

Parenting Decisions When Child Discount Factors Are Endogenous*

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Abstract

I extend the model presented in [Bruno \(2025\)](#) and model parent-child interaction and child cognitive skill development and allow the child's discount factor to be a function of their current stock of cognitive skills.

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1 Introduction

The relationship between parents and their children is fundamental for the growth and development of children. This importance advocates for a good understanding of the time and monetary investments that parents make in their children, as well as the style in which they choose to parent. Most economic models of child development study the effects of parental time and monetary investments in their children, omitting not only the choice of a parenting style, but the strategic nature of the parent-child relationship¹. Some economists have recently incorporated parenting style into models of household interaction and child development. These papers typically study parenting style in isolation, ignoring parental time and monetary investments². This gap in the economics literature provides an opening for questions such as, relative to traditional inputs into the child development production function, how important is the choice of parenting style? Is it beneficial to adopt a given parenting style earlier or later in the development process? How do the three major parenting styles rank in terms of fostering cognitive and non-cognitive skills?

In this paper, I construct a dynamic model of parent-child interaction and child cognitive skill development. In my framework, parents make labor supply decisions, can spend time with their child, and they make a decision on the style raise their child. Children decide how much of their time they allocate towards studying and leisure. The key link between parenting style and child study time is that the different parenting style decisions will induce different time allocation choices from their children. In addition to altering their child's time allocation decisions, the choice of parenting style is allowed to have a direct influence on the production of cognitive skills³, all these choice have dynamic effects, as I allow the child's discount factor to be a function of their current stock of cognitive skills. I use permissive parenting as a reference point, and do not allow a permissive parenting style to shift children's time allocation decisions, nor do I allow any direct impact on the production of cognitive skills. I do not restrict the signs of the effects of the different parenting styles on the production of cognitive skills, therefore, presenting parents with additional trade-offs or benefits when choosing a style, as one parenting style may be more effective at inducing effort, but my come at the cost of negatively impacting the formation of their child's skills.

The standard economic models of child development that only consider parental time and monetary inputs typically constrain the signs of the marginal products in the production function to be positive. This presents parents with the usual trade-offs that spending time

¹See [Bernal \(2008\)](#), [Del Boca et al. \(2014\)](#), [Verriest \(2022\)](#), [Brilli \(2022\)](#), [Mullins \(2022\)](#)

²See [Cosconati \(2009\)](#), [Lizzeri and Siniscalchi \(2008\)](#), [Hao et al. \(2008\)](#), [Bergman \(2021\)](#), [Seror \(2022\)](#)

³See [Agostinelli et al. \(2023\)](#) for an example of this in a model of friendship formation and cognitive skill development.

with their child is beneficial for the development of their skills, but comes at the cost of their leisure time. Similarly, monetary investments, such as schooling or sending a child to a high quality child-care center, is beneficial for child development, but comes at a financial cost to the household. What is less straightforward, are the trade-offs parents face when it comes to adopting a parenting style. In this paper, I consider the three major parenting styles outlined in [Doepke and Zilibotti \(2017\)](#), and originally defined by [Baurmind \(1967\)](#), permissive, authoritarian, and authoritative.

Permissive parenting is characterized by allowing children to make their own choices. Authoritarian and authoritative parenting styles are more involved in the sense parents set limits and rules for their children to follow, however, they differ in the ways these rules are monitored and enforced. Authoritarian parents demand obedience, and will utilize corporal punishment if rules are broken. Authoritative parents still use rules and limits, but they explain to their children why the rules are in place, and do not utilize harsh punishment in the event that rules are broken. The effects of the different parenting styles and use corporal punishment on child development have been well documented in the sociology, psychology, and medical literatures⁴. Outside of [Doepke and Zilibotti \(2017\)](#), economic models that incorporate parenting style typically differentiate between authoritarian and non-authoritarian parenting, ignoring the differences between permissive and authoritative styles and their impact on the choices children make, and the consequences for the development of their cognitive and non-cognitive skills. [Doepke and Zilibotti \(2017\)](#) present a theoretical motivation for why parents choose certain styles, but do not estimate their model, leaving the trade-offs parents face regarding choices of parenting styles left unknown.

I allow the parameters governing the production of child skills to vary with the age of the child, and let the data determine the signs of said parameters. In particular, I break childhood into two development periods, the first pertaining to when the child is between 4 and 9 years of age, and the second from age 10 to 16. The skill productivity parameters are common across households, however, I allow for preference heterogeneity across households. It is assumed that parents incur a utility cost for choosing an authoritarian or authoritative parenting style (permissive parenting has a utility cost that is normalized to 0), however, I do not restrict the ordering between authoritative or authoritarian parenting utility costs. The same is true for how authoritarian and authoritative parenting alters the child's time allocation decision, it is assumed that permissive parenting allows them to make their choice freely, and I do not restrict that authoritative or authoritarian parenting to have a greater influence on the child ex-ante.

I estimate the model using data from the Panel Study of Income Dynamics (PSID) and its

⁴See [Straus \(1991\)](#), [Baumrind \(1991\)](#), [Gershoff \(2002\)](#), [Spera \(2005\)](#)

Child Development Supplement (CDS), the parameters governing the model are estimated using Simulated Method of Moments (SMM). The PSID is a nationally representative survey of U.S households, and is well suited for this study because it contains information about parental labor supply as well as time spent with children, child study time, parenting style choices, and child skills. The additional benefit of the PSID is that it is a long panel, therefore, I am able to understand the dynamics of parenting style decisions over a long time horizon.

Identification of the parameters governing child skill production is driven by correlations between current skill measures with lagged inputs such as maternal and paternal time, child study time, skill measures, and household income, as well as average and standard deviations of parent and child time investment by the age of the child. Household preference parameters are identified by the average and standard deviation of time allocation decisions by the parents and children. I take this a step further for the identification of children's preferences, and match moments of child study time conditional on the parents' choice of a parenting style.

2 Literature Review

This paper contributes to both the child development and intra-household interaction literatures in economics and draws on the works in the fields of psychology and sociology as well.

2.1 Parent-Child Interaction

Beginning with the seminal work of [Becker and Tomes \(1979\)](#), economists have slowly began to study the dynamics of the parent-child relationship in the last twenty-five years. My work attempts to explain the relative importance of parenting style in a larger model of parent and child investment decisions in the skill development of children, where the choice of parenting style augments the time allocation decisions of their children and has additional consequences on their cognitive and non-cognitive skill development. The closest relative of this work would be [Del Boca et al. \(Forthcoming\)](#), who use similar data, and the leader-follower structure, to analyze how paying children an allowance conditional on their study time affects their cognitive and non-cognitive skill development. They show that a paying children an allowance conditional on studying reduces (stochastically) future non-cognitive skills. Their result provides evidence for the theoretical motivation in [Benabou and Tirole \(2003\)](#), who show how it can arise that short-term incentives can have negative long-term consequences. While I do not have monetary incentives as a lever to increase child study time

in my framework, I allow the choice of parenting styles to augment child study time, while also allowing for effects on the development of cognitive and non-cognitive skills. Therefore, one could think of this work as an analog to [Del Boca et al. \(Forthcoming\)](#), as we both consider types of parenting styles and their consequences for child development.

There is a growing literature on the use of parental praise and punishment in the economics literature. [Weinberg \(2001\)](#) presents a theoretical model to explain why the use of corporal punishment is more common among low-income households. The thought is that low income households are financially constrained, making it difficult to motivate children to exert effort using an allowance, and they must resort toward punishing the undesirable outcome instead of rewarding the positive outcome. This framework is static, and is unable to state the dynamic effects of corporal punishment on child development. [Galiani et al. \(2017\)](#) propose a theoretical framework to explain the reduction in the use of punishment of children over the course of the 20th century. The model predicts that a decrease in parental income inequality and a reduction in the number of children in the household shifts the balance of power within homes, which results in a decrease in the use of corporal punishment. [Burton et al. \(2002\)](#) present a model of parental praise of child good behavior, and show that children act out more often in poor households. The main takeaway is that child behavior is influenced by a range of socioeconomic factors, but, socioeconomic factors indirectly affect parenting practices through their response to child behavior. Closely related to the result in [Burton et al. \(2002\)](#) is the conclusion [Harris \(2024\)](#) arrives at, which is, that disadvantaged parents will implement harsher discipline practices as a rational response to raising their children in a more hazardous environment. [Kim \(2019\)](#) analyzes the parent-child relationship using a signaling model, where the signaling method used by the parent is punishment. He shows that when the parent uses consistent punishment to signal poor behavior, the child will eventually be persuaded to behave optimally even when parents do not supervise their child. Finally, [Akabayashi \(2006\)](#) presents a theoretical model of praise and punishment and child effort. Here, effort is unobserved, and Akabayashi presents conditions such that if parents overestimate their child’s abilities, maltreatment of children can arise as the household equilibrium.

While I do not consider the use of praise and punishment explicitly in my model, they are potentially captured. Authoritarian parenting is associated with use of punishment while authoritative parenting is correlated with the use of praise and warmth. I allow for the choice of authoritarian and authoritative parenting to have a direct effect on children’s cognitive and non-cognitive skills, which can capture the positive or negative effects of warmth and punishment. This channel extends the works outlined in the previous paragraph, which do not allow for use of praise or punishment to have positive or negative effects on skills other

than their impact through their effect on child behavior.

Even more recent is the explicit consideration of a choice of parenting style as defined by [Baurmind \(1967\)](#) in the economics literature. [Doepke and Zilibotti \(2017\)](#) and [Doepke et al. \(2019\)](#) present a theoretical framework that rationalizes the choice of parenting style as an optimal choice given the socioeconomic environment of the parents. They provide evidence for why authoritarian parenting styles are more common in unequal societies, while non-authoritarian parenting styles are more common in societies that are more equal. [Cobb-Clark et al. \(2019\)](#) posit the idea that parenting style investments are distinct from time and monetary investments in their framework, and provide evidence that the choice of parenting style is important for child cognitive development and that positive parenting styles are negatively correlated with socioeconomic status. [Cosconati \(2009\)](#) is perhaps the first to estimate a dynamic model of parenting style and child development, where parents choose how strict to be when setting limits for their child, and the child chooses how much time to spend studying. The model is one of private information where only the child knows their type, and the main result is that a stricter parenting style is beneficial for children who place a low value on their human capital, but harms children who place a high value on their human capital. [Agostinelli et al. \(2023\)](#) allow for authoritarian and non-authoritarian parenting in a dynamic model of child friendship formation and human capital development, but assume that the child is myopic and do not allow for study time decisions by children.

The framework in this paper builds on those mentioned in the previous paragraph by allowing differentiating between authoritative and permissive parenting styles, modeling a longer time horizon ([Cosconati \(2009\)](#) only looks at 11 and 12 year old children in a two period model), and modeling the evolution of cognitive and non-cognitive skills (both [Cosconati \(2009\)](#) and [Agostinelli et al. \(2023\)](#) only consider cognitive skill dynamics), and allowing for forward looking children (children are not modeled in [Cobb-Clark et al. \(2019\)](#) and are myopic in [Agostinelli et al. \(2023\)](#)).

2.2 Child Skill Development

There is a large literature concerning the economics of child skill development. This paper is closely related to others who have worked on models of time allocation, the timing of investment, and child skill development. [Todd and Wolpin \(2003\)](#) and [Todd and Wolpin \(2007\)](#) present frameworks for estimating the parameters that govern the production of child skills. [Bernal \(2008\)](#) is perhaps the first to estimate a structural model of maternal investment in the development of child cognitive skills, finding that maternal labor supply has a negative effect on the cognitive development of children under five years of age. The channel that is not directly in her model, is that when mother's enter the labor market, they

are not with their children, and this time is productive for skill development. [Del Boca et al. \(2014\)](#) explicitly consider this channel in their framework and are perhaps the first to explicitly include father’s time investment into a model of child skill development. Their estimates confirm the results in [Carneiro and Heckman \(2003\)](#) and [Cunha et al. \(2010\)](#) in that the marginal product of parental time is decreasing with the age of the child, stressing the importance of early childhood investment. I extend these models by incorporating the choice of parenting style into a model of time allocation, by allowing children to have an active role in their skill development, and by allowing for both direct and indirect effects of the choice of parenting style on the cognitive and non-cognitive skill development of children.

[Brown et al. \(2023\)](#) considers the role that divorce law plays in a dynamic model of child skill development. They find that children’s interests are not necessarily best served by attempting to minimize the divorce rate among parents. Divorce and fertility are absent from my framework, however, parenting style and child time allocation decisions are omitted from their framework.

[Bernal and Keane \(2011\)](#), [Brilli \(2022\)](#) and [Verriest \(2022\)](#) consider the role that non-parental childcare plays in the development of child skills and show that formal childcare is a better substitute for parental time than informal care when it comes to the development of the cognitive skills of children. I do not consider non-parental care decisions, partially because I model households from the age when children are typically already in elementary school, a time where the need for non-parental care is greatly reduced. Further, given that I model child study time, I would need to differentiate different types of non-parental care, such as tutoring versus athletics, versus music, etc., which would present difficulties in modeling choices and estimation. The three papers mentioned earlier in the paragraph do not model the choices of children, nor do they consider the role parenting style plays in child skill development, and therefore, the framework presented below builds upon their work by considering the role of parenting style.

3 Model

The model consists of a set of households, each including two parents, a mother and a father, and a single child. It is assumed that both the parents and the child are forward looking and each make investment decisions in the child’s cognitive human capital development, which augments the child’s discount factor. The parents and the children make decisions in a leader-follower structure, with the parents being the first mover. Parents decide how much of their time to allocate toward leisure, labor supply, and child time investment. They also make many monetary investments in the child and decide on a parenting style. Children observe

the actions of their parents, and conditional on parental choices, allocate their remaining time between studying and leisure.

3.1 Environment

3.1.1 Households

Each household includes two parents, a mother (denoted by superscript m), and a father (denoted by superscript f) who behave under a unitary model, and a single child (denoted by superscript c). All households face a common child cognitive skill production technologies, but vary in the initial levels of child skills and exogenous wage offers. Time is discrete and indexed by the age of the child in years, denoted by t . Each household is followed from some initial age t_0 until the child is T years old⁵.

The parents' period flow utility function is give by

$$u_t^p(l_t^m, l_t^f, c_t, ps_t) = \alpha_l^m \ln(l_t^m) + \alpha_l^f \ln(l_t^f) + \alpha_c \ln(c_t) - \xi(ps_t) \quad (1)$$

where l_t^m is the mother's leisure time, l_t^f is the father's leisure time, c_t is parent consumption, and $\xi(ps_t)$ represents the utility costs incurred by the parents when they choose the parenting style ps_t .

The assumption of a unitary model rules out the strategic interaction between parents when making labor supply and child investment decisions. It is also implied that the choice of parenting style is at the household level as is assumed by [Cosconati \(2009\)](#) and [Agostinelli et al. \(2023\)](#) (who both consider a child and a single parent and parenting style is automatically at the household level), ruling out different parenting style decisions by each parent. This decision is driven by data limitations. In the CDS, both the primary care-giver and the "other" care-giver are asked questions about their parenting style, and there is significant missing data for the other care-giver, which would present identification concerns. Moreover, when the data is available for both parents, the majority of the time, the parents agree on a style. The strategic interaction between parents over choosing a parenting style is a current project of mine, and an avenue for future research. While the unitary model has its limitations, it is a common assumption in the literature (see [Weinberg \(2001\)](#), [Akabayashi \(2006\)](#), [Hao et al. \(2008\)](#), [Liu et al. \(2010\)](#), [Del Boca et al. \(2014\)](#), [Berlinski et al. \(Forthcoming\)](#), [Bernal \(2008\)](#), [Brilli \(2022\)](#), etc.)

Each period, parents jointly make a parenting style decision, $ps_t \in \{AR, AT, P\}$, where AR denotes an authoritarian parenting style, AT and authoritative parenting style, and P a

⁵Here, T represents 16 years of age.

permissive parenting style. They also make continuous choices regarding labor supply and time spent with their child subject to a household budget constraint and individual time constraints. The household budget constraint is given by

$$w_t^f h_t^f + w_t^m h_t^m = c_t + g_t \quad (2)$$

where h_t^j represents parent j 's hours worked in the labor market at hourly wage w_t^j , and g_t are monetary investments in their child. Each parent faces a time constraint

$$112 = \tau_t^j + h_t^j + l_t^j \quad (3)$$

where τ_t^j is the time that parent j spends with their child. It is assumed that each parent has 112 hours each week to allocate toward work, leisure, and time with their child, therefore, all time investment decisions are in hours per week. This implies that total household income, consumption and expenditures on child goods are also at the weekly level.

The child's flow utility function is given by

$$u_t^k(l_t^c, ps_t) = \omega(ps_t) \ln(l_t^c) \quad (4)$$

The child's flow utility function is given by

$$u_t^k(l_t^c, ps_t) = \omega(ps_t) \ln(l_t^c) \quad (5)$$

Notice the link between the parents' choice of a parenting style and the child's utility function. Like [Cosconati \(2009\)](#), I allow the choice of parenting style to influence the child's value of leisure time, augmenting their optimal time allocation decision⁶. The child only faces a time constraint, which is given by

$$112 = \tau_t^k + l_t^c + s_t + \tau_t^m + \tau_t^f \quad (6)$$

where τ_t^k are the number of hours per week the child spends studying and s_t is exogenous time spent in school. Note that the time parents spend with their child appears in the child's time constraint, effectively setting an upper bound for the maximum amount of time a child can spend studying, and therefore, can crowd out child study time.

Both the parents and the child are subject to a skill production function for cognitive

⁶[Cosconati \(2009\)](#) describes this action as the choice of parenting style acting as a composite tax on the child's leisure time. An alternative interpretation is that a child could spend more time in leisure activities, however, they would enjoy them less because they are worried about potential punishment from their parents.

skills, whose parameters are allowed to vary with the age of the child. It is assumed parental time, child study time, goods investments, lagged skills, and the choice of parenting style influence the development process for both cognitive and non-cognitive skills

$$k_{t+1} = f_t(\tau_t^m, \tau_t^f, \tau_t^k, k_t, g_t, ps_t) \quad (7)$$

I assume a log-linear process, and can more explicitly write the laws of motion as follows:

$$\ln(k_{t+1}) = \ln(R_t) + \delta_t^m \ln(\tau_t^m) + \delta_t^f \ln(\tau_t^f) + \delta_t^c \ln(\tau_t^k) + \delta_t^g \ln(g_t) + \delta_t^{ps} (ps_t = ps) + \delta_t^k \ln(k_t) \quad (8)$$

where R_t is exogenous total factor productivity.

The parents and the child are both forward looking agents. Let the state vector at age t be denoted

$$\Gamma_t = (w_t^m, w_t^f, k_t)$$

then, the value function for the parents is

$$V_t^p(\Gamma_t) = \max_{a_t^p} u_t^p(l_t^m, l_t^f, c_t, style) + \beta^p E_t V_{t+1}(\Gamma_{t+1} | a_t^p) \quad (9)$$

where β^p is the parents' discount factor and $a_t^p = (\tau_t^m, \tau_t^f, h_t^m, h_t^f, ps_t, g_t)$ is their choice vector. The child's value function is given by

$$V_t^c(\Gamma_t) = \max_{\tau_t^k} u_t^c(l_t^c, ps_t) + \beta^c(k_t) E_t V(\Gamma_{t+1} | \tau_t^k) \quad (10)$$

where one can see that the child's discount factor is endogenous and a function of the current stock of a child's cognitive skills. Typically, it is the case that children discount the future more than their parents. This is the source of conflict between parents and children, and the driving force behind adoption of a more involved parenting style.

Finally, the terminal value that parents and children place on the child's cognitive skills are given by:

$$V_{T+1}^p(k_{T+1}) = \Xi \ln(k_{T+1}) \quad (11)$$

and

$$V_{T+1}^c(k_{T+1}) = \phi \Xi \ln(k_{T+1}) \quad (12)$$

with $\phi \in [0, 1]$.

3.2 Household Equilibrium

Computing the equilibrium is more involved than [Del Boca et al. \(2014\)](#) and [Bruno \(2025\)](#) because household decisions will depend on the current stock of child cognitive skills k_t . Suppose there are J_k possible points that cognitive skills can take, I must compute the optimal solution for all agents in the household at each of the J_k grid points in each period. First, given a continuous level of human capital returned by the production function, \tilde{k}_{t+1} , the probability of k_{t+1} being any of the points on the grid takes the following ordered logit framework:

$$k_{t+1} = k_j \iff q_{j-1} \leq \tilde{k}_{t+1} \leq q_j \quad (13)$$

where the q_j 's are the cut-off points. The probabilities are then given by

$$Pr(k_{t+1} = k_1 | \tilde{k}_{t+1}) = 1 - \frac{\exp(\tilde{k}_{t+1} - q_1)}{1 + \exp(\tilde{k}_{t+1} - q_1)} \quad (14)$$

$$Pr(k_{t+1} = k_j | \tilde{k}_{t+1}) = \frac{\exp(\tilde{k}_{t+1} - q_{j-1})}{1 + \exp(\tilde{k}_{t+1} - q_{j-1})} - \frac{\exp(\tilde{k}_{t+1} - q_j)}{1 + \exp(\tilde{k}_{t+1} - q_j)}, \quad j = \{2, \dots, J-1\} \quad (15)$$

$$Pr(k_{t+1} = k_J | \tilde{k}_{t+1}) = \frac{\exp(\tilde{k}_{t+1} - q_J)}{1 + \exp(\tilde{k}_{t+1} - q_J)} \quad (16)$$

The state vector is given by $\Gamma_t = (w_t^m, w_t^f, k_t)$, therefore, all that remains is to define the expectation process for parental wages. I follow [Brown et al. \(2023\)](#), and allow each parent j 's wage to take on one of J_W grid points, where W_1, \dots, W_{J_W} where, $W_1 < W_2 < \dots < W_{J_W}$.

Now, I assume that all agents in the household have full information concerning the stochastic laws of motion for all components of the state vector⁷ Starting with the last period, for any state of $\Gamma_T = (k_T, w_T^m, w_T^f)$, the child's reaction function is the solution to:

$$V_T^c(\Gamma_T) = \max_{\tau_T^c} \omega(p_{ST}) \ln(l_T^c) + \beta^c(k_T) E_T \phi \Xi \ln(k_{T+1}(\tau_T^c, a_T^p)) \quad (17)$$

which gives a unique solution for each of the $J_k J_W J_W$ grid points, and a corresponding value $V_T^c(\Gamma_T)$. Using this reaction function, the parents solve

$$V_T^p(\Gamma_T) = \max_{a_T^p} \alpha_l^m \ln(l_T^m) + \alpha_l^f \ln(l_T^f) + \alpha_c \ln(c_T) + \beta^p(k_T) E_T \phi \Xi \ln(k_{T+1}(\tau_T^c, a_T^p)) \quad (18)$$

which gives a unique solution vector $a_T^p(k_j)$ and value $V_T^p(k_j)$.

⁷While the assumption that children know and understand the wage process might be unlikely for young children, the problem should be mitigated if it is found that younger children (with lower test scores) discount the future heavily. This assumption also allows for model tractability.

Keeping these optimal solutions, and values in hand, we move back to period T-1, and this is where expectations become more complicated, as the members of the household must include the wage transition probabilities when calculating future values. Luckily, while wages evolve stochastically, they are not an endogenous process. Consider the child's problem and assume that their stock of human capital is k_j . They know the value of being in each of the $J_k J_W J_W$ states in period T, and, all distributions are independent. The ordered logit probabilities give the probability of being in each state j in period T for human capital, call this F_k . Further, the child observes the level of their parent wages, and can compute the probabilities of the wage in the next period, call these F_f and F_m . Then, the probability of being in a given state next period is just the product of the F's.

4 Solution and Simulation Method

1. Start at period T: loop over all J_k, J_W grid points and solve the household problem
2. Now, with the values of each of the terminal period states in hand, move back to period T-1. Again
3. Start at period T: loop over all J_k, J_W grid points and solve the household problem, now including taking expectation for the wage processes and obtain V_{T-1}^p, V_{T-1}^c for all possible states
4. Continue backwards until the initial period problem is solved
5. Now, we have the solution for all states and all time. To simulate, we draw from the initial distributions, getting k_1, w_1^f, w_1^m and we choose the corresponding solution
6. Given the solution, draw a new state (k_2, w_2^f, w_2^m) , use the solution obtained above, and draw another new state (k_3, w_3^f, w_3^m)
7. Continue until we have simulated all T periods

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