. How traditional are modern societies?

**Huber** takes us to task for arguing that in industrialized societies many of the links that held in ancestral times – links between grandparental help and inclusive fitness, links between economic status and reproductive success, and sex-biased grandparental investment (Trivers-Willard theory) – still hold. The links are more hidden, but they are still there. We respect Huber's conviction in the robustness of evolutionary regularities in modern societies, and agree that trying to uncover them, should they still exist, is a worthy research enterprise.

### R7.3. Are grandparents helpful or not?

**Strassmann & Kurapati** provide a thorough analysis, which they suggest shows – in contrast to a previous

review (Sear & Mace 2008) on which we relied heavily – that grandparents in traditional societies are not, or not strongly, beneficial when measured in terms of child survival. Therefore, so they conclude, referring to humans as cooperative breeders is misplaced, or at least overemphasized. Specifically, **Strassmann & Kurapati** expand Sear and Mace's review by detailing and quantifying all associations between each of the four grandparent types being present (or alive) and grandchild survival, which is split further into effects on grandsons and granddaughters. With the space limitations, **Strassmann & Kurapati** obviously had little opportunity to detail their procedure, and therefore, it is difficult for us to evaluate their analysis in detail. However, let us share some of our observations.

According to **Strassmann & Kurapati**, most of the associations between the maternal grandmother, the grandparent whose impact should be largest, and child survival are non-significant. This is indeed true in 73% of analyses. However, the remaining associations were overwhelmingly positive, rather than negative (22% vs. 0.5%). This is unlikely to be a chance finding. We also noticed that the *negative* effect of the maternal grandmother found by Beise (2005), with a relative risk of 0.79, was taken to be statistically significant at  $p < .1$  for girls, whereas the *positive* effect of the maternal grandmother found by Gibson and Mace (2005), with an odds ratio of 0.714 (and, on inspection of Table 1 in their original article [p. 474], a 95% confidence interval that does not cross 1 [0.51–0.99]), was taken to be non-significant for boys. For others to replicate **Strassmann & Kurapati's** analysis, it would be important to know the standards that the authors applied (which could, for example, be made accessible in a document on their website).

A final observation that we made is that **Strassmann & Kurapati's** detailed analysis should encourage researchers to specify the time course of the predicted effects more precisely, and thus to test them more stringently. Take, for illustration, the Beise (2005) data set. It shows that the maternal grandmother has no effect from 0–11 months of age, which is when most infants are being breastfed; it has a positive effect in three out of four analyses between 12 and 36 months of age, when provisioning of children moves to alloparents, and becomes negative only for girls between 36 and 59 months of age. Obviously, our summary is *post-hoc*, but it does suggest that the initial lack of effects and the subsequent positive effects could be consistent with the role of grandparents as alloparents, thus supporting the proposition that humans are cooperative breeders. Indeed, we suspect that not even the greatest believer in the merits of grandparental investment would predict that benefits hold invariably across all ages and ecologies. Finally, on a technical note, counting the number of negative, positive, or non-significant associations could be highly misleading, when the coarseness of the bins changes across time. For example, the period from 0–11 months, in which one may predict no effect, is divided into three bins in Beise (2005; see Table 1 in **Strassmann & Kurapati**), whereas the period from 12 to 23 months, for which one may predict an effect, is collapsed into one bin only.

Notwithstanding these issues, we applaud **Strassmann & Kurapati's** efforts, even if Sear and Mace's analysis is not as rudimentary as this commentary suggests (see the "other effects and notes" column in Table 2A and 2B;

Sear & Mace 2008). We hope that their contribution will ensure a constructive debate on the relative merits of the grandmother and mother hypotheses.

## 18. Conclusion

We are convinced that to move forward, research on grandparental investment and intergenerational transfers, scattered across disciplines, will need to embrace an ethos of interdisciplinary research. Our target article aimed to take first steps toward a multidisciplinary framework. Generally, the commentaries we received echo this need to travel across disciplinary borders. After reading the thoughtful questions and issues brought up by our commentators we are more than ever persuaded that a joint effort by researchers from psychology, sociology, anthropology, evolutionary biology, and demography will reveal so much more about the effects of grandparenting in the developed world than can a single discipline on its own.

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[Letters “a” and “r” appearing before authors’ initials refer to target article and response references, respectively.]

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