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"Modernization" increases parental investment and sibling resource competition: evidence from a rural development initiative in Ethiopia

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Abstract

Evolutionary models of parental investment often assume that negative effects of competition between offspring (i.e., quantity-quality trade-off effects) will be most apparent under conditions of resource scarcity. However, improvements in resource access associated with "modernization" may reduce levels of extrinsic environmental risk, creating a stronger association between parental investment and offspring success. Here we provide evidence that a rural development initiative in Ethiopia is associated with increased levels of parental investment in offspring status and increased levels of competition for this investment between siblings. Villages with access to an improved water supply, which have reduced levels of childhood mortality, are associated with higher investments in education, and the likelihood of offspring education is more determined by position within the family, compared to neighboring villages without access to water taps. However, there is no evidence of higher parental investment of base-level resources directly related to child health (indicated by childhood vaccination rates). Educational investment may be more sensitive to mortality changes, despite being costly and "surplus" to essential functions, because it has the potential to introduce the greatest economic payoffs for children, e.g., from jobs in an emerging wage-labour market. While tap villages are currently associated with a higher birth rate, we anticipate that in time, and with improved access to family planning, fertility will drop in response to shifts in environmental risk and improved pay-offs to strategies of high parental investment. These villages may be experiencing the initial stages of a demographic transition to small family sizes.

Keywords: Human behavioral ecology; Development intervention; Environmental risk; Birth order; Education

1. Introduction

Human parents invest intensively in their offspring. Our evolved life history has been shaped by the costs of rearing large-brained children who experience a long period of juvenile dependency requiring both parental and grandparental support (Hill & Kaplan, 1999; Mace, 2000; Sear & Mace, 2008). Evolutionary life history theory predicts that since the energetic and time costs of raising simultaneous children (and grandchildren) are high, and resources are finite, parents face a trade-off between number of offspring born and number that can be successfully reared. Numerous animal studies support this model, showing that offspring fitness diminishes with family size (Lack, 1947; Roff, 2002; Stearns, 1992). However, evidence for trade-offs between family size (quantity) and child well-being and/or reproductive success (quality) in humans is mixed (Borgerhoff Mulder, 2000; Desai, 1995; Gillespie, Russell, & Lummaa, 2008; Hagen, Barrett, & Price, 2006; Hill and Hurtado, 1996; Kaplan, Lancaster, Bock, & Johnson, 1995; Low, 1991; Meij et al., 2009; Penn and Smith, 2007; Pennington & Harpending, 1988; Strassmann & Gillespie, 2002; Voland & Dunbar, 1995 and see review in Lawson and Mace, in press).

Many have emphasised the potential for human trade-offs to be masked by social, economic or cultural phenomena which improve resource availability (Borgerhoff Mulder, 2000; Draper & Hames, 2000; Gillespie et al., 2008; Hagen et al., 2006; Hill & Hurtado, 1996; Meij et al., 2009), thus defraying the costs of rearing large families (e.g., through kin support or economic and public health initiatives which reduce mortality and/or increase the local carrying capacity).

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Economic models of the family have also assumed that, since quantity–quality trade-offs are driven by "credit constraint," increases in personal or societal wealth will reduce negative effects of high fertility on offspring (Becker & Lewis, 1973; Grawe, 2010). However, across the world, it is the parents with the greatest access to wealth and resources benefiting from improved economic, technological, and health interventions who increasingly opt for a more quality-driven parental investment strategy (Coale & Treadway, 1986; Lee, 2003; Livi-Bacci, 1986), dramatically curtailing fertility as if sibling resource competition has been increased rather than reduced (Kaplan, Lancaster, Tucker, & Anderson, 2002; Mace, 2007).

In this study, we test one explanatory model for how technological and public health improvements, i.e., "modernization," may magnify parental investment trade-offs based on the reduction of extrinsic environmental risk. We identify the impact of a rural Ethiopian development project, which has dramatically reduced childhood mortality, on levels of parental investment and the intensity of resource competition between siblings.

1.1. Environmental risk and parental investment

Recent studies have highlighted the importance of perceptions of local environmental stability in determining parenting behaviors, particularly whether local environmental mortality risks can be avoided by increasing parenting effort (Pennington & Harpending, 1988; Quinlan, 2007; Winterhalder & Leslie, 2002). Focus has been given to extrinsic, or "care-independent" risk factors, which introduce negative child outcomes largely beyond parental control, e.g., through high prevalence of infectious disease, unpredictable and fluctuating food availability and/or high rates of warfare and intragroup violence. High levels of extrinsic risk create substantial diminishing returns to parental effort, introducing a low saturation point beyond which "chance" becomes the principal determinant of offspring success (Pennington & Harpending, 1988; Quinlan, 2007). Under such conditions, parents should favour low levels of parental investment and resource competition between siblings will be relatively inconsequential to individual fitness. A pattern favouring the allocation of parental resources to high fertility rates whenever possible. Conversely, if external risk factors are low, parents have a greater reliability in their investment returns and so, a greater influence on child survival, development, and ultimately reproductive success. This pattern favouring increased levels of parental effort and elevated sibling competition for this investment, which in turn may lead to a reduction in fertility rates (Winterhalder & Leslie, 2002).

Several studies support a link between levels of extrinsic environmental risk and reproductive and parenting behaviors. In humans, patterns of early reproduction (which typically coincide with high fertility) have been associated with elevated risk factors such as crime rates (United States; Wilson & Daly, 1997), HIV infection (South Africa; Gant, Heath, & Ejikeme, 2009) and life expectancy (United Kingdom; Nettle, 2010). Using a cross-cultural sample, Quinlan (2007) has also presented evidence that high exposure to extrinsic risks (famine, warfare, or very high levels of pathogen stress), is associated with lower levels of direct parenting behaviors (e.g., less mother-child bodily contact and reduced sleeping proximity).

1.2. The impact of modernization

Modernization, through the introduction of social, economic, health, or technological interventions, has the potential to reduce extrinsic environmental risks, increasing the reliability of parental investment returns (Winterhalder & Leslie, 2002). As such, modernization may establish a closer association between parental investment and offspring quality and, subsequently, increased perceived or actual costs to resource competition between siblings (Kaplan et al., 2002; Kaplan, 1996). This argument has been used to account for the modern demographic transition to below replacement fertility in Europe during the 19th century, where improvements of public health (which reduces extrinsic sources of mortality and morbidity) and changing technologies of production (i.e., the introduction of wage-based labour reliant on education) may have interacted to yield increasing payoffs to investments in skill and education, health, and longevity. In turn, favoring investment in child quality at the expense of quantity (Kaplan et al., 2002; Kaplan, 1996). Within these populations, competition for parental investment between siblings may be particularly pronounced in relatively high socioeconomic strata (Lawson & Mace, 2009, 2010). This is because potential for resource generation is highest for those in receipt of initial wealth transfers (Rogers, 1990) and because welfare states guarantee "base" requirements in health care, schooling, and social opportunity are met, alleviating resource competition at lower levels of investment.

Conclusive evidence that parental investment and sibling resource competition are influenced by levels of modernization in populations currently undergoing demographic transition is, however, currently lacking (Gibson & Mace, 2006). A cross-cultural analysis by Desai (1995) on the influence of family size on childhood growth in 15 developing populations provides some supportive findings. Desai (1995) found that higher levels of both access to safe drinking water and health care facilities was associated with larger negative effects of closely spaced siblings on height, suggesting that improvements in parents' ability to influence their own children's well-being through public health initiatives may have resulted in more intensive competition between siblings for this investment. However, country-level associations of this sort may be confounded by extensive regional variation in alternative socioecological factors influencing family structure and child development (Lawson & Mace in press).

In the current study, we are able to directly explore factors altering individual parental investment decisions and competition between siblings following the introduction