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# Parenting Practices and Children's Cognitive Effort: A Laboratory Study

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William Foley<sup>1</sup>  and Jonas Radl<sup>1,2</sup> 

## Abstract

We examine the association between parenting practices (discipline and support) and children's cognitive effort. Cognitive effort is hard to measure; hence, little is known about effort dispositions, and how parenting practices affect effort. We analyse data from 1,148 fifth-grade students from Berlin and Madrid (around 11 years of age). Cognitive effort is measured with tests of executive function, carried out under two reward schemes: an unincentivised and incentivised condition. We study two effort-related outcomes: "effort direction" – the child's decision to voluntarily do a real-effort task – and "effort intensity" – the child's performance on the task. In line with theoretical expectations, results indicate that both parental discipline and support are associated with effort direction when the moderating role of incentives is taken into account. However, only parental discipline is (weakly) associated with effort intensity. We conclude that parenting practices primarily influence deliberative rather than instinctual types of cognitive effort.

## Keywords

parenting, effort, incentives, cognition

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## Introduction

Cognitive effort, the mobilisation of cognitive resources to achieve a particular goal, is typically regarded as “aversive” (Kurzban et al., 2013; Westbrook & Braver, 2015) – i.e. something individuals wish to minimise. Neuroscientific work has revealed that individuals can be “trained” to exert more effort by being offered material incentives (Brown et al., 2022; Clay et al., 2022; Lin et al., 2022). Individuals who have been trained in this way subsequently display greater effort even in non-remunerated tasks. Thus, variations in effort may represent the internalised association between effort and reward. But little is known about what aspects of an individual’s social environment regulate the susceptibility of effort to rewards.

In this paper, we examine the effect of parenting practices on children’s cognitive effort. Extant research has demonstrated that parents exert a huge influence on the development of their children’s personality (Liu & Lachman, 2019; Smith & Skrbis, 2017). Personality traits such as conscientiousness are relatively stable dispositions which have behavioural manifestations (Matthews et al., 2009). The propensity to exert cognitive effort is also a relatively stable disposition with behavioural manifestations (Fleming et al., 2023; Kool & Botvinick, 2018). Thus, it is plausible that children’s effort is influenced by parental actions (Kochanska & Knaack, 2003).

Indeed, individual differences in effort disposition have been shown to partially reflect differences in upbringing, including responsiveness to intrinsic versus extrinsic rewards (Ginsburg & Bronstein, 1993). However, while previous research has reported significant associations between parenting and effort-related personality scales such as locus of control, conscientiousness or effortful control (Aguar et al., 2021; Conger et al., 2021; Taylor et al., 2013), there is a lack of studies using behavioural measures collected under laboratory conditions. While self-reported measures of effort yield valuable insights, behavioural measures have the advantage of avoiding reliability and validity problems associated with self-report (Mækela et al., 2023).

We focus on the role of parental discipline and parental support – arguably the most consequential dimensions of parenting practice (Baumrind, 1991; Liu & Lachman, 2019; Locke & Prinz, 2002) – on children’s effort under different incentive structures. We argue that discipline orients children towards external rewards and hence boosts extrinsic motivation, whereas support develops a child’s self-esteem and hence boosts intrinsic motivation.

In order to test our hypotheses, we analyse a large-scale study featuring almost 1,400 children from Germany and Spain. Novel to the parenting literature is the joint inclusion of (i) varying material incentives; and (ii) behavioural measures of cognitive effort. Cognitive effort – or non-automatic, task-directed cognitive activity – can be measured with tests of executive

function (Kool & Botvinick, 2014; Kurzban et al., 2013; Shenhav et al., 2017). We therefore measure cognitive effort with three different tests, each designed to measure a different subdomain of executive function: information processing and updating, regulation and control, and cognitive flexibility.

Conceptually, we distinguish between “effort direction” – i.e. voluntary participation in a task; and “effort intensity” – i.e. how much effort is invested in the task. The first type constitutes a more deliberative and reflective cognitive activity, the second constitutes a more moment-to-moment and instinctual activity. The study operationalises outcome measures for both types to see whether the theory can equally well account for the more deliberative and instinctual types of cognitive effort.

## Effort and Motivation

Broadly speaking, cognitive effort refers to non-automatic, task-directed cognitive activity. The more automated our thought processes when performing a task, the less effort we exert, and vice versa (Shenhav et al., 2017). Consider the act of learning a language. At first one must exert a lot of effort merely to find the right word. Once one has mastered it, one can speak automatically – i.e. without effort.

Neuroscientists and cognitive psychologists have identified cognitive effort with the brain functions known as “executive function” (Kool & Botvinick, 2014; Kurzban et al., 2013; Shenhav et al., 2017). These brain functions, located in the prefrontal cortex, are engaged when the subject is carrying out non-automatic tasks (Kool & Botvinick, 2014). While scientific understanding of cognitive effort is still evolving (Mækelaë et al., 2023), *behavioural* measures of cognitive effort tend to be identical or very similar to those used to study executive function (Kurzban et al., 2013, p. 675).

Executive function comprises different constituent functions (Anderson, 2002; Miyake et al., 2000), including: (i) information processing and updating; (ii) regulation and control; and (iii) cognitive flexibility and switching between different activities. It follows that the active use of such functions during non-automated thinking – i.e. effort – is costly because they are a limited resource. Effort is therefore theorised to feel “aversive” as the body’s way to signal that important functions are being engaged which could be elsewhere deployed (Kurzban et al., 2013; Shenhav et al., 2017).

Since engaging executive function is costly, the benefits of exerting effort must outweigh the costs (Inzlicht et al., 2018; Kurzban et al., 2013; Westbrook & Braver, 2015). The benefit of effort can be decomposed into extrinsic benefit – instrumental or material rewards such as money – and intrinsic benefit – the inherent value an individual derives from performing a task (Shenhav et al., 2017). It is reasonable to assume that individuals who are more extrinsically (intrinsically) motivated to perform a task will derive more

extrinsic (intrinsic) benefit from doing the task (Bonner & Sprinkle, 2002; Cameron & Pierce, 1994). Intuitively, one might assume that the effects of intrinsic and extrinsic motivation are independent of each other. But it has been repeatedly found that material incentives actually dampen the effect of intrinsic motivation and even *reduce* total effort (Bonner & Sprinkle, 2002; Cerasoli et al., 2014; Deci et al., 1999) – a phenomenon termed “crowding out.”

## Types of Effort

The decision to exert cognitive effort on a given task can be broken down into two distinct aspects: direction and intensity. Direction refers to whether to engage with a task or not; intensity refers to how much effort to invest in the task, given one is engaged with it. While terminologies differ, the direction/intensity distinction is recognised in the literature (Bonner & Sprinkle, 2002; Shenhav et al., 2017).

Effort direction is essentially concerned with preferences: whether the individual is willing to invest themselves in an activity which will place demands on their executive function. Cognitive science represents this as a deliberative process in which an individual “samples” values from the true utility value distribution of alternatives (Rangel & Hare, 2010). Effort direction therefore pertains *moreso* to deliberative and reflective cognitive activity – the weighing up of prospective costs against benefits.

Intensity, on the other hand, is concerned more with performance: how much an individual is disposed to exert themselves, moment-to-moment, in the engagement of their executive function (Bijleveld, 2018; Westbrook & Braver, 2015). Individuals who exert themselves more intensively must constantly overcome the “aversive” feeling of exerting effort (Kurzban et al., 2013; Shenhav et al., 2017). Effort intensity is hence more instinctual, or less reflective, process than effort direction.

The instinctualness and reflectiveness of effort types are best conceived of as poles on a spectrum. Effort intensity still involves some degree of reflectiveness – but less than effort direction, since intensity involves quasi-instantaneous activity. Exerting effort intensively can be compared to the “decision” to keep holding a large weight – often one will involuntarily “let” the weight slip due to a momentary lapse in perseverance. Effort intensity feels aversive because it is costly, and feels less aversive when benefits increase (Kool & Botvinick, 2018; Kurzban et al., 2013). Hence, the greater the cost, or the lower the benefit, the more likely an individual exerting effort intensively will “slip” and find themselves inadvertently distracted from exerting effort.

## Parenting Styles and Motivation

Research on parenting styles has long distinguished *discipline* and *support* as two of the key dimensions of how parents mould childhood behaviour (Locke & Prinz, 2002). The terminology used to describe can vary, and synonymous terms include, but are not limited to, “demandingness” and “responsiveness” (Baumrind, 1991), “discipline” and “affection” (Liu & Lachman, 2019), “discipline” and “nurturance” (Locke & Prinz, 2002), “warmth” and “control” (Maccoby & Martin, 1983).

Generally speaking, both parental support and discipline tend to have positive effects on child achievement (López Turley et al., 2010; Vasquez et al., 2016) and on advantageous personality traits (Aguiar et al., 2021; Conger et al., 2021). According to a meta-analysis by Valcan et al. (2018), parenting behaviours such as warmth and performance-contingent instruction are positively associated with executive function, while behaviours such as harshness or neglect have a negative effect. However, the authors do find substantial heterogeneity of effects across studies.

It has been argued that the empirical underpinning of the two dimensions is limited to more individualist social contexts – e.g. such as the US, where Baumrind’s empirical work is concentrated (Baumrind, 1991) – and does not hold in countries with more collectivistic cultures (Jabaghourian et al., 2014; Sorkhabi, 2005). In our present study, we examine data from Spain and Germany, countries typically placed in the category of individualistic Western cultures (Fernández et al., 2005). Hence, worries about generalisability should be limited.

Parents who emphasise discipline tend to adopt a directive style of communication, and to appraise the *output* of a child’s behaviour according to fixed and external standards (Baumrind, 1991; Lamborn et al., 1991; Lareau, 2011; Pinquart, 2016). As in principal-agent models of economic behaviour (Frey & Jegen, 2001), the parent (principal) adjusts the cost of deviance and the benefit of compliance in order to regulate the child’s behaviour. Discipline therefore enhances responsiveness to extrinsic motivation by orienting children towards instrumental and external incentives (Baumrind, 1991; Lamborn et al., 1991; Ryan & Deci, 2020). Overall then, parental discipline should be associated with greater effort among children, as associating effort with extrinsic incentives boosts the general disposition to exert effort (Brown et al., 2022; Clay et al., 2022; Lin et al., 2022).

**Hypothesis 1a.** Higher parental discipline is associated with greater effort *direction*.

**Hypothesis 1b.** Higher parental discipline is associated with greater effort *intensity*.

And since parental discipline works by attuning children to extrinsic incentives:

**Hypothesis 2a.** The association between parental discipline and effort *direction* is greatest when there are material incentives to perform well.

**Hypothesis 2b.** The association between parental discipline and effort *intensity* is greatest when there are material incentives to perform well.

Parents who emphasise a supportive approach to childhood development tend to adopt a relational style of communication, aiming to elicit the child's feelings and thoughts to encourage their autonomous development (Baumrind, 1971; Lareau, 2011). Emphasis is placed on the *input* to the child's decisions. Parents who adopt a supportive approach aim to build the child's self-esteem by encouraging them to identify and autonomously develop their talents and interests (Duineveld et al., 2017; Kocayörük et al., 2015; Turner et al., 2009). Greater self-esteem is associated with greater self-efficacy and greater performance (Lamborn et al., 1991; Ryan & Deci, 2020). Hence:

**Hypothesis 3a.** High parental support is associated with greater effort *direction*.

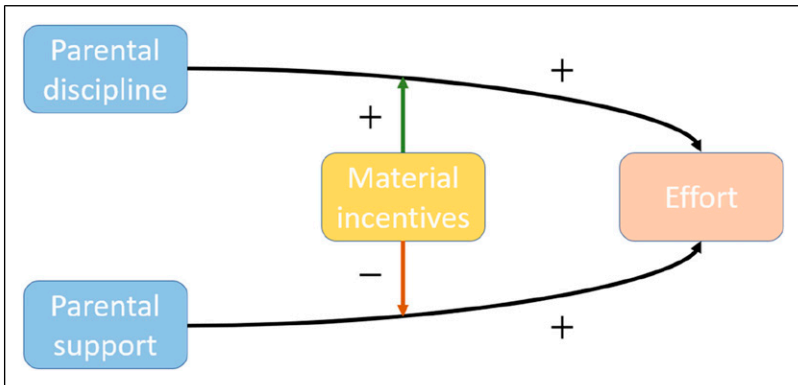
**Hypothesis 3b.** High parental support is associated with greater effort *intensity*.

Parental support boosts self-esteem and autonomy (Duineveld et al., 2017; Ryan & Solky, 1996), which are associated with greater intrinsic motivation (Ryan & Deci, 2020; Turner et al., 2009). However, intrinsic motivation is typically "crowded out" by external rewards (Bénabou & Tirole, 2006; Deci, 1975; Frey & Jegen, 2001). Hence:

**Hypothesis 4a.** The association between parental support and effort *direction* is greatest when there are no material incentives to perform well.

**Hypothesis 4b.** The association between parental support and effort *intensity* is greatest when there are no material incentives to perform well.

The conceptual relationships between parental support, discipline, material incentives and children's effort are graphed in Figure 1. While we have discussed support and discipline as distinct dimensions, the influential work of Baumrind has theorised that discipline and support positively interact (Baumrind, 1991). Empirical work has supported this supposition for mental health and certain non-cognitive skills (Padilla-Walker et al., 2013; Spera, 2006). But it has not been firmly established whether Baumrind's framework translates from its original context - childhood and adolescent emotional development - to more performance-related contexts (Nyarko, 2011; Pinquart, 2016), such as cognitive effort domains.



**Figure 1.** Conceptual model of parenting practices, incentives, and effort.

## Methods

### Participants

We analyse data from a novel experiment featuring the participation of 1,368 fifth-grade students from schools in Madrid and Berlin, carried out between 2019 and 2022. The mean age in the full sample was 10 years and eight months, with a standard deviation of seven months. The majority were ten years of age (72% overall), and most of the remainder were eleven (20% overall). In principle, every child in each participating school class took part in the experiments.

The dataset has several advantages. First, it has a much larger sample size than most laboratory experiments. Second, the schools were randomly selected from a sample that was stratified by neighbourhood income quartile and type of school (public versus private), such that the sample approximates the general population of fifth graders in the two cities. Third, the data implement multiple types of real-effort task to ameliorate bias due to specific abilities as in single-task studies. Fourth, the data allow for measurement of both effort direction and intensity, which is rare in most datasets. And fifth, the children did the task under both an unincentivised and an incentivised condition, a combination rarely if ever achieved using large samples.

### Procedure

The participants completed three different types of real-effort task. Each of the three tasks tests a subdomain of executive function. The slider task (Gill & Prowse, 2019) primarily covers the information processing and updating subdomain. In this task, participants are presented with 48 horizontal lines.



There is a dial on each line and the participant must adjust the dial so it is exactly at the midpoint. The Simon task (Cespón et al., 2016) tests the regulation and control subdomain. Participants had to tap a certain button on the keyboard when a left-pointing arrow appeared on screen and a different button when a right-pointing arrow appeared on screen. The arrows could appear left, centre, or right. The “AX-Continuous Performance Task” (Hefer & Dreisbach, 2016) tested cognitive flexibility. In this task, participants had to press a certain combination of buttons in response to a string of numbers.

The order of the task varied across experimental sessions. Sometimes the slider task was first, sometimes the Simon task, sometimes the AX task. The second and third task varied accordingly, so task order is roughly balanced across the sample.

The experiment was a within-subjects design. Subjects received basic instructions at the start of the experiment. They then did a practice round of the first task, followed by a practice round of two games: a jigsaw puzzle and a ball-bouncing game. Then, the participant did two rounds of the first task under the unincentivised condition. In the unincentivised condition, there was quite simply no material incentive for exerting effort. They then did another two rounds of the first task, but this time under the incentivised condition, where they were rewarded with toys in proportion to their performance. Then came the second task, with two rounds under the unincentivised condition and two rounds under the incentivised condition. Finally they did the third task, with two rounds under the incentivised condition. There were two further rounds under a “tournament” condition, which we omit from the analysis.

In each round participants had the choice to do either the puzzle game or ball game instead. The children decided to do the task in the vast majority (> 98%) of rounds in the material incentive and tournament conditions. Non-tasking was largely confined to the unincentivised condition, where it was the preferred option on circa 54% of rounds. Following the real effort tasks, the students completed a survey and an abbreviated test of fluid intelligence. The procedure is summarised in Table 1.

## Instruments

The design of the experiment allows us to measure both effort direction and intensity as conceptualized above. Effort direction is operationalised as a dichotomous variable which takes a value of 1 if the participant did the task and 0 if they did the game. Effort intensity is operationalised as the number of correct answers, standardised *within-task*. The unit of analysis (i.e. observation) is the student-round, meaning there are multiple observations nested within participants. The real effort tasks are already described in the procedure section above.

**Table 1.** Procedure of an Experimental Session.

Incentive condition	Activity	Duration
n/a	General instructions	5 min approx.
n/a	Practice round for task 1	2 min approx.
n/a	Practice round for game	2 min approx.
Unincentivised	Task 1 or game	2 min
Unincentivised	Task 1 or game	2 min
Incentivised	Task 1 or game	2 min
Incentivised	Task 1 or game	2 min
n/a	Practice round for task 2	2 min approx.
Incentivised	Task 2 or game	2 min
Incentivised	Task 2 or game	2 min
n/a	Practice round for task 3	2 min approx.
Incentivised	Task 3 or game	2 min
Incentivised	Task 3 or game	2 min
Tournament	Task 3 or game	2 min
Tournament	Task 3 or game	2 min
n/a	Break	1 hr approx.
n/a	Survey and IQ test	1 hr approx.

*Note:* The order of the three tasks varied by experimental session. In Berlin there were additional short breaks to accommodate school schedules. Data from the tournament condition is omitted from analysis in the present study.

Our main independent variables are parental discipline and support. In the case of discipline, the children were asked to rank their mother and father on four levels from “*Not strict*” to “*Very strict*”. In the case of support, the children were asked to rank their parent on four levels, ranging from “*She/he doesn’t support me much*” to “*She/he supports me a lot*”. For each question, participants also had the option to answer “*don’t know*” or to refuse to answer – both of which were coded as missing. This format was adapted from survey items in the National Longitudinal Study of Youth which have been used in previous research (Abar et al., 2017; Bolkan et al., 2010).

The data on both parents was combined into a single variable for both discipline and support, taking the average value across both parents. Where data was missing on one parent, just the value from the non-missing parent was used. We also mean-centred these variables to aid interpretation. As discussed in the theory section, Baumrind’s influential work emphasizes the interaction between discipline and support. However, in [Appendix A1](#) we show that there is no statistically significant interaction between parental support and discipline in our data. [Appendix A3](#) provides pairwise correlations between support, discipline, and some behavioural correlates.

In the statistical analysis, we adjust for a number of covariates. We adjust for parental tertiary education, assigning a value of 0 if neither parent attended university and 1 if at least one parent attended. We adjust for gender (0 = female, 1 = male), and age in months. Importantly, we adjust for cognitive ability, using an adapted version of the Raven matrices measure of fluid intelligence (Baumeister et al., 1998), which we standardise. Since the tasks were done on a computer, we control for mouse use (a four-point scale from “never or almost never” using a mouse to using a mouse “every day or almost every day”) and frequency of video game play (a four-point scale from “0–30 minutes” daily to “2+ hours”). We control for number of older and younger siblings, since family size and birth order can affect parenting style (Someya et al., 2000). We adjust for whether the participant liked the task they were doing in the round, and whether they liked the puzzle and ball games; in all cases liking is measured on a five-point Likert scale from “Strongly disagree” to “Strongly agree”. We adjusted for which task they were doing in the round (a categorical variable with the slider task as reference category). Finally, since verbal comprehension of instructions likely affected task performance, we adjusted for whether they spoke the national language at home or not (=1 if they spoke Spanish (in Madrid) or German (in Berlin) at home, and = 0 if they didn’t). We also include a city dummy (0 = Madrid, 1 = Berlin) to account for any further differences in setting.

All covariates either were substantively correlated with effort and hence included to improve precision (e.g. parental tertiary education), and/or were potential confounders with our independent variables of interest (e.g. siblings), and/or related to aspects of the experimental design (e.g. the city, the task they were doing).

We are wary about adjusting for covariates such as personality characteristics, though traits such as need for cognition are generally considered predictors of cognitive effort (Apascaritei et al., 2021; Westbrook & Braver, 2015). Parents exert a huge influence on a child’s psychological composition. Hence, adjusting for psychological traits could lead to overcontrol bias (Grätz, 2022), which we wished to avoid. In practice, these psychological variables do not seem to mediate the association between parenting practices and effort (see Appendix A1).

Finally, we do not have any solid theoretical or empirical rationale to suppose that the covariates we do include in the regression should induce “collider” or endogenous selection bias (Elwert & Winship, 2014). Nonetheless, it is not possible to conclusively establish that the independent variables of interest are exogenous conditional on observed variables. In the Results section we implement a formal test to assess robustness to omitted variable bias.

Table 2 gives the descriptive statistics for each variable in the statistical analysis with a meaningful numeric interpretation. Descriptive statistics for a

**Table 2.** Descriptive Statistics.

Variable	Valid obs.	Mean	Std. Dev.	Min	Max
Task chosen instead of game?	13433	0.88	0.33	0	1
Correct, standardised by task	11365	0	1	−4.29	2.65
Parental discipline - mean centred	11810	0.03	0.77	−0.9	2.1
Parental support - mean centred	12320	0.03	0.58	−2.6	.4
Parental tertiary education (0/1)	11600	0.53	0.5	0	1
Male	13170	0.48	0.5	0	1
Age in months	13330	127.86	6.91	99	201
Fluid intelligence, standardised	13190	0	1	−5.15	3.56
Mouse use	13380	1.2	1.15	0	3
Daily computer use - videogames	13350	2.11	1.2	0	4
Number of older siblings	13290	0.88	1.26	0	24
Number of younger siblings	13280	0.71	0.86	0	8
Child liked the task	11964	4.27	0.93	1	5
I liked the game Ball-E	13390	3.43	1.33	1	5
I liked the puzzle	13390	3.53	1.25	1	5
Speak Spanish/German at home	13390	0.96	0.19	0	1
Berlin	13680	0.41	0.49	0	1

Note. Valid obs. refers to the non-missing observations for that variable. The theoretical maximum N = 13,680, representing 1,368 students doing 10 rounds.

given variable pertain to all non-missing values for that variable in the dataset, including the tournament rounds that are excluded from the analytic sample.

*Statistical Analysis*

Each participant did up to eight rounds of real effort tasks (plus two tournament rounds, excluded here), meaning that within-participant observations are not independent. Participants are also nested in classrooms, meaning that there is within-classroom dependence. To account for the nested structure, we run analyses using multilevel models of the general form:

$$y_{ijk} = \beta_0 + \beta_1 Discipline_{jk} + \beta_2 Support_{jk} + \beta_1 Extrinsic_{ijk} + XB + \gamma_k + \mu_j + \epsilon_{ijk} \# \tag{1}$$

Where *i* indexes the observation, *j* indexes the participant, and *k* indexes the classroom. The dependent variable, *y<sub>ij</sub>*, is the measure of effort (dichotomous or continuous, depending on the model). *Discipline* is the parental discipline variable, and *Support* is the parental support variable. *Extrinsic* is a dummy variable, taking a value of 1 if the observation belongs to the incentivised condition. *XB* is a vector of covariates and their coefficients, *γ<sub>k</sub>* is a random

intercept at the class level,  $\mu_j$  is a random intercept fitted to each participant, and  $\varepsilon_{ij}$  is the idiosyncratic error term. Equation (1) is modified slightly depending on the precise analysis, for example by interacting *Extrinsic* with the parenting dimensions.

Results

Effort Direction

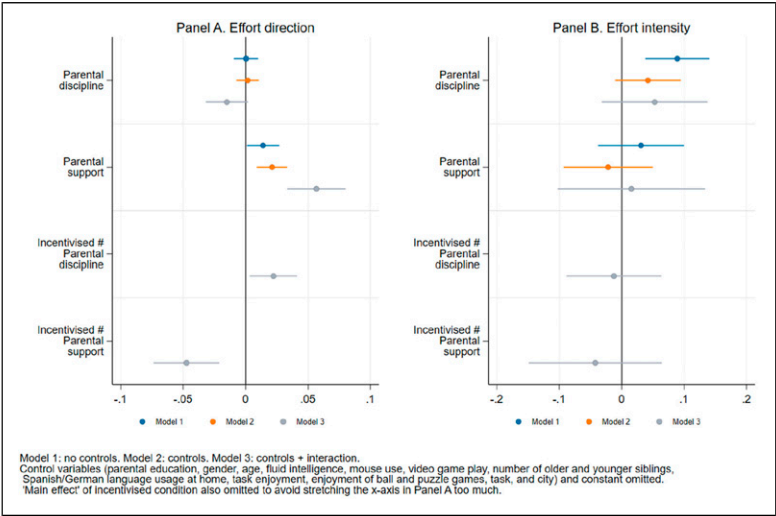
We begin our analysis with the effect of parenting practices on effort direction – i.e. the decision about whether or not to do the task. Three different specifications based on the general model (equation (1) above) were estimated. In each case the dependent variable,  $y_{ijk}$ , was the decision in round  $i$  of child  $j$  in school  $k$  to do the task or not. The key parameter estimates from the model are given in Table 3, and in Panel A of Figure 2. The marginal effects for the interaction are graphed in Figure 3. The full parameter estimates, along with alternative models including additional control vectors, are given in Appendix A1.

Model 1 regresses effort direction on parental support and discipline without including any “control” variables. Model 2 includes the vector of

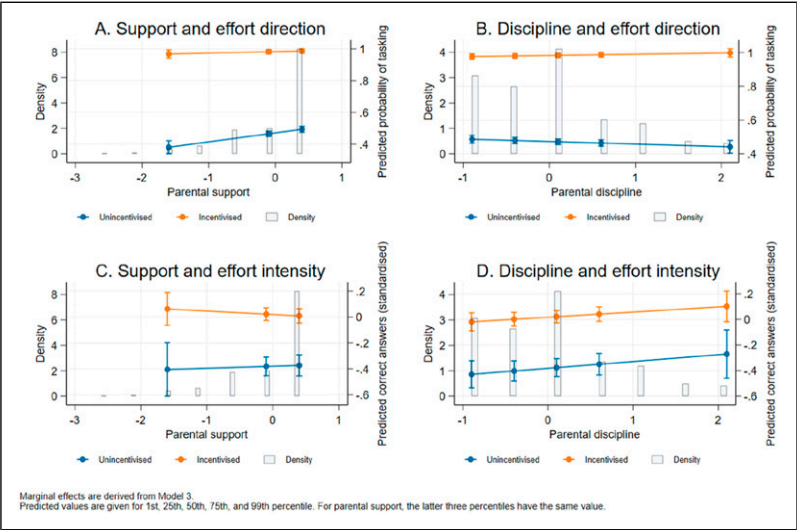
Table 3. Regression of Effort Direction (Decision to Task).

	Model 1	Model 2	Model 3
Parental discipline	0.000 (0.005)	0.002 (0.005)	−0.015 (0.009)
Parental support	0.014* (0.007)	0.021*** (0.006)	0.057*** (0.012)
Incentivised (ref. cat = Unincentivised)		0.511*** (0.008)	0.510*** (0.008)
Incentivised * Parental discipline			0.022* (0.010)
Incentivised * Parental support			−0.047*** (0.013)
Constant	0.849*** (0.006)	0.358*** (0.080)	0.360*** (0.080)
Controls	No	Yes	Yes
Class-level std dev	0.034*** (0.005)	0.036*** (0.005)	0.036*** (0.005)
Participant-level std dev	0.000*** (0.000)	0.020*** (0.013)	0.021*** (0.012)
Observation-level std dev	0.356*** (0.003)	0.269*** (0.003)	0.268*** (0.002)
N	9166	6588	6588

Note. Standard errors in parentheses. \*  $p < .5$  \*\*  $p < .01$  \*\*\*  $p < .001$ .



**Figure 2.** Plot of estimated coefficients for the regression of effort on parenting practices.



**Figure 3.** Marginal effects of parenting practices on decision to task and on correct answers.

control variables. Across both models, the coefficient on parental discipline is statistically insignificant and close to zero (no support for Hypothesis 1a). On the other hand, the estimate for parental support is positive and statistically significant, and of roughly comparable magnitude across both models (support for Hypothesis 3a).

Model 3 interacts the parenting dimensions with the incentive condition (a dummy which takes a value of 1 if the round in the observation belonged to the incentivised condition). The interactions can be most easily interpreted by examining the Panels A and B of [Figure 3](#). The model reveals a *positive* and statistically significant interaction between parental discipline and material incentives, providing support for Hypothesis 2a. A one-point increase in discipline (on a four-point scale), increases the probability of tasking by about 2% when there are material incentives. This effect roughly cancels out the negative association between discipline and effort direction observed in the unincentivised condition.

Contrariwise, in Model 3 we see that parenting support has a *negative* interaction with incentives, providing support for Hypothesis 4a. A one-point increase in parental support (on a four-point scale), increases the probability of tasking by about 5% *when there are no material incentives*. But, as can be seen in Panel A of [Figure 3](#), the relationship between support and effort direction is almost flat in the incentivised condition.

[Appendix A2](#) gives the results by city for a variety of models. The estimates are largely consistent within the city subsamples, albeit not always significant in Berlin (where the sample is smallest).

### Effort Intensity

We now turn to the effect of parenting practices on effort intensity - the number of correct answers per round, standardised within-task. Rounds where the child did not do the task are excluded. As with the analysis of direction, three different models are estimated, using as the dependent variable  $y_{ijk}$  the number of correct answers (standardised within-task) in round  $i$ , for participant  $j$  in class  $k$ . The key coefficients are given in [Table 4](#), and in Panel B of [Figure 2](#). The full model estimates are given, alongside additional models, in [Appendix A1](#).

Model 1 – the model without any control variables – shows a generally positive association between discipline and effort intensity, and a null association for support. However, the introduction of controls in Model 2 reduces discipline to statistical insignificance. Hence we have only suggestive evidence, at best, to support Hypothesis 1b. There is no support for Hypothesis 3b.

Model 3 interacts parenting with incentives and here we see, as illustrated in Panel D of [Figure 3](#), no evidence of an interaction between incentives and

**Table 4.** Regression of Effort Intensity (Correct Answer, Standardised).

	Model 1	Model 2	Model 3
Parental discipline	0.099*** (0.028)	0.045 (0.027)	0.053 (0.043)
Parental support	0.042 (0.037)	−0.021 (0.036)	0.013 (0.060)
Incentivised		0.392*** (0.030)	0.394*** (0.030)
(ref. cat = Unincentivised)			
Incentivised * Parental discipline			−0.009 (0.039)
Incentivised * Parental support			−0.039 (0.055)
Constant	−0.070 (0.037)	−2.307*** (0.466)	−2.311*** (0.466)
Controls	No	Yes	Yes
Class-level std dev	0.226*** (0.031)	0.085*** (0.035)	0.085*** (0.035)
Participant-level std dev	0.577*** (0.017)	0.502*** (0.017)	0.502*** (0.017)
Observation-level std dev	0.753*** (0.007)	0.731*** (0.008)	0.731*** (0.008)
N	6670	5463	5463

Note. Standard errors in parentheses. \*  $p < .05$  \*\*  $p < .01$  \*\*\*  $p < .001$ .

parental discipline (no support for Hypothesis 2b). The interaction between support and incentives is likewise insignificant (no support for Hypothesis 4b).

The results by city are given in [Appendix A2](#). The association between discipline (non-interacted) and effort only holds up for the (larger) Madrid subsample.

**Robustness of Results**

Despite conditioning on a vector of controls, the estimates are still vulnerable to omitted variable bias. To address this, we implement Oster’s method for assessing robustness of coefficient estimates to omitted variable bias ([Oster, 2019](#)).

The basic idea revolves around two quantities,  $\delta$  and  $R_{max}$ .  $\delta$  represents how much the omitted variables are correlated with the independent variable of interest, relative to observed confounders.  $R_{max}$  represents the r-squared if the unobserved variables were included. The analysis proceeds by seeing how much our estimate of the “true” coefficient,  $\beta^*$ , changes as  $\delta$  and  $R_{max}$  increase towards a theoretically plausible upper bound. [Oster \(2019\)](#) suggests 1 is an



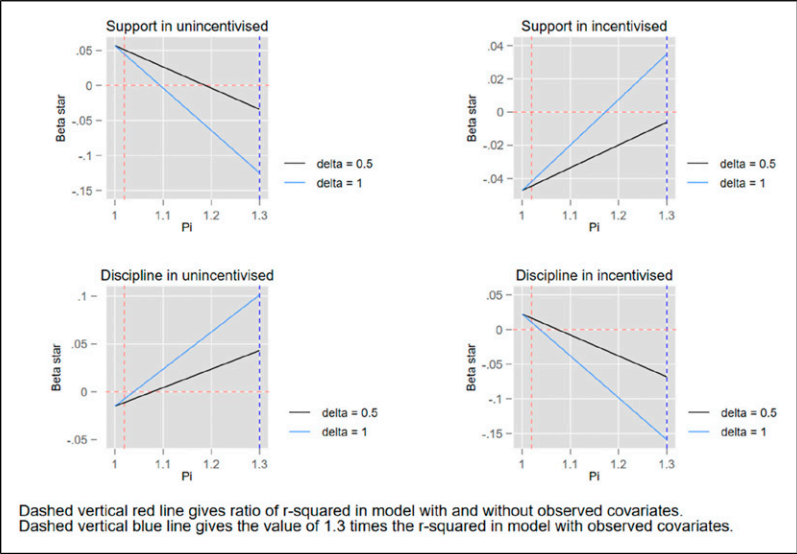
upper bound for  $\delta$ . Meanwhile, let  $R_{max} = \Pi \tilde{R}$ , where  $\tilde{R}$  is the r-squared in the regression with all controls included. Oster suggests a bounding value of  $\Pi = 1.3$ . We also consider the less conservative bound of  $\Pi = \tilde{R}/\dot{R}$ , where  $\dot{R}$  is the r-squared from the uncontrolled regression. The formula for  $\beta^*$ , the theoretical unbiased coefficient, as a function of  $\delta$  and  $R_{max}$  is:

$$\beta^* \approx \tilde{\beta} - \delta[\dot{\beta} - \tilde{\beta}] \frac{R_{max} - \tilde{R}}{\tilde{R} - \dot{R}}$$

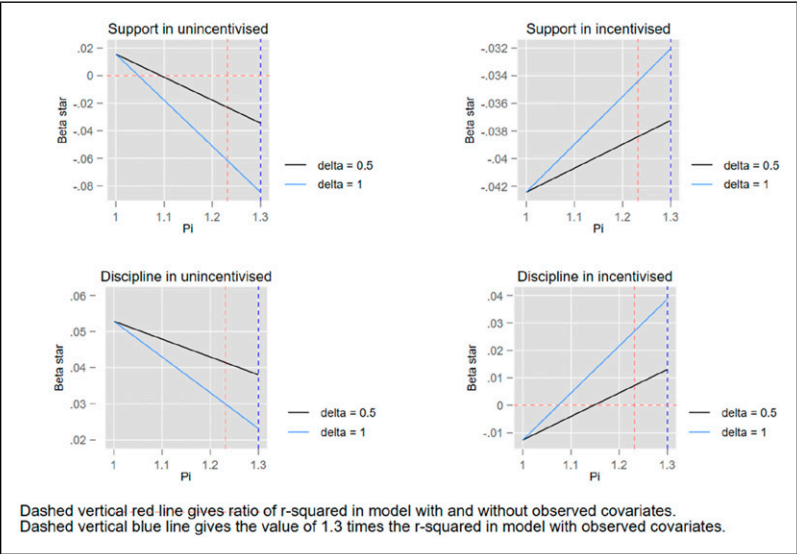
Here the tilde superscript indicates a parameter from the adjusted regression (with controls) and the dot superscript represents a parameter from the unadjusted regression. Logically, the greater is  $\dot{\beta} - \tilde{\beta}$ , the difference between the adjusted and unadjusted coefficients, the quicker  $\beta^*$  reaches zero as a function of  $\delta$  and  $R_{max}$ .

We use this formula to study the robustness of the estimates from Model 3 in effort direction and intensity. We are interested in four coefficients per effort type: the “main effects” of support and discipline (i.e. the estimated partial correlations in the unincentivised condition, when the incentive dummy is zero), and the interaction terms between support/discipline and incentives. In some cases, the coefficient in the adjusted model,  $\tilde{\beta}$ , is greater than the unadjusted model,  $\dot{\beta}$ . Hence, we conservatively assume that further adjustments shrink  $\beta^*$ , and we replace  $\dot{\beta} - \tilde{\beta}$  with its absolute value. In [Appendix A4](#) we describe the logic of the method, and the details of its implementation, in greater detail.

[Figures 4](#) and [5](#) graph the relationship between  $\beta^*$  and  $\Pi$  for effort direction and intensity respectively, for two values of  $\delta$ ,  $\delta = 0.5$  (black line) and  $\delta = 1$  (blue line). The vertical dashed blue line marks the value  $\Pi = 1.3$ . The dashed vertical red line gives the value  $\Pi = \tilde{R}/\dot{R}$ . We do not have space here to discuss each parameter (that is done in greater detail in [Appendix A4](#)). But generally speaking, the analysis indicates that the statistically significant results presented above are fairly robust to omitted variable bias. For example, the coefficient on the interaction between parental support and incentives in effort direction (top right graph in [Figure 4](#)) does not reach zero by the upper



**Figure 4.** Coefficient Stability for effort direction.



**Figure 5.** Coefficient Stability for effort intensity.

bound of  $\Pi = 1.3$  for the case where  $\delta = 0.5$ . Where  $\delta = 1$ , the parameter reaches zero before  $\Pi = 1.3$ , but well after  $\Pi = \bar{R}/\bar{R}$ . And this is conservatively assuming that further adjustments shrink  $\beta^*$ , when in fact the adjusted parameter  $\tilde{\beta}$  is greater in magnitude than unadjusted parameter  $\hat{\beta}$ , for this interaction.

## Discussion and Conclusions

In this paper we examined the association of parental discipline and support with cognitive effort in a balanced sample of fifth graders in Spain and Germany. Drawing on neuroscientific and cognitive psychological accounts we distinguished between two types of effort – direction and intensity. The former, we argued, concerns more reflective or deliberative cognitive processes, and the latter more reactive and instinctual ones. Following the literature on parenting styles and motivation we argued that parental discipline should be associated with greater effort direction (Hypothesis 1a) and intensity (Hypothesis 1b), especially when material incentives were *present* (Hypotheses 2a and 2b). We theorised that parental support should also be associated with greater effort direction (Hypothesis 3a) and intensity (Hypothesis 3b), especially when material incentives were *absent* (Hypotheses 4a and 4b).

Results showed support for Hypotheses 2a, 3a, and 4a in the case of effort direction. But for effort intensity, we found only Hypothesis 1b was (weakly) supported. Substantively, we conclude that our theoretical account best fits the case of effort direction. Parenting seems to influence the deliberative process involved in weighing the cost and benefits of exerting effort. In line with theory, parenting discipline is associated with children giving more weight to material incentives in their deliberation, whereas parenting support is associated with children showing more intrinsic motivation.

However, our theoretical model is not consistent with the results on effort intensity. The failure to accord with these findings suggests that a theoretical refinement is required. We propose that parenting practices have greater impact on deliberative or reflective reasoning – such as is involved in effort direction – than the more instinctual cognitive processes involved in effort intensity. This nuance may have gone hitherto unnoticed since studies which look at parenting and effort-related traits usually rely on self-reported outcomes. See, for example, studies which investigate locus of control (Aguiar et al., 2021; Rodriguez, 2003), conscientiousness (Basirion et al., 2014; Conger et al., 2021), and self-efficacy (Theresya et al., 2018; Turner et al., 2009). Self-reports by nature involve deliberative cognitive processes – they invite the respondent to reflect on their own preferences or traits. Such deliberative self-accounts cannot readily capture processes of cognitive fatigue

or biases that arise in moment-to-moment situations testing the limits of individual willpower. It follows that theories based on self-reported evidence will tend to have greater validity for a deliberative cognitive process such as effort direction than an instinctual cognitive process such as effort intensity, suggesting the need for further theoretical development and refinement.

One of the major limitations of this study is that our dependent variables are not exogeneous – hence we cannot provide (strong) causal interpretations of our observed associations. Our application of Oster’s method (2019) shows the main findings are likely robust to omitted variable bias.

But this does not rule out the problem of reverse causality. Indeed, it has been established that behavioural traits of children also influence parenting practices (Patterson & Fisher, 2002), though the effects tend to be somewhat weak (Eisenberg et al., 2005; Meunier et al., 2011; Moilanen et al., 2015). The ideal method for identifying causality would be to experimentally vary parenting practices. And there is indeed a literature which randomly assigns parental *training*, though such training tends to encompass a “package” of measures including both disciplinary and supportive approaches (Dishion et al., 2002; Martinez & Forgatch, 2001). Anyway, such studies remain limited to intent-to-treat estimates, and the outcome variables are typically mental or behavioural dysfunctions, making the findings hard to compare to the present study.

Another approach is the “sibling study” which allow the researcher to control for unobserved family-level heterogeneities, yielding a more plausible causal interpretation than standard observational approaches (albeit without variation in incentive structure). This literature has shown that parents consequentially influence traits such as conscientiousness, perseverance and focus, and locus of control (Anger & Schnitzlein, 2017; Grönqvist et al., 2017; Mazumder, 2008). Though none of these outcomes are exactly cognitive effort, they are close cousins. Hence, the evidence from sibling designs lends theoretical plausibility to the parenting-effort correlations that are reported in the present study.

Another limitation to our study is that parenting practices were reported by children. Nevertheless, while children’s self-reports may be restricted in accuracy, children of five and older tend to be almost as reliable as adults on self-reporting big 5 traits (Measelle et al., 2005) and quality of life (C.-Y. Lin et al., 2013). Regrettably, we do not have parental self-reports to cross-check reliability. However, parents’ self-reports on their own parenting – while less limited by cognitive immaturity – are naturally also subject to social desirability (Morsbach & Prinz, 2006).

A final limitation is that the length of the experimental sessions, which comprised real effort tasks as well as a substantial survey component, may have fatigued the children – leading, for example, to inaccurate survey answers. This was a problem we foresaw, and several breaks were built into the

session programming. Although one might argue that overcoming fatigue is an essential element of effort dispositions, we acknowledge that fatigue may have contributed to measurement error – which would bias downwards coefficients.

In sum, this study shows that parenting practices are associated with children's preferences for effort exertion. Accordingly, supportive parenting boosts children's intrinsic motivation to exert effort, whereas disciplinary parenting boosts children's extrinsic motivation. However, these motivations do not seem to convert into substantive differences in exerted effort, a more instinctual cognitive process, which parents seem to have less influence over. Overall this suggests – at least for the particular area of cognitive effort – that children's reflective cognitive processes are more susceptible to parental influence than their unreflective cognitive processes.

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### **Supplemental Material**

Supplemental material for this article is available online.

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