Are Children's Socio-Emotional Skills Shaped by Parental Health Shocks?

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August 3, 2022

Abstract

Child skills are shaped by parental investments. Health shocks to parents can affect these investments and their children's skills. This paper estimates causal effects of severe parental health shocks on child socio-emotional skills. Drawing on a large-scale survey linked to hospital records, we find that socio-emotional skills of 11-16 year-olds are robust to these shocks, except for small reductions in Conscientiousness. We estimate short-run effects with child-fixed effects and dynamics around shocks with event studies. In the long-run, we find some evidence of build-up of effects that may be rationalized with shocks having a delayed impact on children's skills.

JEL Classification: J24, I10, I21.

Keywords: Big Five personality traits, development of personality traits, parental health shocks, socio-emotional skills, non-cognitive skills, skill formation

Acknowledgements: We are very grateful for discussions with and comments from Aline Bütikofer, Gordon Dahl, Titus Galama, Mette Gørtz, Torben Heien Nielsen, Jon Skinner, Stefanie Schurer, Eddy van Doorslaer, and all participants at the Novo Workshop on "Behavioral responses to health innovations and the consequences for socioeconomic outcomes" at the University of Copenhagen and at the Venice Summer Institute on "Emergence and dynamics of personality and attitudes over the life cycle". Part of this research was carried out at the Institute for Fiscal Studies (IFS); its hospitality is gratefully acknowledged. We also appreciate generous funding from the Novo Nordisk Foundation (grant no. NNF17OC0026542) and from the Danish National Research Foundation through its grant (DNRF-134) to the Center for Economic Behavior and Inequality (CEBI) at the University of Copenhagen. The views expressed in this paper are those of the authors and do not necessarily represent the views of the Bank of Spain or the Eurosystem. García-Miralles: esteban.garcia.miralles@bde.es; Gensowski: mig@rff.dk.

I. Introduction

Socio-emotional skills, often measured with personality traits, are important determinants of life outcomes (Almlund et al., 2011, Bleidorn et al., 2019). They are essential building blocks to a healthy, wealthy, and happy life (Lindqvist and Vestman, 2011, Heckman et al., 2013, Roberts et al., 2014), predicting educational attainment, health, earnings, and employment at rates similar to cognitive skills (Roberts et al., 2007). Even early childhood personality traits predict major life outcomes (Moffitt et al., 2011).

The formation of skills starts early in life, and canonical models of skill formation place parents at the center as the main investors in their children (Becker and Tomes, 1986, Cunha and Heckman, 2007). Yet despite the importance of socio-emotional skills, there exists only little causal evidence as to how they are exactly shaped by parents during childhood. A few papers provide estimates for how children's socio-emotional skills are influenced by rather permanent characteristics such as parental education (McGue et al., 2017, Lundborg et al., 2018, Ludeke et al., 2021), family structure (Golsteyn and Magnée, 2017, 2020), or birth order (Black et al., 2018, at age 18).

Our approach is to study how child socio-emotional skills are affected by one type of time-varying parental characteristic, namely parental health and parental death. There is important evidence presented in Akee et al. (2018), who show that an unconditional income transfer shapes child personality traits and behaviors in adolescence. We study parental health shocks and deaths that generate potentially larger variation in inputs. Because different types of health shocks affect parental income and time differently, we can furthermore examine how the effects on child socio-emotional skills vary with the type of shock to better understand the production of child human capital. Parental health shocks are also interesting in their own right because they are relatively common during childhood. Understanding how they impact children's socio-emotional skills can inform whether specific policy interventions are needed.

In this paper, we estimate the causal effect of parental health shocks and parental death on the formation of children's socio-emotional skills. We construct a unique panel dataset that combines detailed hospital records for the entire Danish population with a large-scale survey of all children in public schools during the period 2015–2018. We define parental health shocks as diagnoses for cardiovascular episodes, cancer, or mental health, and we observe the exact date of parental death. The survey contains repeated information on validated measures of Conscientiousness, Agreeableness, Emotional Stability, and Academic Self-Concept for 11-16 year-old children. This combination allows us to identify the causal effect of parental shocks on childrens' socio-emotional skills exploiting the random *timing* of when exactly a shock occurs (as in Grogger, 1995 or more recently Fadlon and Nielsen, 2021). Specifically, we implement three separate empirical strategies that identify i) the short-run effects of parental shocks using child fixed effects, ii) the dynamics before and after the shocks using event studies, and iii) long-run effects of the shocks from sibling-pair comparisons.

Our identification strategies overcome three distinct identification challenges that are present when estimating the causal effects of parental health shocks on child skills. First, shocks do not occur randomly, therefore unobserved confounded characteristics of parents and children (such as a shared genes or environment) can lead to selection bias. To overcome this, we rely on variation within individuals and within families using fixed effects. Second, there is a risk of reverse causality when using parental self-reported health if socio-emotional problems of the child affect parental self-reports or if they actually harm parental health. We address this by exploiting objective, third-party information on severe parental health shocks that are unlikely to be caused by their child's socio-emotional skills. Third, a problem of measurement error emerges if the socio-emotional skills of the child are reported by their parents, as ill parental health might influence how parents perceive and report their children's skills even if they are *de facto* unchanged. We avoid this by using child self-reported measures of their own skills. The use of self-reported socio-emotional skills is standard practice in the literature. Lüdtke et al. (2011) and Specht et al. (2011) show that even around life shocks, these measures capture true changes in socio-emotional skills, as opposed to mere changes in reporting. We further argue in the robustness section that, in light of our results, a potential reporting bias is unlikely to drive our findings.

We find that socio-emotional skills of children aged 11-16 are only weakly affected in the immediate aftermath of severe parental shocks, considering up to 3 years later. Conscientiousness, one of the most important traits, is reduced by only .05% of a standard deviation from losing a parent, and .02% of a standard deviation from the health shocks considered jointly. There are no significant effects on Agreeableness, Emotional Stability, or Academic Self-Concept. With 95% confidence, we can rule out effects larger than 4% of a standard deviation for the parental health shocks considered jointly, or 10% of a standard deviation for parental deaths. This is still small compared to the differences in socio-emotional skills we document by parental education, income, or child gender, which go up to 40% (see Online Appendix Table 1). We perform a back-of-the-envelope calculation that extrapolates these effects on socio-emotional skills to educational attainment and earnings in adulthood and conclude that even the most severe of shocks, a parent passing away, would harm these outcomes by no more than 0.002% and 0.41% of a standard deviation. Our event studies display dynamics consistent with these results, and reassuringly, they show no evidence of anticipation effects in the 3 years preceding the shocks.

In order to unpack the skill formation process, we investigate potential mechanisms by which parental shocks influence children's skill formation. We refer to a distilled model of skill formation as guidance: parents invest time and income, subject to time and budget constraints, and the effectiveness of investments depends on both child and parent skills. We first show how time and income are differentially affected by the different types of parental shocks, as we can measure their impact on household income and the length of the hospital visits. By contrasting effects of these different shocks, and exploring heterogeneous effects on groups whose budget and time constraints differ, we find suggestive evidence that parental time is more influential than parental income in the socio-emotional skill formation process. Shocks that lead to significant reductions in (post-transfer) income generally lead to similarly small effects in socio-emotional skills as shocks that do not reduce income. Yet in terms of pre-existing income levels, health shocks only have (slightly detrimental) effects for children in low-income families. This is consistent with parental time being important for the development of socio-emotional skills, if the bulk of investments in low-income families is via own time (rather than financial) and the shocks decrease that available time. Further evidence speaking to the importance of time comes from the fact that health shocks with long hospitalizations are driving all negative effects.

The effectiveness of parental investments could depend on the the gender match between the parent and the child. We test whether shocks to fathers affect their sons more, and shocks to mothers affect daughters more, and do not find support for this hypothesis. We find that there are almost no effects of maternal shocks. We furthermore investigate whether boys are more vulnerable in their socio-emotional skill development to health shocks and also fail to find support for this hypothesis (Autor et al., 2019, Brenøe and Lundberg, 2018), or that boys are more vulnerable to a father's absence (Bertrand and Pan, 2013, Lundberg, 2017). Our findings do point to a slightly greater effectiveness of fathers' investments in terms of Conscientiousness, mirroring findings in Elkins and Schurer (2020).

Even mild shocks early in life can have substantial negative long-run impacts (Almond et al., 2018) because of dynamic complementarities (Cunha and Heckman, 2007). We provide novel evidence on long-run effects of parental health shocks on children's socio-emotional skills. We compare siblings who experienced the same shock at different ages, from birth to age 14, with a parent-fixed effect strategy. While these long-run analyses must be interpreted with caution due to a small sample size and the different interpretation of the estimates as within-family, they point to the existence of long run effects on Conscientiousness from shocks that occur earlier in the child's life. It thus seems that parents are not mitigating long-run effects through compensatory life-cycle investments in this skill (Bharadwaj et al., 2017).

Our short-run results are most related to the two studies by Mühlenweg et al. (2016) and Le and Nguyen (2017), who examine effects of parental self-reported *general* health on child socio-emotional behavior. Mühlenweg et al. (2016) use cross-sectional data and an empirical strategy that controls for child characteristics, finding substantial negative spillovers from changes in parental general health. Le and Nguyen (2017) demonstrate that using child fixed-effects to control for unobserved confounders significantly decreases the magnitude of estimates. They conclude, contrary to Mühlenweg et al. (2016), that there are only limited effects of changes in parental health on child socio-emotional malfunctioning. We overcome several limitations of both studies. First, we are not restricted to the use of self-reported parental health that risks a problem of reverse causality. Instead, we exploit objective, third-party information by medical professionals on severe parental health shocks. Second, the rich medical data allows us to disaggregate different types of physical health shocks or death, which is not possible with the use of a single survey measure of self-reported general health. This allows us to explore mechanisms that relate to parental investments through time or income. Third, regarding the child's outcome measures, note that Mühlenweg et al. (2016) and Le and Nguyen (2017) rely on the Strengths and Difficulties Questionnaire, which is rather concentrated on the malfunctioning end of the socio-emotional skill spectrum. We study productive socio-emotional skills linked to the Big Five traits.[1]

[1]Cuadros-Menaca et al. (2018) use survey data from Indonesia with information on Conscientiousness and Neuroticism measured at age 24 and a sibling-comparison strategy to estimate long-run effects of changes in general parental health, and find some evidence of negative effects on Conscientiousness.

Our paper contributes to the existing knowledge on human capital formation in four ways. First, we provide novel evidence on the effect of parental health shocks on *productive* socio-emotional skills, as opposed to socio-emotional malfunctioning. Second, we exploit the breadth of our data to explore mechanisms that can help explain the skill formation process, including household income, time at the hospital, and gender of the shocked parent and children. We contrast different types of physical health shocks to parents as well as death. Third, we use three complementary estimation strategies to estimate not just short-run effects of the parental shocks but also dynamics around the shocks and long-run effects. Fourth, we provide *causal* estimates that overcome the identification challenges of selection, measurement error, and in particular reverse causality, which might be present in previous work that exploits survey self-reports of parental health.

Our findings provide input for policy design at a practical level. Parental health shocks are unfortunately not infrequent: in an average Danish primary school class, one child will lose a parent before graduating high school, and two to three will experience a severe parental health shock (Kristiansen, 2021). Therefore, understanding the effects of these shocks is important for policy design. We discuss below the implications of the observed short- and long-run effects in the context of existing policies that may already alleviate negative consequences of shocks on household income and mental health of children, among others.

Were our results to be expected? On one hand they were, as the existing literature on adult personality generally finds that it is robust over time and in the presence of major life shocks (e.g. Specht et al., 2011, Cobb-Clark and Schurer, 2012, Elkins et al., 2017). Furthermore, the existing evidence on the effect of parental shocks on childrens' socio-emotional behavior also points in the direction of null or small effects (Mühlenweg et al., 2016, Le and Nguyen, 2017). On the other hand, our results are surprising because we focus on ages where socio-emotional skills are found to be most malleable and dependent on parental investments (e.g. Roberts and DelVecchio, 2000, Bleidorn, 2015). Furthermore, we observe severe parental shocks that are expected to greatly affect parental investments. Our findings suggest that in our context, parental health shocks do not affect children's socio-emotional skills in the short run, suggesting that new public policies might not be needed around this period. However, we note that negative effects might be buffered by policies that are already in place in the Danish context (Kristiansen, 2021), and that there is some evidence of harmful effects in the long run that call for further investigation.

II. Data and Samples of Analysis

We construct a unique dataset by combining several administrative registers for the entire population of Denmark with a nation-wide panel survey of children in public schools. The registers include hospital health records, as well as information on education, income, demographic variables, and family linkages, allowing us to match children to their parents and siblings. This provides us with a panel of observations that follows the children, their siblings, and their parents, for potentially their entire lifespan.

A. Parental Shocks

Health shocks are identified in the National Patient Registry, which covers hospitalizations from both private and public hospitals. It contains information on the exact date of admission, the duration of the hospitalization, and detailed diagnoses following the International Classification of Diseases and Related Health Problems (ICD-10 system).

We consider three types of health shocks: *Cardiovascular* shocks, including myocardial infarction of the heart or brain; *Cancer* diagnoses, including malignant cancers of any type; and *Mental health* episodes that require hospitalization.[2] We also aggregate the three aforementioned health shocks into a variable called *Any Health Shock*. We use the first occurrence of each health shock by restricting them to shocks that have not been preceded by the same type of diagnosis in the previous 5 years.

Mortality shocks are identified using administrative registers that contain information on the exact date of the event. There is of course a large number of deaths that are preceded by a health shock. We try to address this with further restrictions that depend on each sample of analysis. These are laid out in Section C.

Length of hospital stay is also observed for the health shocks, based on the number of days in the hospital associated to the first occurrence of the diagnosis. We use this variable to explore mechanisms, distinguished between three categories: 1-day visits to the hospital that do not require overnight stays, which present around 30% in our sample of analysis; 2 to 7 days long hospitalizations, requiring overnight stays, which represent around 40% in our sample; and 7+ days hospitalizations that make up the remaining 30%.

Parental information is obtained by linking different administrative registers. For each child, we observe a personal identifier for each of their biological parents or legal parents in case of adoptions, allowing us to link all parental information available in the registers. For some children, the registers do not list the personal identifier of the mother or the father, in which case we include these children as long as we have information on at least one parent.

We observe parental education, region, and income measured before and after the parental shocks. We define household income as the sum of father's and mother's income, which includes labor market earnings, entrepreneurial profits, pensions and other transfers, interest and dividend income. We use this definition to study the effect of parental shocks on household income. For the study of heterogeneity by household income level, however, we adjust this measure to reflect a per-person measurement of disposable income that corrects for the number of adult and child members living in the household, making it a more representative measure of the economic status of the family.[3]

[2]The specific ICD-10 diagnoses that define each health shock are the following. Cardiovascular: I20-I24, I6. Cancer: C00-C97, D00-D09. Mental Health: F00-F99. Of the latter, around half are related to substance abuse, mostly alcohol. We found no differential effects between mental health hospitalizations that are due to substance-abuse and those that are not.

[3]This measure is provided by Statistics Denmark. Starting from our definition of household income, it adds the rent-equivalent value of owned real estate, subtracts taxes, interest and alimony payments, then adjusts for the number of children and adults with the modified OECD equivalency scales. For heterogeneity analyses, we use maternal characteristics (there are very few children without a maternal personal identifier, less than 0.2%).

B. Child Personality

We obtain our measures of the outcome of interest, child socio-emotional skills, from four waves of a nation-wide survey of children in public schools, the "Danish Well-being Survey" (DWS).[4] This survey was introduced in 2015, and until 2018 it was mandatory for all Danish public schools to administer it. The survey therefore approaches representativeness at the national level and is less prone to sample selection problems than small voluntary samples.[5] Public schools ("Folkeskole") cover grades 0-9, and we use the survey version given to older students, grade 4-9 (about age 11-16).

Students' self-reports are used to construct validated measures of Conscientiousness, Agreeableness, and Emotional Stability, as well as Academic Self-Concept. These measures have good internal consistency, and Andersen et al. (2015, 2020) demonstrates in validation studies with separate data collections that they also correlate well with the relevant items from the Big Five Inventory (John and Srivastava, 1999). We thus cover three of the Big Five personality traits (McCrae and John, 1992, McCrae and Costa, 1999, lacking Openness and Extraversion). Conveniently these three traits indicate a psychologically healthy personality (Bleidorn et al., 2020). The survey remained the same throughout the period, there was only a re-ordering of questions between 2015 and 2016. Thus, we have an unbalanced panel structure, for which we construct the following four scores that measure the otherwise unobserved personality traits:

Conscientiousness, or how *responsible, and careful* one behaves, and one's tendency to *finish work*, is measured with the items "I can complete tasks and projects that I've committed to," "During class, I can concentrate well," "If interrupted during class, I can quickly concentrate again" (Cronbach's α measure of reliability in the full DWS sample, pooled over ages: $\alpha = .69$).[6] **Agreeableness**, reflecting *cooperation and empathy*, draws on "I try to understand my friends' feelings when they are sad or upset," and "I am good at collaborating with others" ($\alpha = .40$). Neuroticism (the reverse of **Emotional Stability**) reflects *vulnerability to stress*. We use the items "I often feel lonely," "My fellow students accept me for who I am," and "I always feel safe at school" ($\alpha = .70$). **Academic Self-Concept** is assessed by "I am doing well academically in school" and "I am making good academic progress in school" ($\alpha = .80$). This trait is not part of the Big Five, but it is predictive of future academic performance and attainment (Gensowski et al., 2021).

To measure personality traits, we generate four scores for each individual by first standardizing all items individually to mean zero and standard deviation one, by child's sex, grade, and calendar year, and second, forming the simple average and re-standardizing it. Using these standardized dependent variables means that the coefficients of interest in our analyses can be interpreted as effects in terms of percentages of a standard deviation. The standardization by

[4]For general information, see `https://emu.dk/grundskole/undervisningsmiljo/trivselsmaling`.

[5]It was typically administered during a regular school class in the school's computer room, led by a designated teacher. Students responded individually, and schools had to upload the data according to certain standards, which included that all questionnaires should be linked to the students' national identification number. We are therefore able to combine the survey data with data described above on parental health shocks.

[6] The corresponding Cronbach's alphas for the sub-sample of respondents who experience a parental health shock are equivalent or higher: Conscientiousness $\alpha = .70$, Agreeableness $\alpha = .43$, Emotional Stability $\alpha = .71$, Academic Self-Concept $\alpha = .81$.

age, sex, and calendar year allows us to identify effects of parental health shocks that are not influenced by other mechanisms that may be happening simultaneously. In the context of our analyses, we worry that by comparing personality traits measured after a shock to those measured before the shock, we confound the effect of the shock with spurious age-related differences that reflect overall maturation patterns.[7] The standardization by school grade avoids picking up these spurious effects. Sex effects are also present (Soto et al., 2011), thus standardizing by sex (together with grade) removes differential developments over time by sex. The standardization by year takes out survey-wave specific effects (such as, for example, the re-ordering of items from 2015 to 2016).

C. Samples of Analysis

This section describes how we define our two samples if analysis. In Table 1 we report the descriptive statistics for the full sample of respondents to the DWS, compared to these two samples of analysis.

Short-run analyses. For the short run analyses, we exploit the panel dimension of the well-being survey data available from 2015 to 2018. Each year there were about 260,000 survey responses.[8] This amounts to 1,026,664 child-year observations from 457,227 children for whom we observe the four socio-emotional skills of interest.

We obtain individual-level variation within each child by restricting the sample of analysis to children who experience a parental shock in between any two DWS waves. We observe both the exact date of the survey and of the shock, so there is a very low probability of assigning the timing of the shock wrong. We only consider health shocks where the parent who experienced the health shock survived at least one year. Otherwise, the shock is considered a mortality shock and assigned to the year where the death occurred. Note that some health shocks might be preceded by symptoms that could affect the child in anticipation. While this is likely the case for mental health, the occurrence of a stroke or a cancer diagnosis is likely to come unexpectedly (Fadlon and Nielsen, 2021). Our analysis allows us to test for these anticipation effects, which could be different depending on the type of shock.

Our sample of analysis contains 10,904 unique children who experience a parental shock and 33,249 child-year observations. We identify 1,253 deaths and 9,679 health shocks of which 3,076 are cardiovascular shocks, 4,074 are cancer shocks, and 2,644 are mental health episodes.[9] These are on average 418 deaths per year and 3,226 combined health shocks per year.

In comparison to the full sample of DWS respondents, this sub-sample of children who experience a parental shock between any of the DWS waves scores less favorably on some socio-emotional

[7] It is well documented in the literature that personality traits display developmental maturation patterns, which are changes in traits that appear consistently with age (see, for example van den Akker et al., 2014, Soto, 2016). Adolescence, in particular, is a time during which there are distinct decreases (dips) in Conscientiousness and Agreeableness (Soto et al., 2011) and academic self-esteem (Gensowski et al., 2021).

[8] Precise numbers are 2015: 242,380, 2016: 268,047, 2017: 265,935, 2018: 250,302.

[9] The sum of the disaggregated health shocks is greater than the number of aggregated health shocks because if a child experiences different types of parental health shocks, such as a paternal cancer and a maternal cardiovascular shock, these shocks will both be considered separately for the disaggregated definitions, but when using the aggregated definition, only the earliest of those shocks will be included.

skills, and is different in terms of parental background—see the third column of Table 1. We further discuss this in Section III.

Long-run analysis. For the long-run analysis, we implement a parents fixed effects strategy to study the effect of the timing of parental shocks on children's socio-emotional skills, which are measured at age 15, the latest age with full sample size. This sample contains all children who completed the DWS at age 15 (166,665 children) and who experienced a parental shock before age 15 (32,732 children).

We further restrict the sample to siblings (pairs or triplets) who have experienced the same parental shock at different ages (hence excluding twins). To avoid further reducing the sample size, we consider all health shocks together and do not impose a one-year survival period. We also explore the effect of a parental death separately. Importantly, we ensure that the health shock experienced by the siblings is the same, either cardiovascular, cancer, or mental health. The resulting sample of analysis contains 3,772 children who experience a parental health shock and 482 children who experience a parental death.

The fourth column of Table 1 shows that this sub-sample differs from the full DWS sample in having less favourable socio-emotional skills, but it differs less than the short-run sample. This is explained by the less strict restriction of having experienced a parental shock over a much longer period of time. The differences are also less significant due to the small sample size.

Table 1: Descriptive Statistics

	DWS Sample		Shocked Short-run	Shocked Long-run
	Mean	S.D.	Difference	Difference
Conscientiousness	0.000	1.000	-0.040^{***}	-0.025
Agreeableness	0.000	1.000	-0.002	-0.033^{**}
Emot.Stability	0.000	1.000	0.008	0.005
Acad.Self-Concept	0.000	1.000	-0.029^{***}	-0.023
Age	13.531	1.739	0.117^{***}	0.000
Female	0.491	0.500	0.006^{**}	0.004
Parents College	0.501	0.500	-0.031^{***}	-0.010
Mother Income Lowest Quar.	0.239	0.426	0.054^{***}	0.119^{***}
Single Mother	0.306	0.461	0.069^{***}	0.039^{***}
Cohort Mother	1972.6	5.049	-1.177^{***}	0.141^{*}
Observations	1 026 664		33 249	3 772

Note: Showing mean and standard deviations (S.D.) for the entire sample of children responding to the DWS 2015-2018 (DWS Sample) and the sub-samples of children who experienced a short-run shock (that occurred in between DWS waves) or a long-run shock (that occurred to sibling pairs before they reach age 15). The columns denoted "Difference" report t-tests of means for each shocked subsample, comparing to the full DWS Sample. Note that the long-run sample compares only children who are 15 years old in both samples. $^{*}(p < 0.10)$,** $(p < 0.05)$,*** $(p < 0.01)$.

III. Short Run Effects of Parental Health Shocks on Child Socio-emotional Skills

Children whose parents suffer a health shock have, on average, significantly less favorable socio-emotional skills than children of parents who do not, in terms of Conscientiousness and Academic Self-Concept (as shown in Table 1). A naive comparison of these two groups of children would lead us to conclude that parental health shocks produce large and significant differences in some socio-emotional traits in children. Yet, this comparison is flawed because parents who suffer from severe health shocks are different *ex ante*, and are likely to have children that differ *ex ante* as well, therefore these differences in skills cannot be attributed to the shocks. The naive comparison in Table 1 conflates the causal effect of a parental health shock with selection "into" the shocks.

To overcome this challenge and obtain causal evidence of the effect of parental health shocks on child socio-emotional skills, we exploit the panel dimension of our data to control for unobserved characteristics that might confound the occurrence of the shocks. In this section we explore the short-run effect of parental shocks, and in IV we estimate the long-run effects.

A. Main Results. OLS with Child Fixed Effects

The first strategy uses child-level fixed effects, identifying the effect of a parental health shock from within-child variation. The estimation model is:

$$Y_{it} = \alpha + \beta D_{it} + \phi_i + \epsilon_{it} \quad \text{for } t \in [2015, 2018] \tag{1}$$

where Y_{it} is child i's standardized trait at time t; D_{it} is an indicator variable that takes 1 from time t and onward if a parental shock took place between $t-1$ and t, and ϕ_i is an individual fixed effect. Under the assumption of no time-covarying unobservables, the parameter β identifies the causal effect of a parental shock on children's socio-emotional skills in the short run. This strategy is comparable to Le and Nguyen (2017). It is a short-run measure in our setting because skills are observed until at most 3 years after the shock. The identification strategy is similar in spirit to the timing-based argument that assumes that within a given (short) window, the timing of events can be considered random from the individual's perspective (see, for example Fadlon and Nielsen, 2021, Persson and Rossin-Slater, 2018, Grogger, 1995). Since β is not time-varying, it captures the average effect of the shock throughout the post-shock short-run period, but we investigate short-run dynamics in the section below.

Note that an alternative specification could allow β_a coefficients for different ages a at which children experience the shock. Testing this specification (see Online Appendix Section III) did not reveal any robust patterns of the effects by age of the child. Since that means that the β of Equation (1) does not mask sensitive periods in socio-emotional skill formation within ages 11-16, we favor this pooled version as it provides more precise estimates.

Table 2 summarizes the results from estimating Equation (1). A parental death, arguably the most severe type of shock we consider, has a small but significant effect on the child's

Conscientiousness, reducing it by .05 of a standard deviation in the period following the death (one to three years after). Conscientiousness is also slightly decreased, by .02 of a standard deviation, following a parental health shock, particularly cancer. On the one hand, this finding is important because Conscientiousness is regarded as a "super trait"—it is associated with many productive outcomes in terms of education, the labor market, or health. On the other hand, the effects are objectively very small. The other three traits we measure in the DWS—Agreeableness, Emotional Stability, and Academic Self-Concept—are *not* significantly reduced on average by the loss of a parent or the combined "Any Health Shock," and the point estimates are very small.

These finding points to children being remarkably robust to even drastic shocks to their parents' health. Note that these findings hold despite a substantial sample size for each test which allows us to obtain precise estimates. We can exclude, with a 95% confidence band, harmful effects on Emotional Stability of more than .03 of a standard deviation from Any Health Shock and .04 from parental mortality; and for Agreeableness and Academic Self-Concept we can exclude reductions of more than .02 and .08. Conscientiousness can be decreased by up to .10 of a standard deviation from parental death and .04 from Any Health Shock.

Table 2: The Short Run Effect of Parental Shocks. Child Fixed Effects Estimates

	(1) Conscientiousn.	(2) Agreeablen.	(3) Emot.Stability	(4) Acad.Self-Concept	(5) # Shocks
Death	-0.049^{*}	-0.014	0.014	-0.028	1,253
	(0.03)	(0.03)	(0.03)	(0.03)	
Any Health Shock	-0.022^{**}	-0.001	-0.008	-0.004	9,679
	(0.01)	(0.01)	(0.01)	(0.01)	
Cardiovascular	-0.016	-0.034^{*}	0.013	-0.020	3,076
	(0.02)	(0.02)	(0.02)	(0.02)	
Cancer	-0.026^{*}	0.009	-0.011	0.014	4,074
	(0.01)	(0.01)	(0.01)	(0.01)	
Mental Health	-0.014	0.033^{*}	-0.013	-0.008	2,644
	(0.02)	(0.02)	(0.02)	(0.02)	

Note: Each cell reports the β coefficient of interest from estimating Equation (1) separately for each personality trait of the children and for each type of parental shock. Each β coefficient identifies the causal effect of experiencing a given parental shock on the children's skills, which are standardized by child's sex, grade, and calendar year to have mean zero and standard deviation 1. Standard errors in parentheses clustered at the child level. $^{*}(p < 0.10)$,** $(p < 0.05)$,*** $(p < 0.01)$.

There are two lessons from separating out Any Health Shock into its components of cardiovascular shocks, cancer and mental health diagnoses: First, children's Conscientiousness is significantly reduced following a parental cancer diagnosis, which seems to drive the overall finding. Second, the null finding for Agreeableness hides both a harmful effect of a cardiovascular shock (which reduces Agreeableness by .03 of a standard deviation) together with a *beneficial* effect from the parent having a mental health episode, i.e. the parent being hospitalized following a mental health episode.

To provide more context on how small the few significant effects are, we can benchmark them against effect sizes found in other contexts. The *gender gap* in Agreeableness is 38% of a standard deviation (higher for females) in our sample, for example, and females score on average 29% of a standard deviation lower on Emotional Stability (see Table 1). *SES gaps* are also an order of magnitude larger: Children of parents with at least some post-secondary education score 29% std. dev. higher on Conscientiousness than children of less educated parents, and the corresponding gaps in Agreeableness are 16%, Emotional Stability 12%, and Academic Self-Concept 27%. The evidence on the effects of *schooling and other interventions* on personality traits also show much larger effects. Randomized interventions have been reported to boost socio-emotional skills by up to 57% std. dev. (see overview in Almlund et al., 2011). Increasing schooling from 12 to 13 or more years increases Self-Esteem by more than 50% std. dev. in Heckman et al. (2006). Summarizing the literature, Schurer (2017) writes that with the exception of two studies that find even larger effects, treatment effects of education on skills of adolescents are "bound between -.25 std. dev. and 0.25 std. dev." In comparison to these findings, children's socio-emotional skills are only weakly affected by severe parental health shocks.

We further contextualize the size of our estimates by calculating how they would affect socio-economic outcomes. We perform an extrapolation exercise based on existing estimates in the literature. Almlund et al. (2011) shows that the effect of Conscientiousness on years of schooling is up to .18 of a standard deviation, and of Emotional Stability .09. Extrapolating from our short-run effects in Table 2, we could exclude greater reductions in education than .007 of a standard deviation in schooling from any parental health shock on Conscientiousness, and by .003 from Emotional Stability, since the point estimate is positive. Almlund et al. (2011) also present estimates of the effects of standardized personality traits on earnings, where Conscientiousness increases log earnings by .041 and Emotional Stability by .036. Therefore, if the short-term effects of Any Health Shock in Table 2 persisted throughout the children's adult working lives, their annual earnings would decrease by no more than .098% (Conscientiousness) or .108% (Emotional Stability). Even from parental death would we not expect more detrimental effects than a reduction of education by 0.018 of a standard deviation via Conscientiousness, if the short-run effects of Table 2 were extrapolated to the longer term, and we would exclude larger wage effects than 0.41% from the mortality shock's effect on Conscientiousness.

These results, particularity on Emotional Stability, are noteworthy. There is evidence of parental health causally affecting children's *health* and *educational* attainment (see, for example, Currie and Moretti, 2007, Kristiansen, 2021).[10] Furthermore, the context of our study is ideal to find any potential effects of parental shocks on child skills: We consider severe health shocks, and we observe productive socio-emotional skills of children (not only socio-emotional malfunctioning), at an age where one expects most malleability and influence of parents. Yet Cobb-Clark and Schurer (2012, 2013), Elkins et al. (2017), Lüdtke et al. (2011) or Specht et al. (2011) do not find, in the context of adult personality traits, consistent effects of common family- or health-related shocks. Kristiansen (2021) has shown, in the same context as our study, that children's

[10] Many studies on children's educational outcomes use data from developing or transition countries (e.g Bhalotra and Rawlings, 2011, Bratti and Mendola, 2014, Senne, 2014, Alam, 2015). For US studies that rely on controlling for observables, see Andrews and Logan, 2010, or Johnson and Reynolds, 2013.

prescription of therapy and anti-depressant medication increases immediately after a parental death (or health shock). Emotional Stability is related to both state and trait anxiety as well as depression (see Rodriguez-Ramos et al., 2021 and the meta-analysis in Kotov et al., 2010). It is therefore possible that the availability of free health care, and treatment for those children who need it, successfully buffers the potential negative effects of parental shocks on child mental health and Emotional Stability.

B. Event Studies

Child fixed effects are a credible identification strategy, but they do not provide insight into the dynamics of how shocks affect child skills over time. Fixed effects could also hide potentially interesting anticipation effects. This is particularly salient in our context, where some diagnoses, such as mental health diagnoses, are likely to occur after the family has already experienced the effects of symptoms.

We estimate event study regressions to provide insight into such dynamics exploiting the sharp and precise date occurrence of the different shocks. Specifically, we estimate the following regression:

$$Y_{it} = \alpha + \sum_{t \neq -1} \beta_t \cdot t + \varepsilon_{it} \tag{2}$$

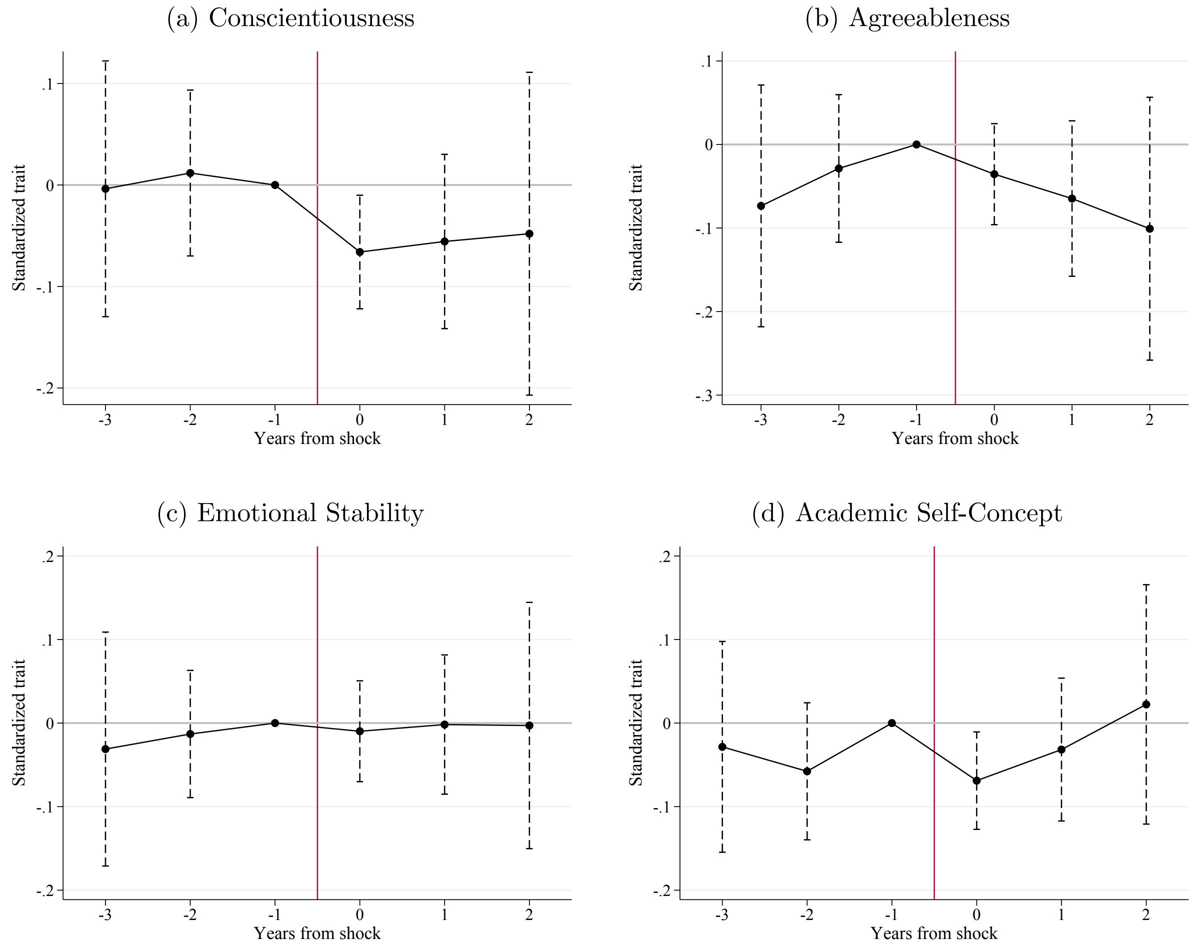
where Y_{it} is child i's standardized trait at time relative to shock t (with $t = 0$ already affected). Since we observe up to 4 waves of the well-being survey for each child, we can identify parameters up to three years after the shock (periods 0, 1 and 2) for children who experienced the shock right after they filled out the first survey in 2015, and up to 2 years before the shock (periods -1 and -2). Note that we do not include individual fixed effects in this event-study model, since a potential linear trend would not be identified (as pointed out by Borusyak et al., 2021). We perform this event study on the same sample of children as the OLS estimates presented above.

Figure 1 plots the β_t coefficients estimated from Equation (2) that show the dynamics of the different socio-emotional skills around the death of a parent. We observe that, despite the possibility of important anticipation effects, there are no statistically significant dynamics. This is of particular importance for parental deaths, as these shocks could be preceded by a health shock. Consider the case of Conscientiousness, where we had identified small significant negative effects from a parental death: in the periods leading up to the shock (periods -2 and -1), Conscientiousness remains flat, indicating that this trait is not affected in anticipation of the parental death. This is consistent with results in Kristiansen (2021), who studies the effects of parental death, cancer diagnoses, or strokes, on children's use of therapy and anti-depressant medication and finds no evidence of anticipatory effects in children's' mental health. As for dynamics after the shock, we observe that the estimated coefficients tend to be negative, particularly in period 0, immediately after the shock. For the case of Conscientiousness, the coefficient for $t = 0$ is negative and statistically significant while coefficients in periods 1 and 2 remain negative but statistically insignificant.

Figure 2 presents the event studies for parental health shocks. We observe similar patterns as for parental deaths, with pre-shock estimates remaining mainly flat and insignificant. If anything, the time trend before the health shock looks like it increases slightly leading up to the shocks. In the immediate year after the shock, period 0, the estimates for the different traits tend to be negative and significant, but very small.

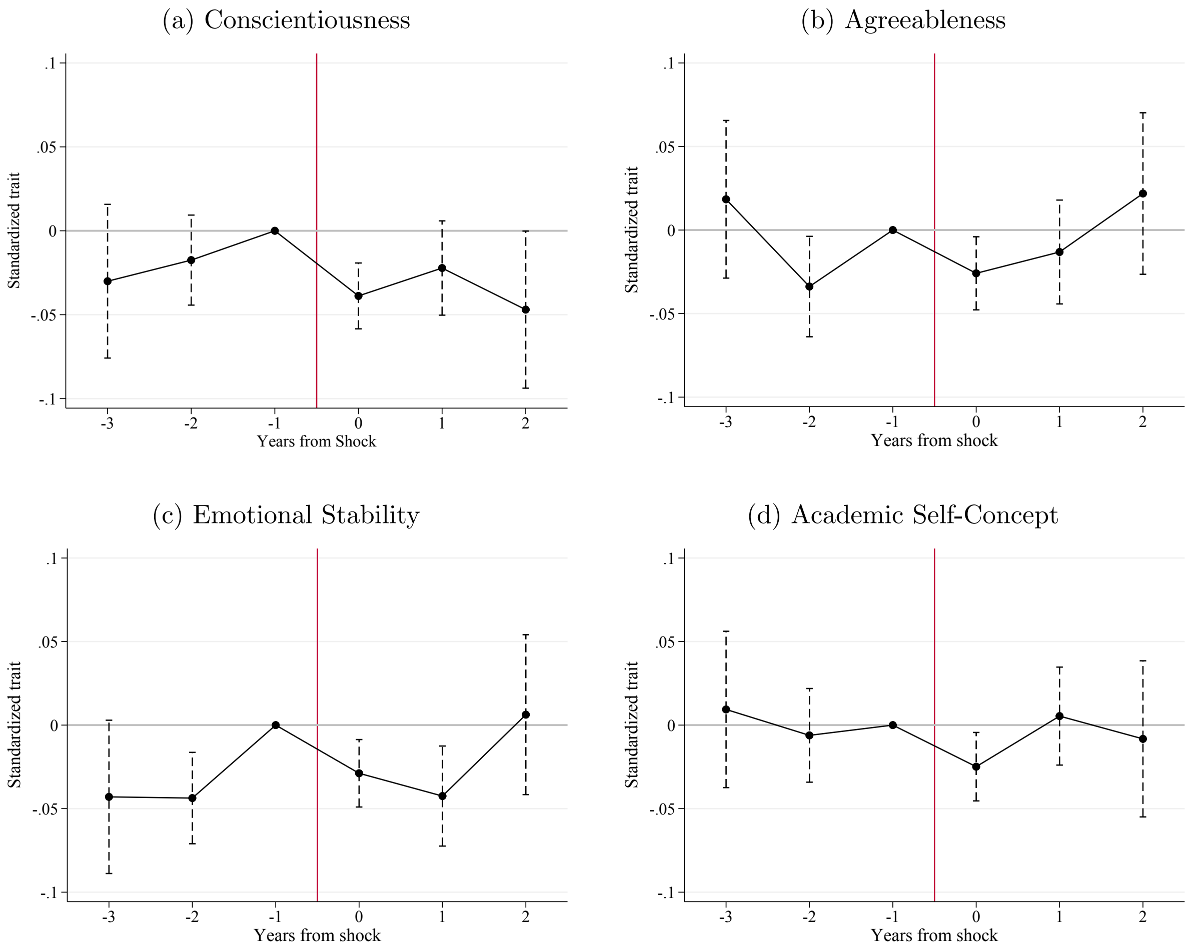
Overall, despite the reduced precision of these event study estimates, we conclude that we do not find significant pre-trends that could suggest any anticipation effects, and the dynamics we observe are consistent with the estimation results from the pooled child-fixed effects strategy that we presented in Table 2. We conclude that on average, Conscientiousness is moderately affected by the occurrence of a parental shock, while there are no immediate significant negative effects of parental death on Agreeableness, Emotional Stability, or Academic Self-Concept.

Figure 1: Event Study: Parental Death



Note: These figures show the β_t coefficients estimated from Equation (2) describing the dynamics of each socio-emotional skill around the time of their parent's death, which is indicated with the vertical red line between -1 and 0. The confidence intervals of each coefficient at the 95% level are calculated from standard errors clustered at the individual level.

Figure 2: Event Study: Any Health Shock



Note: These figures show the β_t coefficients estimated from Equation (2) describing the dynamics of each socio-emotional skill around the time of Any Health Shock, which is indicated with the vertical red line between -1 and 0. The confidence intervals of each coefficient at the 95% level are calculated from standard errors clustered at the individual level. See Online Appendix Figures 1 to 4 for the results split by child's sex and disaggregated health shocks.

C. Mechanisms

In classical models of child skill formation, in the tradition of Becker and Tomes (1986) and Cunha and Heckman (2007), parents invest in their children using time and financial resources, under both time and financial constraints. The effectiveness of investments is determined by both parent and children's pre-existing skills. This stylized framework can serve as a guide to studying the mechanisms at play in the effects of parental health shocks on children's socio-emotional skills. We analyze how parental health shocks influence financial resources and time, and whether the tightness of pre-existing constraints leads to differential effects of the shocks. The gender of parent and the child can also determine the effectiveness of investments, or boys may be more vulnerable to shocks (Bertrand and Pan, 2013, Lundberg, 2017).

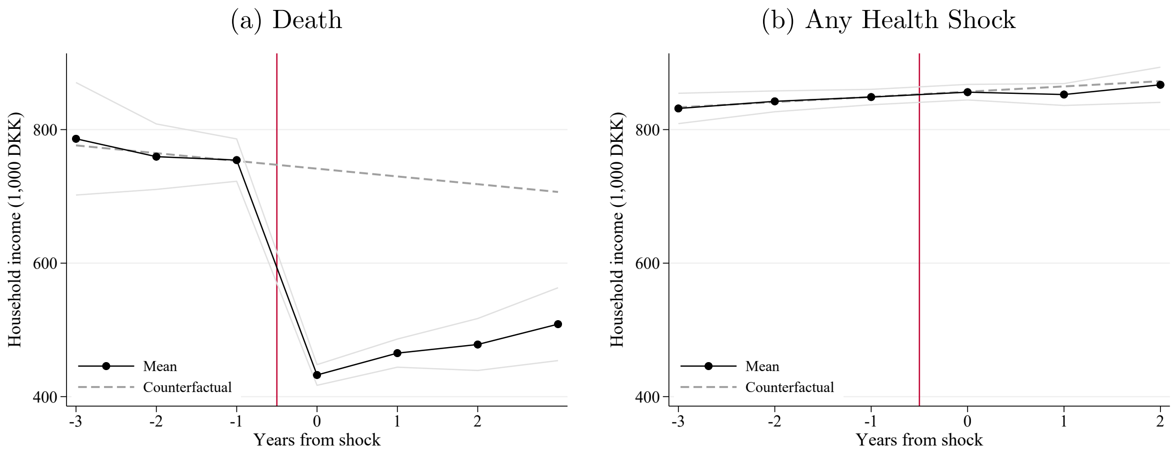
First, we begin by exploring the role of household income. We examine the repercussions of parental health shocks on family finances, and we analyze whether families with fewer financial resources - who are more likely to hit the lower bounds of financial investments in their children - experience greater spillover effects of parental health shocks (Section C.1). Next, we focus on parental time, using the length of the hospital stay as a proxy for how the health shock influenced the quantity of time available for the parent to invest in their child (Section C.2). Finally, we examine heterogeneous effects of parental shocks by both child and parent gender (Section C.3). It is crucial to explore differential impacts by gender or by parent-child gender match because there are concerns in the literature that boys' skill development is more vulnerable to the father's absence. There is also evidence for parent-gender-specific effects in the existing work by Mühlenweg et al. (2016) and Le and Nguyen (2017), as well as Dinku et al. (2018).

C.1. Income

Income is a potential mediator of parental shocks because it has been shown to directly influence child cognitive skills and socio-emotional skills (Dahl and Lochner, 2012, Akee et al., 2018). It is well-documented that earnings and income decrease from ill health or disability, because of lower employment and work hours (Riphahn, 1999, Smith, 1999, Wu, 2003, Charles, 2003, Smith, 2013). Specifically, health shocks and hospital admissions have been shown to lower patients' earnings and income both in the American context (Dobkin et al., 2018) as well as for the Danish population (Fadlon and Nielsen, 2021). In the Danish context, the social security system includes universal health care coverage, making medical bankruptcies rare. The ultimate impact of health shocks on household income therefore depends on the extent to which household incomes are insured by public transfers. Fadlon and Nielsen (2021) document that health shocks are largely insured while the death of a partner leads to a drop in household income. We begin by confirming these patterns for our sample of analysis, before studying heterogeneity in the effects of parental health by pre-shock income levels.

Effect of shocks on income. Figure 3 shows event studies for the effect of one parent's death and health shocks on total household income, which we define as the sum of father's and mother's income including public transfers. While total household income is almost unaffected by the (non-fatal) health shocks, it is decreased in a sharp, large, and persistent manner, consistent

Figure 3: Short Run Effect of Parental Shocks on Household Income



Note: These graphs plot event studies for the effect of parental shocks on household income. Panel (a) shows the effect of parental death and panel (b) shows the effect of health shocks. The solid black line plots mean household income for each year from the shocks. The light gray solid lines are 95% confidence intervals. The dashed line plots a linear fit estimated for the pre-shock periods and projected forward to serve as counterfactual.

with Fadlon and Nielsen (2021). It is therefore quite remarkable that child socio-emotional skills are so robust to bereavement (c.f. Table 2 and Figure 1)—and that there are no larger differences between the effects of parental death and health shocks. Two shocks that have quite differing implications for family resources have similarly small short-run effects on child skills. This suggests that income losses do not play a major role in shaping socio-emotional skills in our context, in contrast to Dahl and Lochner (2012) and Akee et al. (2018), which both used data from the US. Akee et al. (2018) use an unconditional household income increase that is estimated to be at around 3,500 USD per year. This is an order of magnitude smaller than the average household income drop from death in our setting, at around 320,000 DKK $\approx$ 50,000 USD today. The relative decrease in household income in our setting is about 40%, whereas the increase in Akee et al. (2018) was around 15%.

Heterogeneity by income. We next study whether pre-existing differences in household resources result in differential effects on children's skills. To do so, we define children living in low-income families as those whose mothers are in the lowest quartile of households' disposable per-capita income after transfers in 2014, before any health shock occurred. On the one hand, we expect that families in the lowest quartile are more financially vulnerable and a shock might affect their investments in child skills more. On the other hand, parents from high income quartiles are different in many other ways. Kalil and Ryan (2020) show that while *all* parents would like to support their children's development with the same type of cultural and educational activities, there are gaps in investments by family income. High-income parents also have higher education, and these two markers of socio-economic status are demonstrably associated with different investment levels and parental behaviors—see summaries in Heckman and Mosso (2014) or Lareau (2011).

Table 3 contrasts children in the bottom quartile of disposable household income to the other three quartiles. We find that the small negative effect of parental deaths on Conscientiousness is driven by the *top* three income quartiles. These families experience larger income drops in absolute terms, although the drop in relative terms is similar (around 40% for both groups). This result would fit a model of skill formation where parents with higher skills, here proxied by income, invest their time in their children more effectively towards fostering socio-emotional skills (Cunha and Heckman, 2007). As Kalil and Ryan (2020) write, high income parents "spend more time in educational activities with their children, produce more cognitively stimulating home learning environments, and are more likely to read and do math-related activities with their children." In line with this, theoretical models of skill formation would imply that losing the time-input of a highly-skilled parents may result in a greater investment loss, here evidenced for Conscientiousness only.

The heterogeneous effect of health shocks have the opposite pattern, albeit the differences are generally less stark: health shocks have small negative effects mostly for low-income families. Children from low-income families experience small but significant drops in Agreeableness and Academic Self-Concept, and Conscientiousness decreases slightly more for low- than high-income families. Interestingly, the *increase* in Agreeableness that was found for the whole sample, following a parental hospitalization for a mental health shock, is driven by the top quartiles of the income distribution. This points to credit constraints being more important in dealing with health shocks.

If the bulk of investments in low-income families is via own time (rather than financial), and health shocks reduce that available time, children of these credit constrained families may experience greater decreases in their investments even though their family income did not change much from the shock. Thus, these results can point to the importance of parental time investments as well. We next study heterogeneous effects as a function of parental time spent at the hospital, before referring back to the stylized model of human capital formation for interpretation.

Table 3: The Short Run Effect of Parental Shocks by Disposable Income Quartiles. Child Fixed Effects Estimates

	Conscientiousness		Agreeableness		Emotional Stability		Academic Self-Concept		# Shocks	
	(1) Top Q2-Q4	(2) Bottom Q1	(3) Top Q2-Q4	(4) Bottom Q1	(5) Top Q2-Q4	(6) Bottom Q1	(7) Top Q2-Q4	(8) Bottom Q1	(9) Top Q2-Q4	(10) Bottom Q1
Death	−0.084***	0.015	−0.024	0.003	0.015	0.017	−0.047	0.014	784	456
	(0.031)	(0.048)	(0.035)	(0.051)	(0.033)	(0.050)	(0.032)	(0.049)		
p-value of difference		0.0843		0.665		0.976		0.303		
Any Health Shock	−0.018*	−0.031*	0.017	−0.040*	−0.011	0.001	0.009	−0.034*	6,881	2,813
	(0.011)	(0.018)	(0.012)	(0.020)	(0.011)	(0.019)	(0.011)	(0.019)		
p-value of difference		0.534		0.0159		0.591		0.0503		
Cardiovascular	−0.015	−0.015	−0.022	−0.054	0.001	0.038	−0.013	−0.025	2,082	956
	(0.020)	(0.031)	(0.021)	(0.035)	(0.021)	(0.032)	(0.021)	(0.032)		
p-value of difference		0.999		0.440		0.331		0.751		
Cancer	−0.021	−0.050	0.024	−0.043	−0.006	−0.023	0.024	−0.024	3,244	813
	(0.015)	(0.032)	(0.016)	(0.037)	(0.015)	(0.035)	(0.015)	(0.034)		
p-value of difference		0.414		0.0963		0.650		0.200		
Mental Health	−0.011	−0.020	0.059**	−0.009	−0.019	−0.006	0.019	−0.049	1,585	1,034
	(0.023)	(0.031)	(0.025)	(0.033)	(0.023)	(0.033)	(0.024)	(0.034)		
p-value of difference		0.828		0.101		0.744		0.0983		

Note: Each cell reports the β coefficient from Equation (1) that identifies the causal effect of experiencing a given parental shock on the children's socio-emotional skills, in the respective sub-sample by quartile of per-person disposable family income before the shock. The child skills are standardized by child's sex, grade and calendar year, to have mean zero and standard deviation 1. Standard errors in parentheses clustered at the child level. $^*(p < 0.10)$,** $(p < 0.05)$,*** $(p < 0.01)$.

C.2. Length of Hospital Visit

Parents also invest their own time in children's skill formation, with the associated time constraints. The effect of health shocks on parental time investment in their children is multifaceted. While existing literature is limited, we know that parental health shocks do not lead to increases in the likelihood of divorce (Charles and Stephens, 2004) and that labor supply of the spouse can be affected (Fadlon and Nielsen, 2021). In our context, one measure of parental time availability after a health shock is the number of days spent at the hospital following the shock, as it is probably more difficult to spend time with the child while hospitalized than during convalescence at home. In this vein, we see length of the stay as a proxy for the reduction in time investments in the child.

About 30% of the health shocks analyzed here are single-day stays at the hospital, and include outpatient contacts with the hospital that did not require an overnight stay. Almost 50% of diagnoses lead to spending 2-7 days in the hospital, and 20% of the diagnoses are associated with hospitalizations of more than a week. As Table 4 shows, children socio-emotional skills are especially robust to shorter hospital stays, which presumably involve smaller reductions in parental time investments. Longer hospital stays of more than a week drive the small but significant drop in Conscientiousness that we found in the full sample results.

Taken together with the results on income, these findings suggest that time investments are a more important mechanism of skill formation than financial investments. Large differences in family income changes did not lead to very different effects on child socio-emotional skills in the case of parental death, while longer hospitalizations explain the negative effects from health shocks that we found.

Table 4: Short Run Effect of Parental Health Shocks by Length of Hospital Stay

	(1) Conscientiousn.	(2) Agreeablen.	(3) Emot.Stability	(4) Acad.Self-Concept	(5) # Shocks
1 day	-0.022	0.006	-0.021	-0.013	$3,099$
	(0.02)	(0.02)	(0.02)	(0.02)	
2 to 7 days	-0.008	-0.002	-0.002	0.008	$4,599$
	(0.01)	(0.01)	(0.01)	(0.01)	
8 or more days	-0.053^{***}	-0.008	-0.002	-0.020	$1,981$
	(0.02)	(0.02)	(0.02)	(0.02)	

Note: Each cell reports the estimate of the causal effect of "Any Health Shock," β from Equation (1), separately for each personality trait of the children, where the shocks are split by the length of the associated hospital stay. Standard errors in parentheses clustered at the child level. $^{*}(p < 0.10)$,** $(p < 0.05)$,*** $(p < 0.01)$.

C.3. Gender of Child and Parent

There are theoretical reasons and empirical evidence suggesting that that the overall results reported in Table 2 might mask important heterogeneity by gender of the child and the parent. Fathers and mothers may differentially affect children's acquisition of the different socio-emotional skills if the gender of the child or the parent-child-gender match are associated with the effectiveness of investments. There is a literature discussing the greater vulnerability of boys relative to girls in terms of family disadvantage—of which parent health shocks can be one manifestation (Autor et al., 2019, Brenøe and Lundberg, 2018), or that boys are more vulnerable to the absence of a father (Bertrand and Pan, 2013, Lundberg, 2017). Mothers' investments have been shown to be more reactive to their own mental health status for their daughters than for their sons (Baranov et al., 2020). Father's involvement is particularly important for long-run socio-emotional skills of girls according to Elkins and Schurer (2020). Differential effects by which of the two parents falls ill can be due to intra-household specialization. Dinku et al. (2018) show that parental health shocks have a striking gender-specific pattern in their effect on child time: after health shocks, children replace parental time spent on chores (mothers) or market work (fathers). While these results are from a developing country context with traditional gender roles, Denmark and other Western countries also still face these types of gender norms. Men only do 41% of household work in Denmark (Thielemans et al., 2021), and unequal sharing of household work was especially prevalent among parents during the Covid-19 pandemic (Giurge et al., 2021). In our context, we also observe that Mühlenweg et al. (2016) find that only mothers' health has a significant impact on child skills, and Le and Nguyen (2017) remark on the greater effect of paternal mental health. Therefore, it is important to also disaggregate the results by children's and parents' gender.[11]

Table 5 shows effects on boys, and Table 6 on girls, of parental shocks split by whether they occur to the mother or the father.[12] Overall, only shocks to the father have small detrimental effects. These are mostly concentrated in Conscientiousness. The only significant effect of a health shock to the mother is a positive effect of maternal death on boys' agreeableness. Generally there are only few significant differences between shocks coming from the mother relative to the father.

For boys, the harmful effect of a parental death on Conscientiousness is entirely driven by losing their father, as the point estimate of losing a mother is insignificant and positive. Similarly, the effects of health shocks are larger if they happened to boys' fathers (the interaction terms for the difference to mothers are all negative in column 3, although not statistically significant). The reduction in Agreeableness from a cardiovascular shock to their parents is equally important for both parents, while the positive reaction to a mental health diagnosis stems from mothers. Agreeableness is one of two cases where pooling parents masks two significant effects: Firstly, losing their mother significantly *increases* Agreeableness by .13 of a standard deviation—while losing a father reduces it insignificantly. This positive effect of a severe shock on Agreeableness for boys could not be seen in Table 2. Similarly, Academic Self-Concept of boys is reduced following the mental health diagnosis of their father, but not their mother.

Girls' Conscientiousness only decreases significantly following a father's health shock—similarly to boys—and the effects are driven by a father's cancer diagnosis (the effect of a mother's cancer

[11] Even when we write gender, we observe only biological sex in the administrative registers.

[12] Since these regressions include direct interaction tests of the effect of the shock by parental sex (every column called "Diff."), we drop the few children who experience a shock from both the mother and father. The share of excluded children ranges from 0.34% (cancer) to 1.16% (any health shock). We also report the interaction coefficient between health shock and child sex in Table 2.

diagnosis has no statistically significant effect). The positive effect of a mental health diagnosis for Agreeableness, which was observed in Table 2, stems mostly from the effect of fathers' diagnoses on girls. In girls, there are two cases where the difference between effects of maternal and paternal diagnoses is statistically significant: the effects of a parent's cancer on children's Conscientiousness and the positive effect of a mental health diagnosis on Agreeableness. Both Emotional Stability and Academic Self-Concept are unaffected by shocks to either the mother or the father.

We finally note that there is no support for a greater vulnerability of boys in terms of socio-emotional skills relative to girls from this type of family disadvantage. Tests of the interaction between parental shocks and child gender (see Table 2) show very few significant interaction terms, and boys are not generally affected more negatively than girls.[13] While this result does not find the same patterns, in our context, as the aforementioned studies, it can possibly contribute an explanation for a recent puzzle: Lei and Lundberg (2020) find that while a father's absence leads to greater school problems among boys than girls, this does *not* affect boys' long-run outcomes in terms of educational attainment, employment, or income. Our results on death are of course only partially related to father absence (which can be due to many other reasons), but the relative robustness of boys' skills to this type of absence can speak to long-run results as well.

[13] Only 4 out of 40 tests are statistically significant, and two of those are even *positive* interactions with male gender (bereavement and mental health diagnosis of mother on Agreeableness). All significant interactions are concentrated in Agreeableness, not Conscientiousness which otherwise showed the only consistent effects of shocks. Boys decrease more than girls in Agreeableness from Any Health Shock or a mental health diagnosis to the father).

Table 5: The Short Run Effect of Parental Shocks by Parental Gender. Effect on Boys. Child Fixed Effects Estimates

	Conscientiousness			Agreeableness			Emotional Stability			Academic Self-Concept			# Shocks	
	(1) Father	(2) Mother	(3) Diff.	(4) Father	(5) Mother	(6) Diff.	(7) Father	(8) Mother	(9) Diff.	(10) Father	(11) Mother	(12) Diff.	(13) Father	(14) Mother
Death	−0.081*	0.029	−0.111	−0.081	0.131*	−0.212**	0.018	−0.036	0.054	−0.064	0.062	−0.126	416	220
	(0.04)	(0.07)	(0.08)	(0.05)	(0.07)	(0.09)	(0.05)	(0.07)	(0.08)	(0.05)	(0.07)	(0.08)		
Any Health Shock	−0.029	−0.012	−0.017	−0.029	−0.005	−0.024	−0.026	0.010	−0.035	−0.022	0.024	−0.046*	2,451	2,399
	(0.02)	(0.02)	(0.03)	(0.02)	(0.02)	(0.03)	(0.02)	(0.02)	(0.03)	(0.02)	(0.02)	(0.03)		
Cardiovascular	−0.027	−0.017	−0.010	−0.042	−0.048	0.006	−0.021	0.041	−0.062	−0.002	−0.042	0.040	1,098	488
	(0.03)	(0.04)	(0.05)	(0.03)	(0.04)	(0.05)	(0.03)	(0.04)	(0.05)	(0.03)	(0.04)	(0.05)		
Cancer	−0.033	−0.025	−0.008	−0.005	−0.023	0.018	−0.010	0.001	−0.012	0.014	0.035	−0.022	856	1,177
	(0.03)	(0.02)	(0.04)	(0.03)	(0.03)	(0.04)	(0.03)	(0.03)	(0.04)	(0.03)	(0.03)	(0.04)		
Mental Health	−0.027	0.010	−0.037	0.007	0.053	−0.047	−0.059	0.013	−0.072	−0.084*	0.052	−0.137**	532	768
	(0.04)	(0.03)	(0.05)	(0.05)	(0.04)	(0.06)	(0.04)	(0.04)	(0.06)	(0.04)	(0.04)	(0.06)		

Note: This table reports the results for the sub-sample of boys only, distinguishing the parental shocks by whether they are experienced by the father or the mother. Each cell from columns "Father" and "Mother" reports the β coefficient from Equation (1) that identifies the causal effect of experiencing a given parental shock on the children's socio-emotional skills. Columns "Diff." report the coefficient on the interaction term between the indicator for the respective shock and the sex of the shocked parent, estimated over the sample of boys, who experience a parental shock to either the mother or the father. Standard errors in parentheses clustered at the child level. $^{*}(p < 0.10)$,** $(p < 0.05)$,*** $(p < 0.01)$.

Table 6: The Short Run Effect of Parental Shocks by Parental Gender. Effect on Girls. Child Fixed Effects Estimates

	Conscientiousness			Agreeableness			EmotionalStability			Academic Self-Concept			# Shocks	
	(1) Father	(2) Mother	(3) Diff.	(4) Father	(5) Mother	(6) Diff.	(7) Father	(8) Mother	(9) Diff.	(10) Father	(11) Mother	(12) Diff.	(13) Father	(14) Mother
Death	−0.071	−0.039	−0.032	0.014	−0.096	0.110	0.027	0.016	0.011	−0.015	−0.083	0.068	392	221
	(0.04)	(0.07)	(0.08)	(0.05)	(0.07)	(0.09)	(0.05)	(0.06)	(0.08)	(0.05)	(0.07)	(0.08)		
Any Health Shock	−0.039**	−0.003	−0.036	0.029	−0.004	0.032	0.009	−0.027	0.036	−0.011	−0.010	−0.001	2,377	2,337
	(0.02)	(0.02)	(0.03)	(0.02)	(0.02)	(0.03)	(0.02)	(0.02)	(0.03)	(0.02)	(0.02)	(0.03)		
Cardiovascular	0.010	−0.030	0.040	−0.022	−0.011	−0.011	0.027	0.042	−0.015	−0.020	−0.022	0.002	1,021	444
	(0.03)	(0.04)	(0.05)	(0.03)	(0.05)	(0.06)	(0.03)	(0.05)	(0.06)	(0.03)	(0.04)	(0.05)		
Cancer	−0.085***	0.017	−0.102***	0.038	0.028	0.010	0.016	−0.038	0.054	0.006	0.001	0.004	800	1,225
	(0.03)	(0.02)	(0.04)	(0.03)	(0.03)	(0.04)	(0.03)	(0.03)	(0.04)	(0.03)	(0.03)	(0.04)		
Mental Health	−0.049	−0.013	−0.036	0.114***	−0.049	0.163***	−0.004	−0.030	0.026	−0.011	−0.018	0.007	603	724
	(0.04)	(0.03)	(0.05)	(0.04)	(0.04)	(0.05)	(0.04)	(0.04)	(0.05)	(0.04)	(0.04)	(0.05)		

Note: This table reports the results for the sub-sample of girls only, distinguishing the parental shocks by whether they are experienced by the father or the mother. Each cell from columns "Father" and "Mother" reports the β coefficient from Equation (1) that identifies the causal effect of experiencing a given parental shock on the children's socio-emotional skills. Columns "Diff." report the coefficient on the interaction term between the indicator for the respective shock and the sex of the shocked parent, estimated over the sample of girls, who experience a parental shock to either the mother or the father. Standard errors in parentheses clustered at the child level. $^{*}(p < 0.10)$,** $(p < 0.05)$,*** $(p < 0.01)$.

IV. Long Run Effects of Parental Shocks on Child Socio-Emotional Skills

The previous sections have painted a picture of relative robustness of children's socio-emotional skills. We have found evidence of small but significant effects in Conscientiousness and some effects on Agreeableness and Emotional Stability for specific subgroups.

Yet as discussed earlier, one could surmise that the effects of parental shocks do not materialize immediately, but rather accumulate over time into long-run effects. Under this hypothesis, children who experience a shock earlier in life would have less advantageous socio-emotional skills later in life. Both the pooled child-fixed effects and the event study design are limited to the study of shocks that occurred during the 4 years during which we observe the socio-emotional skills in the DWS, at ages 10 to 16. While the event study lets us explore dynamics to some extent, the latest we observe child outcomes is three years after the parental health shock.

To explore the long-run effects of parental shocks that affect children from earlier ages, we employ an empirical strategy that identifies these effects by comparing siblings. This strategy has also been employed by Laird et al. (2020) on Danish data to study the effect of divorce on educational attainment, and by Chen et al. (2009) to study the effect of a parental death on educational attainment in Taiwan. Specifically, we estimate the following model over a sample of sibling pairs who experienced the same parental health shock at different ages from 0 to 14:

$$Y_{ipa} = \alpha + \sum_{s=0}^{13} \beta_s \cdot I(AgeShock_i = s) + \phi_p + \gamma X_i + \epsilon_{ipa} \tag{3}$$

where Y_{ipa} is the standardized trait of child i, born to parent p, measured at age a (in our case, age 15); $AgeShock_i$ is an indicator for child i experiencing a shock at age s; ϕ_p is a parent fixed effect; and X_i is a vector of controls, including birth order and sex of the child. The β_s parameters identify the causal effect of experiencing a parental shock at a given age with respect to experiencing it at a baseline age (here, age 14) without assuming any parametric form. With this strategy we are able to consider all shocks a child can experience from age 0 to age 14. We are, however, restricted to analyzing sibling pairs who have lived through the same parental shock and who have both completed the DWS at age 15. Therefore, with four waves of the survey, the sample of siblings considered can be born at most four years apart, and the gap in a given shock occurring between the two can also be at most four years.[14]

We apply this strategy to study, primarily, the effect of Any Health Shock, as this definition of parental shocks provides us with the largest sample size of sibling pairs who experience a parental shock. Figure 4 plots the estimated effect of experiencing a parental health shock at a given age relative to experiencing the same shock at age 14. We see that with the exception of Conscientiousness, children's socio-emotional skills are not diminished from experiencing parental health shocks earlier in life. The non-parametric effects of early shocks on Conscientiousness are, in general, significant and their size is up to 1 standard deviation for shocks experienced during

[14] This leads to larger confidence intervals of the coefficients for shocks experienced at ages further from the baseline age of 14, as they are the compounded effect from smaller gaps in the shocks experienced by siblings.

the first years of the children's lives.

Since these non-parametric age-by-age estimates of Equation (3) look rather linear, we also estimate the following linear specification to gauge the magnitude of the effect and increase precision, differing from Equation (3) only in that the age at which each child i experiences the shock enters linearly:

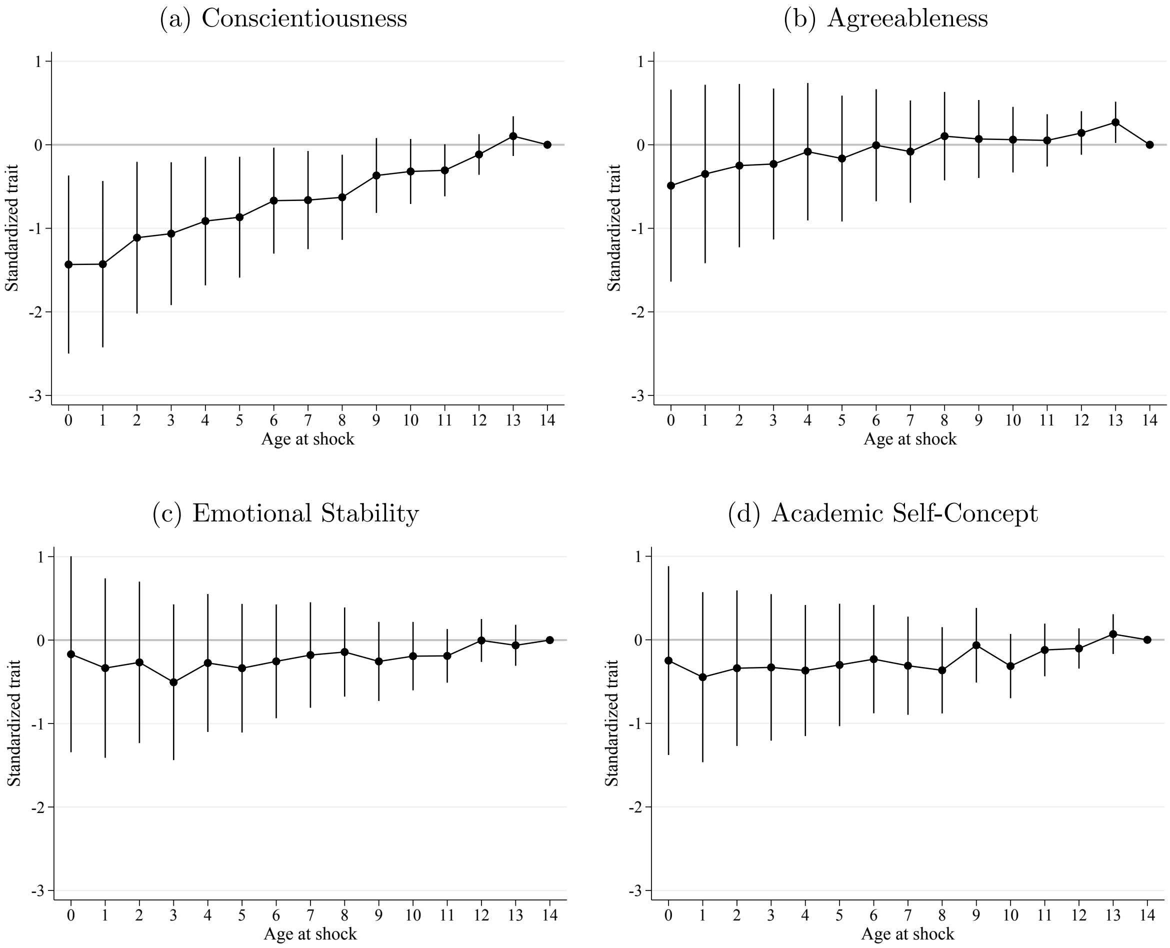
$$Y_{ipa} = \alpha + \beta \cdot AgeShock_i + \phi_p + \gamma X_i + \epsilon_{ipa} \tag{4}$$

We report the results in Table 7. The first row corresponds to the effect for Any Health Shock, and shows results consistent with the non-parametric estimates: that experiencing a health shock earlier, rather than later, has significantly more harmful effects on Conscientiousness at age 15. Specifically, we find that experiencing a parental health shock one year later increases Conscientiousness by 0.12 of a standard deviation. The other traits also have positive estimates for experiencing the health shock later in life, but are smaller and not statistically significant. These results would be in line with an accumulation of disadvantage, which could stem from the dynamic complementarity in skill formation over the life cycle.

Perhaps surprisingly, the long-run effect of experiencing a shock one year later is larger than the short-run effect of experiencing the shock as estimated in Table 2. Note however that the two estimates are not directly comparable: the short-run results in Table 2 use a child's pre-shock socio-emotional score as a counterfactual to identify the effect of the shock immediately after, while the long-run effects from Table 7 use the sibling's score measured at the same ages (15) as a counterfactual to identify the effect of having experienced a shock at different ages. Also, the short-run sample considers shocks that can occur between ages 10-15 while the long-run shocks considers shocks between ages 0-14. One explanation under which both results would be reconciled, if we engaged in the thought experiment of considering them strictly comparable, is the case where there is no effect on socio-emotional skills in the period immediately after the shock, but it emerges some time after. This could be seen as an "incubation" period. Under this hypothesis, our short-run strategy would not capture the effects from the post-incubation period, while the long-run strategy, which evaluates the traits at a later age of 15, would. If this were the case, the long-run strategy should not find an effect for shocks experienced right before the socio-emotional skills are measured, and we indeed see a flat or less pronounced slope for shocks between ages 12 and 14.

Next, we apply our long-run methodology to study the effect of parental deaths. We note, however, that this exercise is severely limited by the reduction in sample size, and we therefore interpret the results with caution. The second row of Table 7 reports the results for parental deaths and Online Appendix Figure 5 and Figure 6 show the corresponding non-parametric estimates. We note that the effect of experiencing a later parental death on Conscientiousness is similar in magnitude to the one from experiencing a later parental health shock, although not statistically significant. Interestingly though, we observe that a parental death experienced earlier in childhood has a negative and significant effect on Emotional Stability and on Academic Self-Concept. We explore these results in more depth in the third and fourth rows by splitting the sample based on whether the surviving parent repartners (either remarrying or cohabiting with a new partner) by the time the older sibling has reached age 15. We find that the effects on Emotional Stability and on Academic Self-Concept are driven by families that do not repartner. We also find that among families who do repartner, an early parental death leads to higher levels of Agreeableness. While some of these findings based on repartnering might suggest interesting insights, such as the attenuating role of repartnering after a parental death, we refrain from making those claims, as the selected sample of families who repartner might be different in other ways that could correlate with how well they cope with a parental loss. We see this as a potential line of future research.

Figure 4: Long Run Effect of Experiencing a Parental Health Shock at Different Ages



Note: These graphs report the β_s coefficients from Equation (3), where each coefficient identifies the causal effect of experiencing a parental health shock at a given age relative to experiencing the same shock at age 14. Identification comes from comparing siblings who both experienced the same shock but at different ages. We report confidence intervals at the 95% level from clustered standard errors at the parental level.

With all mentioned caveats, we see the long-run results as complementary of the main analysis. It is very difficult to obtain very early pre-shock measures of socio-emotional skills for a large sample of children, and then have long-run follow-up data. Therefore, even though we interpret

Table 7: Long Run Effect of Parental Shocks. Linear Estimates from Parent FE

	(1) Conscient.	(2) Agreeablen.	(3) Emot.Stability	(4) Acad.Self-Concept	(5) # Shocks
Age Any Health Shock	0.117***	0.0498	0.0342	0.0512	3,772
	(0.038)	(0.041)	(0.041)	(0.038)	
Age at Death Shock	0.131	-0.0212	0.192*	0.210**	482
	(0.11)	(0.11)	(0.11)	(0.096)	
Not Repartnered	0.122	0.183	0.348**	0.309**	322
	(0.15)	(0.13)	(0.14)	(0.13)	
Repartnered	0.144	-0.416**	-0.118	0.0354	160
	(0.16)	(0.20)	(0.16)	(0.13)	

Note: This table reports the β coefficient estimated in Equation (4) that identifies the linear effect of experiencing a parental shock one year later, closer to the baseline age of 14. Each column reports the effect on a different socio-emotional skill, which are standardized by child's sex, grade, and calendar year to have mean zero and standard deviation 1, and are measured at age 15. The first row reports the for parental health shocks, the second row reports the effect for parental deaths, the third and fourth rows report the effect for parental deaths distinguishing between families who do not repartner and families who do. Robust standard errors clustered at the parental level are reported in parentheses. $^{*}(p<0.10)$,** $(p<0.05)$,*** $(p<0.01)$

the results with caution, they provide important suggestive evidence for the importance of the timing of early shocks — this calls for further research in this area to explore long-run dynamics of children's personality formation and to speak directly to the literature on life cycle skill formation.

V. Robustness

The measures of socio-emotional skills in our study are based on self-reports on a repeated survey, the DWS. This way of assessing skills is associated with two separate concerns we discuss in detail here. First, there is the question of whether the measurement of socio-emotional skills is invariant to shocks. Second, we empirically assess whether selective nonresponse could drive our small-to-zero findings.

A. Using Child Self-Reported Measures of Socio-Emotional Skills

We interpret changes in the reported socio-emotional skills as true changes in these skills. There is a possibility, however, that parental health shocks affect the way their children *perceive* and *report* on their own skills independently of *true* changes in their skills. We argue that this form of reporting error is unlikely to have affected our results, for the following two main reasons.

Firstly, note that we *consistently* find very small or precise-zero estimates in the majority of traits and shocks. Therefore, the potential reporting error from *perception* changes in skills would have to exactly offset the true effect in skills caused by the parental shock. For example, if a parental shock causally decreases their child's Emotional Stability, for us to find a precise null effect the parental shock would have to induce the child to misperceive that their Emotional

Stability had actually *increased* by the same amount. We consider it highly unlikely that this occurs regularly, particularly in light of our finding of very small effects across all four socio-emotional skills and across all sub-groups. In addition, because our event studies also show small effects consistently during the three years following the shock, this would require that the magnitude of the bias was consistently offsetting the real effect over this entire period.

Secondly, influential studies have tested this possibility directly, concluding that reporting was unchanged following different life shocks. Lüdtke et al. (2011) and Specht et al. (2011) rely on the fact that the unobserved personality trait (the factor) manifests itself in the answers to *many* questionnaire items. They use latent trait models of personality to test whether life events or shocks changed the reporting on items relative to the factor. In other words, they examine whether the factor loadings of the items, intercepts, and residual variances remain the same (see a discussion of the power of these tests in Jackson and Allemand, 2014). The results from these studies using two different, large datasets show that personality measurements are characterized by strict factorial invariance over time. They conclude that the relationship between (unobserved) true personality and the (observed) measures did *not* change, and that therefore changes in the measures could be interpreted as changes in the underlying personality trait.

B. Testing Nonresponse in the DWS as a Function of Shocks

A second challenge for our analysis is the possibility that children who just experienced a parental shock may not show up in the following survey. This challenge is common to most other studies, but our access to register data for the entire population of children in Denmark gives us the unique opportunity to quantify the degree of non-participation and partial responses, and we can implement a Lee-bounds inspired imputation. This still results in small effects of parental shocks, showing that our findings are not driven by nonresponse. Nonresponse can stem from non-participation in the survey, possibly because children did not attend school when the survey was distributed. There may also be partial response if children who participate in the DWS after experiencing a parental shock do not answer the specific questions that we use to construct the measure of socio-emotional skills.

Non-participation in the DWS. Starting with the full population of children in Denmark who were enrolled in schools that administered the survey in a given year, for a given age group,[15] we focus on children who experienced a parental shock during the period in which the DWS was collected, and who participated in the DWS the year before the shock.

We test whether the parental shock increases the likelihood of not participating in the DWS the years after ($t = \{0, 1, 2\}$) against the likelihood of not participating in the DWS the years before ($t = \{-2, -3\}$). Specifically, we estimate the following regression

$$Y_{it} = \alpha + \beta \cdot Post_{it} + \delta \cdot D_{-1} + \gamma X_i + \epsilon_{it} \tag{5}$$

[15] Note that we do not observe the class or grade of children who do not participate in the DWS, which is why we use age instead.

where Y_{it} is an indicator for not participating in the DWS, $Post_{it}$ is an indicator for time after the parental shock $t = \{0, 1, 2\}$ and D_{-1} is a dummy variable for the period just before the shock, that we exclude because by construction all children participate in the DWS in that period. X_i is a vector of controls composed of children's age interacted with sex.

The non-participation test in column (1) of Table 8 shows that children who experience a parental shock have a slightly increased likelihood of non-participation the years after. The effects are small and only significant for mortality shocks (.032 of a standard deviation) and cancer shocks (.016 of a standard deviation).

The increased probability of non-participation in the DWS after a parental shock could bias our results if the non-participant children are a selected subsample, such as those affected the most by the parental shock. To be reassured that our results are robust to this possible bias, we replicate our analysis imputing the traits of the missing respondents with the least favorable and the most favorable outcomes from the observed distribution of children who participated in the DWS (see Online Appendix Table 3). This test is inspired by Lee (2009). With the least favorable imputation, assigning the worst outcomes (10^{th} percentile of the distribution) to all non-participant children, only a few coefficients are significantly different from zero, and all point estimates are below -0.075 of a standard deviation (in absolute terms). These are still fairly small effects.

Non-participation is almost a non-issue in the DWS thanks to the way it was distributed, reaching almost all children in public schools. This is an advantage especially in comparison to smaller, voluntary surveys, particularly if the respondents are the potentially shocked parents. Selective non-participation is mostly unfeasible in these settings.

Partial response in the DWS. The second type of non-response would occur if children who experience a parental shock are less likely to answer the questions we use to construct the socio-emotional skills, and are therefore excluded from the analysis.

To test partial response we consider the full sample of children who participated in the DWS, and construct an indicator variable for when a child did not answer one or more of the questions used to construct the socio-emotional skills and therefore misses one or more trait. We then apply the same empirical strategy as for the short-run analysis, and estimate Equation (1) for the partial-response dummy variable. The results are reported in column (3) of Table 8 and we find no evidence of a greater likelihood of missing traits (partial response) after experiencing a parental health shock. For bereavement, the point estimate is 0.023 but it is not statistically significant from zero.

VI. Discussion and Conclusion

We have presented causal evidence for the effects—or absence of effects—of parental health shocks on child socio-emotional skills. Our short run analyses using child fixed effects and event studies suggest relative robustness of 11-16 year-old children's socio-emotional skills against the severe parental shocks that we consider. One trait, Conscientiousness, is consistently lowered in the wake of parental health shocks or bereavement, but the magnitude is small. Even in the more detailed subgroup analyses, the largest negative estimates of short-run effects remain

Table 8: Non-Response as Function of Parental Shocks

	(1) Non-participation	(2) # Shocks	(3) Partial Response	(4) # Shocks
Death	0.032**	1,598	−0.023	1,368
	(0.01)		(0.014)	
Any Health Shock	0.002	11,720	−0.006	10,515
	(0.00)		(0.005)	
Cardiovascular	−0.007	3,777	0.002	3,371
	(0.01)		(0.009)	
Cancer	0.016**	4,773	−0.012	4,356
	(0.01)		(0.007)	
Mental Health	0.003	3,335	−0.006	2,922
	(0.01)		(0.01)	

Note: Each cell of column (1) reports the β coefficient from Equation (5) for each parental shock, capturing the increased likelihood of not participating in the DWS after experiencing a parental shock. Column (3) reports the β coefficients from Equation (1) for an outcome variable that takes one if a child did not answer one or more questions used to construct the socio-emotional traits. The number of shocks is larger in the test of non-participation (col. (2) vs (4)) because we also include shocked children who did not participate in the DWS. Robust standard errors clustered at the individual level. $^{*}(p < 0.10)$,** $(p < 0.05)$,*** $(p < 0.01)$.

below -.085. While there is some heterogeneity in the effects by family income and gender, we do not find specific groups that have a consistently greater risk of experiencing decreases in their socio-emotional skills following parental shocks. Our complementary analysis on long-run effects also shows generally robust socio-emotional skills, although we observe some accumulation of effects that lead to significant effects, particularly in Conscientiousness.

The absence of large effects of parental health shocks is not surprising when considering the existing evidence for adults that shows the resilience of their socio-emotional skills. Cobb-Clark and Schurer (2012) study the stability of Big Five personality traits and conclude that intra-individual changes are unrelated to adverse life events and are small in magnitude. Cobb-Clark and Schurer (2013) convincingly show that the personality trait of Locus of Control is invariant to life events such as family formation and dissolution, fertility, labor market shocks, retirement, and own health shocks. Lüdtke et al. (2011) also find that Conscientiousness and Agreeableness do not change much following most life events. One of the 34 life events they consider is the death of a family member, which was also not significantly associated with changes to any of the Big Five personality traits. Specht et al. (2011) test for individual-specific changes in personality in response to life events including death of a parent, not finding any significant associations for individuals aged 16-82. For adolescents, Elkins et al. (2017) observe individuals for an eight-year span into young adulthood, and do not find any systematic association between major life events and different personality traits. Finally, Prevoo and ter Weel (2015) present non-causal evidence of how children's skills are changed after family disruptions, including parental deaths. Conditionally on covariates, parental deaths do not significantly affect Self-esteem, Locus of Control, and behavioral problems.

On the other hand, this robustness was not to be expected for the sample of children in the age range 11-16 that we consider. We study the period in life during where one would expect the largest potential effects of parental shocks on socio-emotional skills. Childhood and early adolescence is the time in one's life during which personality traits are potentially the most malleable (see, for ex. Roberts and DelVecchio, 2000), and personality has been observed to generally change the most during adolescence and early adulthood (Roberts and DelVecchio 2000, Bleidorn 2015) together with old age (Specht et al. 2011, Lucas and Donnellan 2011). Accordingly, Cobb-Clark and Schurer (2013) show that personality changes are concentrated among the *young*. Furthermore, personality is malleable even within short periods when they are triggered by a major life transition, of which severe parental health shocks could plausibly be one example (Bleidorn, 2012), although the existing literature has focused on childbirth, entering working life, and the like. Childhood is also the time during which parents still exert a considerable influence—thus leaving the door open for the largest spillovers.

Expecting *some* effects during childhood, however, does not yet say whether these should be positive or negative. One could have expected negative effects due to the fact that we consider more severe shocks than Mühlenweg et al. (2016) and Le and Nguyen (2017), which had pointed to some negative effects. Furthermore, there is evidence presented in Kristiansen (2021) using similar Danish data that parental health shocks not only negatively affect children's educational performance and attainment, but also increases their use of anti-depressant medication and therapy. Since Emotional Stability is related to anxiety and depression (Rodriguez-Ramos et al., 2021, Kotov et al., 2010), we would have expected negative effects on this measure of socio-emotional skills. It is important to note, however, that the finding that psychotherapy and anti-depressant medication increase after experiencing these parental shocks might in itself be an explanation for the lack of negative effects we find, as it suggest that there are already policies in place meant to buffer these shocks.

Note however, that we find evidence of long-run decreases in child's Conscientiousness, and to some extent Emotional Stability or Academic Self-Concept, when comparing siblings who experience the same parental shock at different ages. While we interpret these estimates with caution due to the large standard errors, they provide novel evidence on the formation of children's socio-emotional skills, potentially reflecting accumulation or incubation dynamics following early shocks. Providing this type of causal estimates demands large datasets over a long period of time, with information on both parents' health and children's socio-emotional skills, making our dataset ideally suited to the task. Still, we think further research is needed to better understand the long-run dynamics of parental investments on children's personality formation.

We have tested whether parental health shocks causally shape child socio-emotional skills. We thereby contribute to the literature on life cycle skill formation, because child skills are shaped by parental investments in terms of time and resources, and both of these are possibly affected by shocks to parents' health. A large literature documents how early childhood experiences affect long-run outcomes, but many of these experiences are intertwined and correlated with other parental characteristics. Therefore, it is important that we find that parental health shocks *in themselves* do not generate large differences in child skills, at least in the short-run.

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Are Children's Socio-Emotional Skills Shaped by Parental Health Shocks?

ONLINE APPENDIX

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I. Supplementary Material

Table 1: Association of Socio-Emotional Skills with Demographic Characteristics

	(1) Conscient.	(2) Agreeablen.	(3) Emot.Stability	(4) Acad.Self-Concept
Female	-0.035^{***}	0.389^{***}	-0.292^{***}	-0.023^{***}
	(0.003)	(0.002)	(0.003)	(0.003)
Parents College	0.289^{***}	0.160^{***}	0.121^{***}	0.269^{***}
	(0.003)	(0.003)	(0.003)	(0.003)
Mother Income Lowest Quart.	-0.241^{***}	-0.151^{***}	-0.155^{***}	-0.216^{***}
	(0.003)	(0.003)	(0.003)	(0.003)
Single Mother	-0.246^{***}	-0.133^{***}	-0.172^{***}	-0.210^{***}
	(0.003)	(0.003)	(0.003)	(0.003)
Observations	1026664	1026664	1026664	1026664

Note: This table shows the differences in socio-emotional skills by socio-demographic characteristics for the full DWS. Each cell reports the β coefficient from estimating the equation $Y_{it} = \alpha + \beta D_i + \epsilon_{it}$ where D_i is a variable that takes 1 if the child's gender is female, or their parents have college education, or their mothers' income is in the lowest quartile or if, sequentially, the mother is a single mother. Socio-emotional skills are standardized by child's gender, grade, and calendar year except for the estimation of the gender gap, where we do not standardize by gender. $^{*}(p < 0.10)$,** $(p < 0.05)$,*** $(p < 0.01)$.

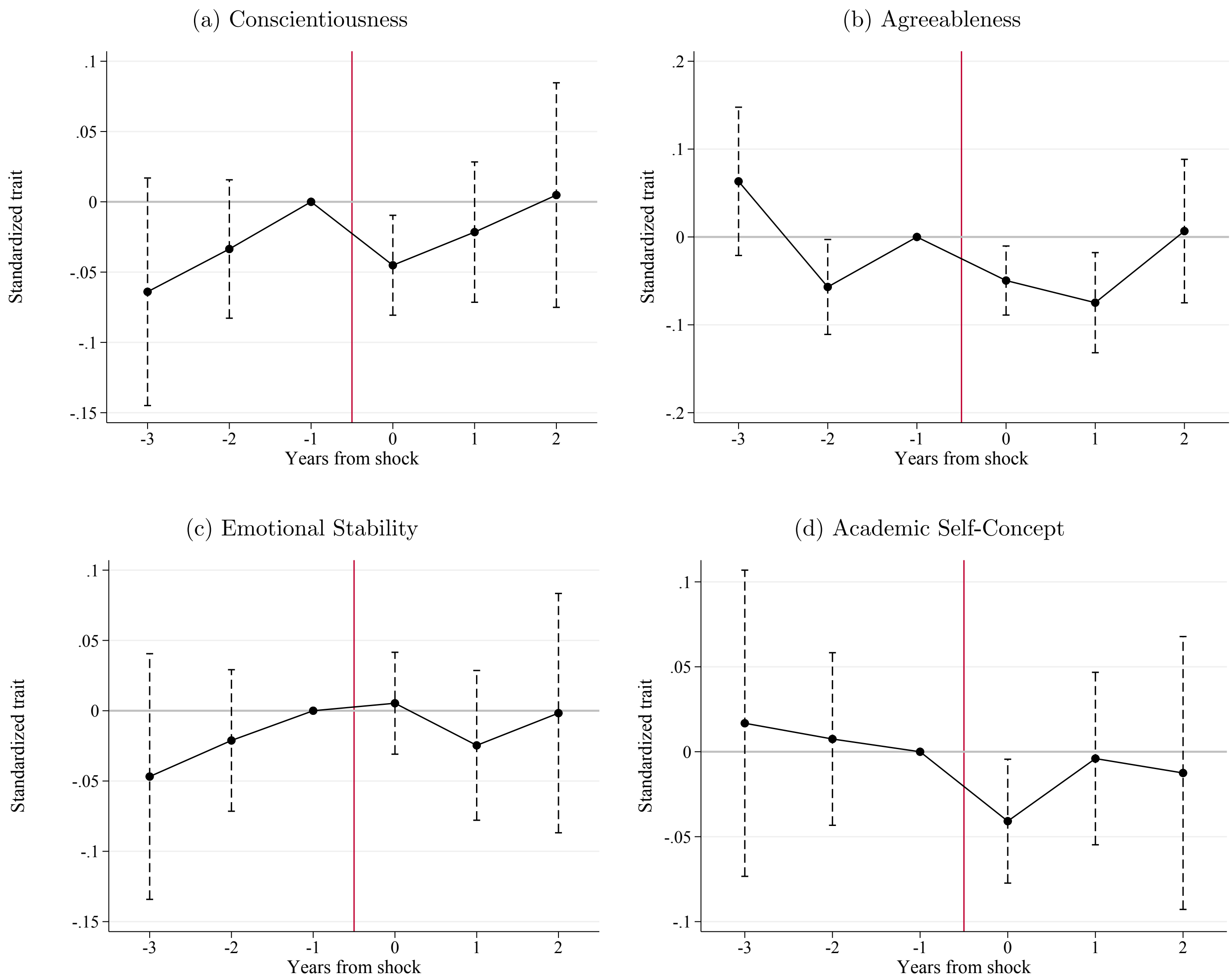
II. Additional Results on Short-Run Effects

Table 2: The Short Run Effect of Parental Shocks by Parent and Child Sex

	(1) Conscient.	(2) Agreeablen.	(3) Emot.Stability	(4) Acad.Self-Concept
Death Father	−0.071*	0.014	0.027	−0.015
	(0.04)	(0.05)	(0.05)	(0.05)
Death Father × Male	−0.010	−0.095	−0.009	−0.050
	(0.06)	(0.07)	(0.07)	(0.07)
Death Mother	−0.039	−0.096	0.016	−0.083
	(0.07)	(0.07)	(0.06)	(0.07)
Death Mother × Male	0.068	0.227**	−0.052	0.145
	(0.10)	(0.10)	(0.09)	(0.09)
Health Shock Father	−0.039**	0.029	0.009	−0.011
	(0.02)	(0.02)	(0.02)	(0.02)
Health Shock Father × Male	0.010	−0.058**	−0.034	−0.011
	(0.03)	(0.03)	(0.03)	(0.03)
Health Shock Mother	−0.003	−0.004	−0.027	−0.010
	(0.02)	(0.02)	(0.02)	(0.02)
Health Shock Mother × Male	−0.009	−0.001	0.037	0.034
	(0.03)	(0.03)	(0.03)	(0.03)
Cardiovascular Father	0.010	−0.022	0.027	−0.020
	(0.03)	(0.03)	(0.03)	(0.03)
Cardiovascular Father × Male	−0.037	−0.020	−0.048	0.018
	(0.04)	(0.04)	(0.04)	(0.04)
Cardiovascular Mother	−0.030	−0.011	0.042	−0.022
	(0.04)	(0.05)	(0.05)	(0.04)
Cardiovascular Mother × Male	0.013	−0.037	−0.000	−0.020
	(0.06)	(0.06)	(0.06)	(0.06)
Cancer Father	−0.085***	0.038	0.016	0.006
	(0.03)	(0.03)	(0.03)	(0.03)
Cancer Father × Male	0.052	−0.043	−0.027	0.008
	(0.04)	(0.05)	(0.04)	(0.04)
Cancer Mother	0.017	0.028	−0.038	0.001
	(0.02)	(0.03)	(0.03)	(0.03)
Cancer Mother × Male	−0.042	−0.051	0.039	0.034
	(0.04)	(0.04)	(0.04)	(0.04)
Mental Health Father	−0.049	0.114***	−0.004	−0.011
	(0.04)	(0.04)	(0.04)	(0.04)
Mental Health Father × Male	0.022	−0.107*	−0.055	−0.074
	(0.06)	(0.06)	(0.06)	(0.06)
Mental Health Mother	−0.013	−0.049	−0.030	−0.018
	(0.03)	(0.04)	(0.04)	(0.04)
Mental Health Mother × Male	0.024	0.102**	0.043	0.070
	(0.05)	(0.05)	(0.05)	(0.05)

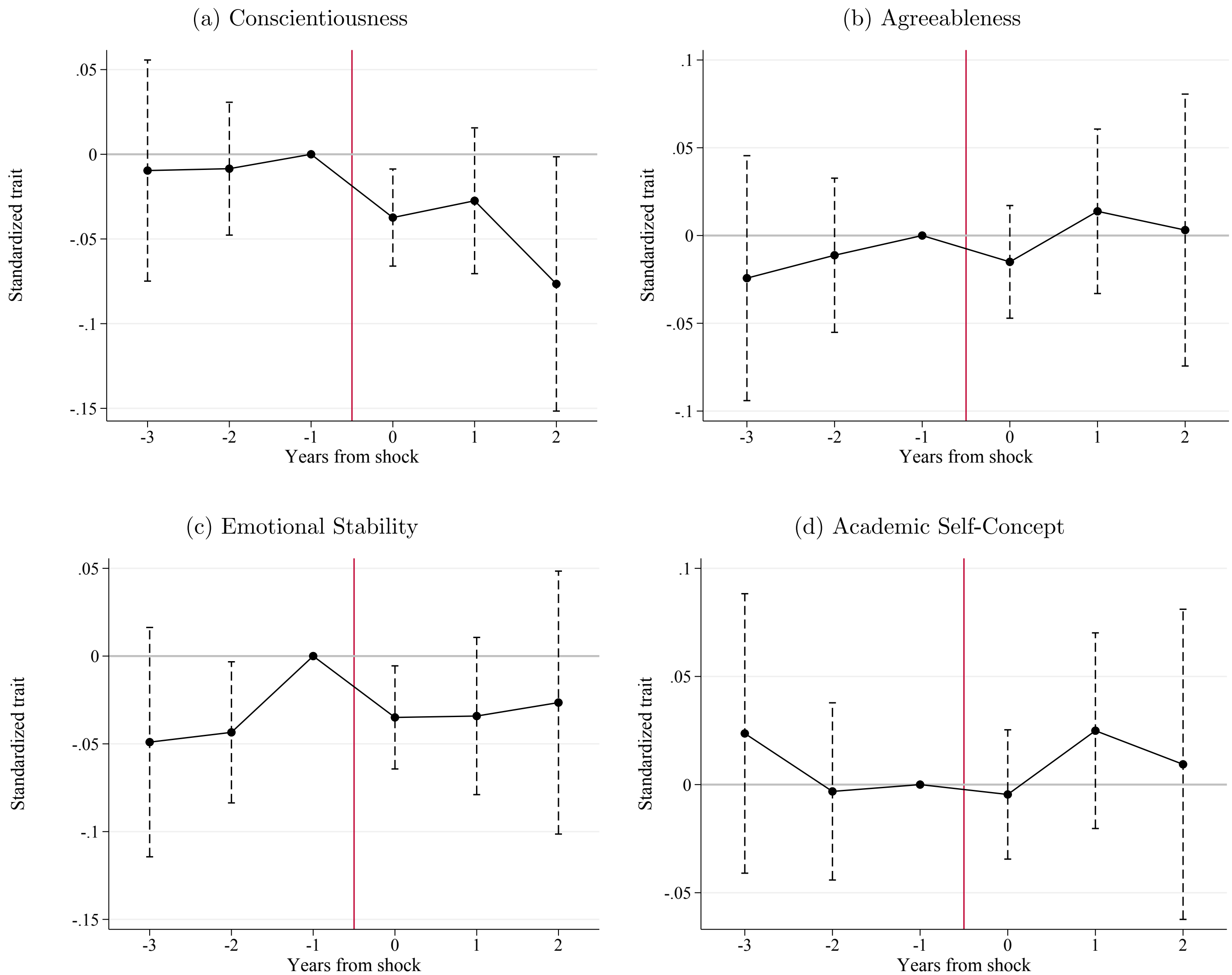
Note: This table presents the main results for the short-run effects estimated from Eq. (1) over the pooled sample of boys and girls but adding an interaction term if the child is male and experienced the a parental shock (such as "Death Father × Male." Parental shocks are also disaggregated by parental gender. This table therefore subsumes both Table 5 and Table 6 offering a statistical test for whether boys and girls are significantly affected differently by each type of parental shock. $^{*}(p < 0.10)$,** $(p < 0.05)$,*** $(p < 0.01)$.

Figure 1: Event Study: Cardiovascular Shock



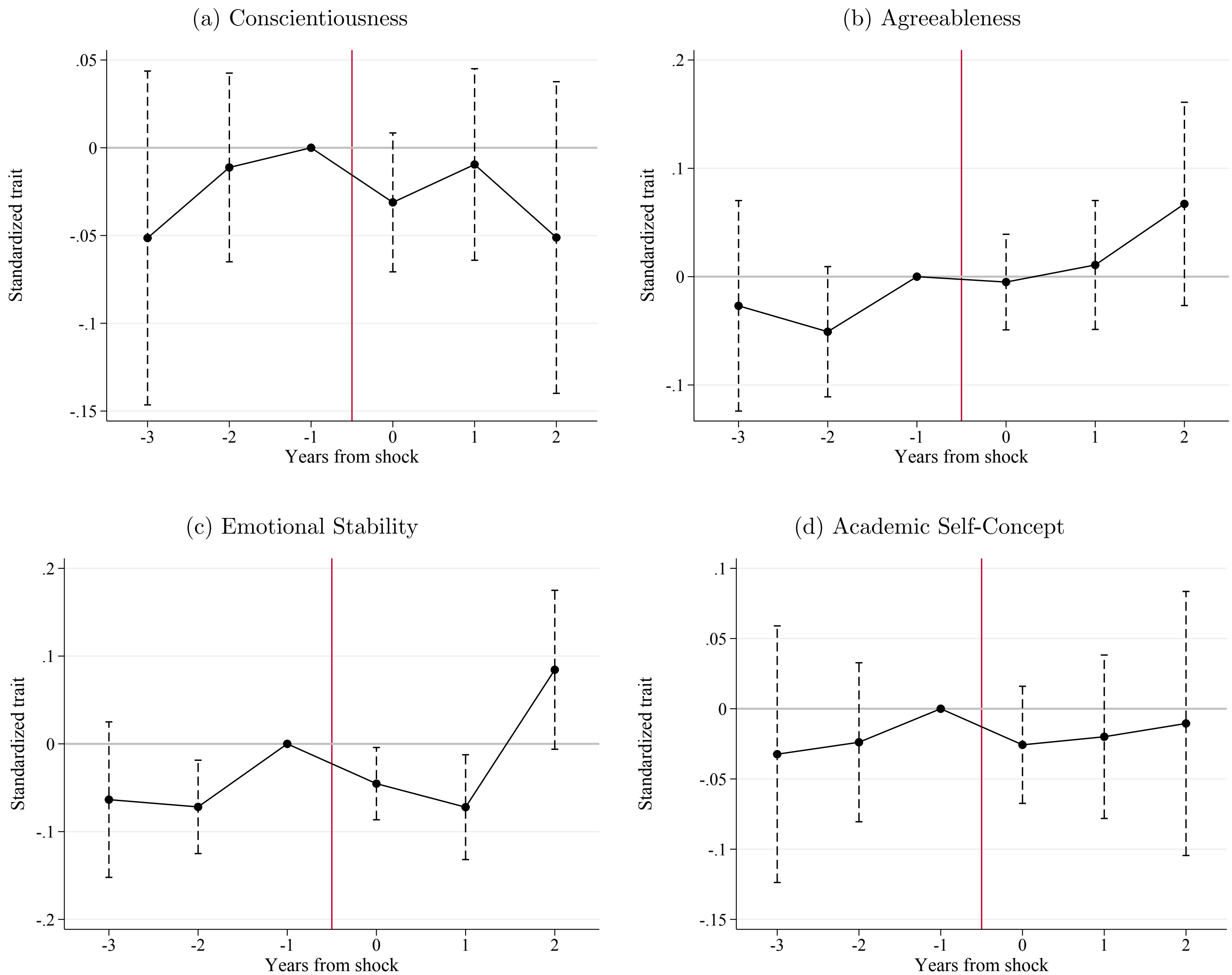
Note: These figures show the β_t coefficients estimated from Eq. (2) describing the dynamics of each socio-emotional skill around the time of the parent's health shock, which is indicated with the vertical red line between -1 and 0. The confidence intervals of each coefficient at the 95% level are calculated from standard errors clustered at the individual level.

Figure 2: Event Study: Cancer



Note: These figures show the β_t coefficients estimated from Eq. (2) describing the dynamics of each socio-emotional skill around the time of the parent's health shock, which is indicated with the vertical red line between -1 and 0. The confidence intervals of each coefficient at the 95% level are calculated from standard errors clustered at the individual level.

Figure 3: Event Study: Mental Health Diagnosis

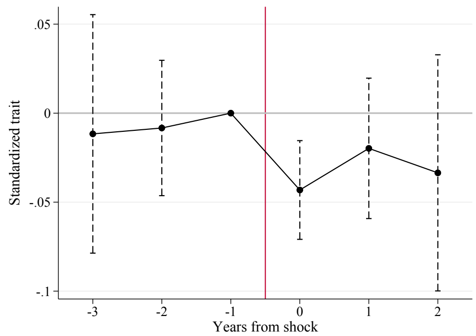


Note: These figures show the β_t coefficients estimated from Eq. (2) describing the dynamics of each socio-emotional skill around the time of the parent's health shock, which is indicated with the vertical red line between -1 and 0. The confidence intervals of each coefficient at the 95% level are calculated from standard errors clustered at the individual level.

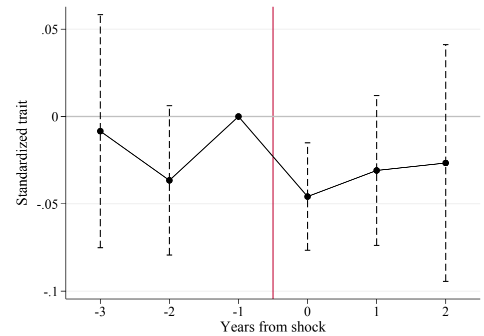
Figure 4: Event Study: Any Health Shock, by Child Gender

A. Boys

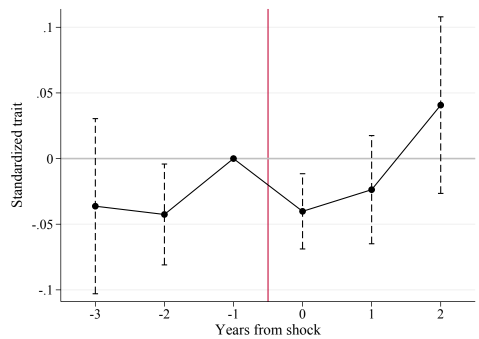
(a) Conscientiousness



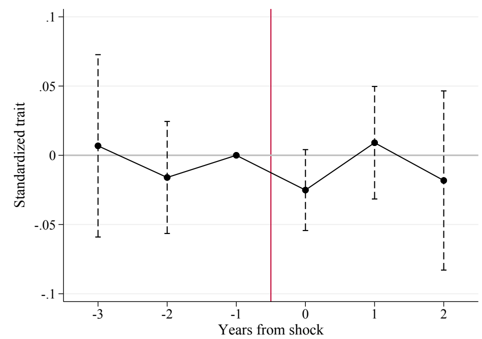
(b) Agreeableness



(c) Emotional Stability

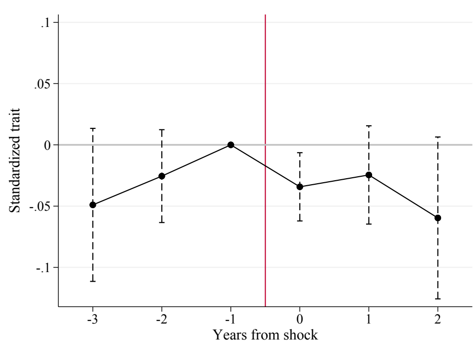


(d) Academic Self-Concept

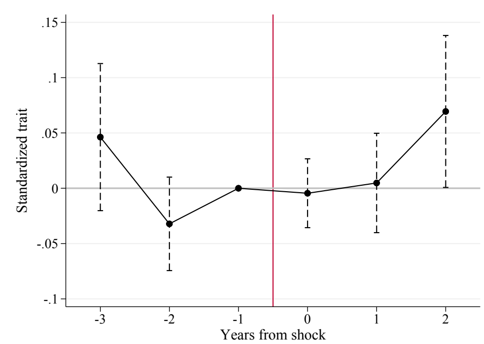


B. Girls

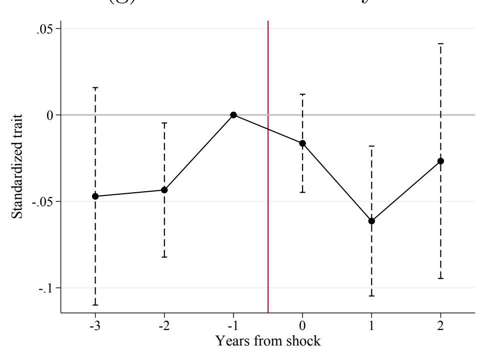
(e) Conscientiousness



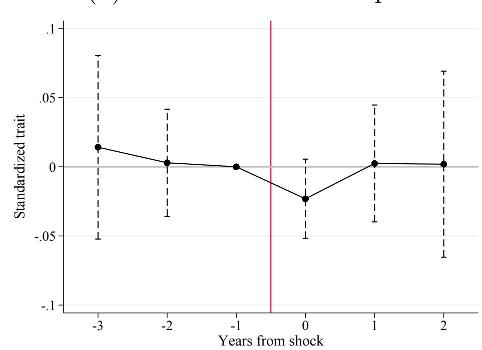
(f) Agreeableness



(g) Emotional Stability



(h) Academic Self-Concept



Note: See notes to Fig. 2 for further notes. Here replicating the strategy simply split by child sex.

Table 3: Individual Fixed Effects, Short Run

	(1) Conscient.	(2) Agreeablen.	(3) Emot.Stability	(4) Acad.Self-Concept	(5) # Shocks
A. Baseline					
Death	−0.054	0.026	0.022	0.002	1,436
	(0.04)	(0.05)	(0.04)	(0.04)	
Any Health Shock	−0.018	0.001	0.025*	−0.003	10,699
	(0.01)	(0.02)	(0.02)	(0.02)	
Cardiovascular	−0.008	−0.004	0.035	−0.035	3,436
	(0.03)	(0.03)	(0.03)	(0.03)	
Cancer	−0.026	−0.015	0.022	0.004	4,452
	(0.02)	(0.02)	(0.02)	(0.02)	
Mental Health	−0.010	0.054*	0.037	0.026	2,960
	(0.03)	(0.03)	(0.03)	(0.03)	
B. Lower bound					
Death	−0.073*	−0.043	−0.055	−0.037	1,531
	(0.04)	(0.04)	(0.04)	(0.04)	
Any Health Shock	−0.027*	−0.030**	−0.003	−0.020	11,221
	(0.01)	(0.02)	(0.02)	(0.01)	
Cardiovascular	−0.034	−0.057**	−0.030	−0.077***	3,610
	(0.03)	(0.03)	(0.03)	(0.03)	
Cancer	−0.029	−0.031	0.010	−0.006	4,620
	(0.02)	(0.02)	(0.02)	(0.02)	
Mental Health	−0.022	0.001	0.004	0.007	3,145
	(0.03)	(0.03)	(0.03)	(0.03)	
C. Upper bound					
Death	0.073*	0.110**	0.090**	0.123***	1,531
	(0.04)	(0.05)	(0.04)	(0.05)	
Any Health Shock	0.022	0.020	0.045***	0.033**	11,221
	(0.02)	(0.02)	(0.01)	(0.02)	
Cardiovascular	0.078***	0.060**	0.080***	0.045	3,610
	(0.03)	(0.03)	(0.03)	(0.03)	
Cancer	−0.000	−0.001	0.039*	0.026	4,620
	(0.02)	(0.02)	(0.02)	(0.02)	
Mental Health	0.014	0.039	0.040	0.047	3,145
	(0.03)	(0.03)	(0.03)	(0.03)	

Note: This table presents the result of the bounding exercise. Panel A presents the baseline estimates where children who do not participate in the DWS are not included. Note that this panel is equivalent to Table 2 except that we have excluded the observations from the year just before the parental shock, since by definition all children from this period participate in the DWS and including them in the estimation would bias the bounding exercise by adding one entire year of observations to the pre-shock period that will not be imputed. Instead, we follow the same strategy as we used to quantify the degree of non-participation and exclude the year before the shock. Panel B presents the estimates from a sample where for all children who did not participate in the DWS but who should have participated (based on the school they attend, their age and the calendar year), their traits have been imputed with the 10^{th} percentile of the observed distribution of children who participated. Panel C reports the results from imputing the most favorable outcomes to the non-participant children, based on the 90^{th} percentile of the observed distribution. See notes from Table 2 for more details. $^{*}(p < 0.10)$,** $(p < 0.05)$,*** $(p < 0.01)$.

III. Age-Specific Short-Run Effects of Parental Shocks

The fixed-effects estimates of Eq. (1) in our main specification in Section A. do not disaggregate effects by age of the child. The skill-formation literature explicitly mentions the possibility of sensitive and critical periods, especially early in life. Theoretically, there are also sensitive periods possible within the age range of our sample, 11-16 years. These age-specific effects can be tested in an alternative specification, such as

$$Y_{i,a} = \alpha + \beta_a D_{i,a} + \phi_i + \varepsilon_{i,a}, \tag{1}$$

where i denotes the child, t denote the calendar year, and a the child's age. As in the paper, Y_{it} is child i's standardized trait at time t; D_{it} is an indicator variable that takes 1 from time t and onward if a parental shock took place between $t-1$ and t, and ϕ_i is an individual fixed effect. the term ϕ_i is the child fixed effect, and $\varepsilon_{i,t}$ is the time-variant unobserved component. The difference to the main specification is that now β_a is age-specific.

The results from this estimation are in Tables 4 and 5. There are no age-specific patterns to the effects of these parental health shocks. There are 8 out of the 100 shocks that have significant results, which are below the number that would arise from chance within the 10% significance level accepting type 1 errors (falsely rejecting the null hypothesis of no effect).

Table 4: The Short Run Effect of Parental Shocks. Child Fixed Effects Estimates. Disaggregated by Age of the Child when Shock Occurred

	(1) Conscient.	(2) Agreeablen.	(3) Emot.Stability	(4) Acad.Self-Concept	(5) Obs.
Death Age 12	-0.067	0.030	0.073	-0.046	185
	(0.08)	(0.08)	(0.10)	(0.09)	
Death Age 13	-0.073	0.018	-0.020	-0.030	223
	(0.07)	(0.07)	(0.07)	(0.07)	
Death Age 14	-0.061	-0.027	-0.026	-0.057	271
	(0.06)	(0.06)	(0.06)	(0.06)	
Death Age 15	-0.043	0.009	0.084	0.072	257
	(0.06)	(0.07)	(0.06)	(0.06)	
Death Age 16	-0.030	0.013	0.039	-0.063	261
	(0.05)	(0.06)	(0.05)	(0.06)	
Any Health Shock Age 12	-0.006	0.019	0.005	-0.003	1,628
	(0.03)	(0.03)	(0.03)	(0.03)	
Any Health Shock Age 13	-0.015	-0.005	0.036	0.022	1,951
	(0.02)	(0.02)	(0.02)	(0.02)	
Any Health Shock Age 14	-0.031	0.005	-0.002	-0.029	1,939
	(0.02)	(0.02)	(0.02)	(0.02)	
Any Health Shock Age 15	-0.028	0.018	0.019	0.001	1,970
	(0.02)	(0.02)	(0.02)	(0.02)	
Any Health Shock Age 16	-0.024	-0.040^{*}	-0.031	-0.033	1,786
	(0.02)	(0.02)	(0.02)	(0.02)	

Note: Each cell reports the β_a coefficient of interest from estimating Eq. (1) separately for each personality trait of the children and for each type of parental shock. Each β coefficient identifies the causal effect of experiencing a given parental shock on the children's skills, which are standardized by child's sex, grade, and calendar year to have mean zero and standard deviation 1. Standard errors in parentheses clustered at the child level. $^{*}(p < 0.10)$,** $(p < 0.05)$,*** $(p < 0.01)$.

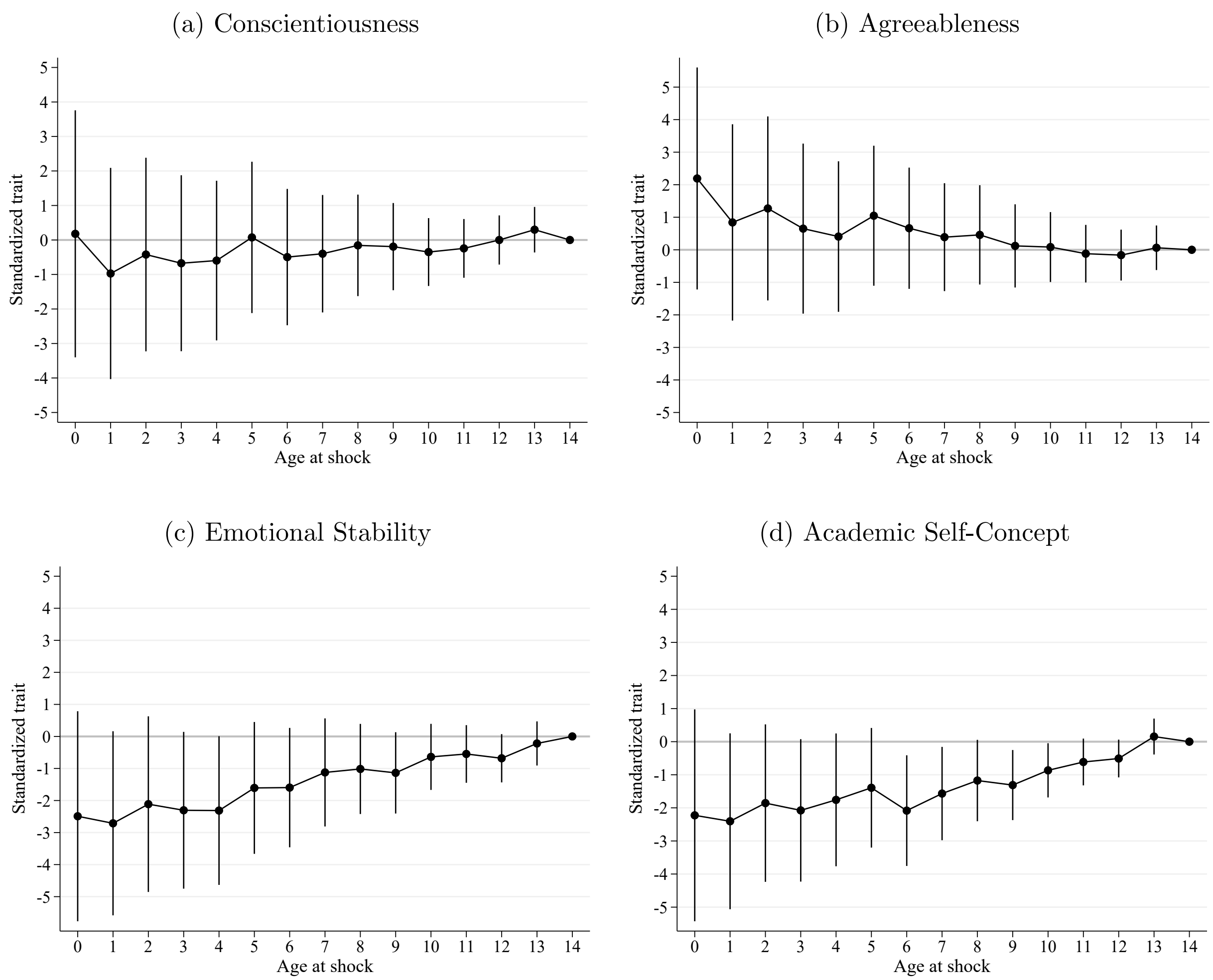
Table 5: The Short Run Effect of Parental Shocks. Child Fixed Effects Estimates. Disaggregated by Age of the Child when Shock Occurred

	(1) Conscient.	(2) Agreeablen.	(3) Emot.Stability	(4) Acad.Self-Concept	(5) Obs.
Cardiovascular Age 12	0.073	−0.073	0.020	0.026	488
	(0.05)	(0.06)	(0.05)	(0.05)	
Cardiovascular Age 13	−0.036	−0.028	0.096**	0.024	580
	(0.04)	(0.04)	(0.04)	(0.04)	
Cardiovascular Age 14	−0.045	−0.027	0.002	−0.059	619
	(0.04)	(0.04)	(0.04)	(0.04)	
Cardiovascular Age 15	−0.030	−0.003	0.028	0.003	645
	(0.04)	(0.04)	(0.04)	(0.04)	
Cardiovascular Age 16	−0.043	−0.040	0.025	−0.047	584
	(0.04)	(0.04)	(0.04)	(0.04)	
Cancer Age 12	−0.010	0.064	0.022	0.043	636
	(0.04)	(0.04)	(0.04)	(0.04)	
Cancer Age 13	−0.006	0.035	0.014	0.053*	858
	(0.03)	(0.03)	(0.03)	(0.03)	
Cancer Age 14	−0.016	0.015	−0.050	−0.036	828
	(0.03)	(0.03)	(0.03)	(0.03)	
Cancer Age 15	−0.027	0.025	0.024	0.011	839
	(0.03)	(0.03)	(0.03)	(0.03)	
Cancer Age 16	−0.032	−0.071**	−0.014	−0.037	761
	(0.03)	(0.03)	(0.03)	(0.03)	
Mental Health Age 12	−0.077*	0.049	−0.023	−0.081	507
	(0.05)	(0.05)	(0.05)	(0.05)	
Mental Health Age 13	−0.002	−0.049	0.015	−0.002	533
	(0.04)	(0.05)	(0.04)	(0.05)	
Mental Health Age 14	−0.014	0.027	0.084*	0.020	520
	(0.04)	(0.05)	(0.05)	(0.05)	
Mental Health Age 15	−0.022	0.079*	0.028	0.003	515
	(0.04)	(0.05)	(0.04)	(0.05)	
Mental Health Age 16	−0.002	0.033	−0.115**	−0.016	473
	(0.05)	(0.05)	(0.05)	(0.05)	

Note: Each cell reports the β_a coefficient of interest from estimating Eq. (1) separately for each personality trait of the children and for each type of parental shock. Each β coefficient identifies the causal effect of experiencing a given parental shock on the children's skills, which are standardized by child's sex, grade, and calendar year to have mean zero and standard deviation 1. Standard errors in parentheses clustered at the child level. $^{*}(p < 0.10)$,** $(p < 0.05)$,*** $(p < 0.01)$.

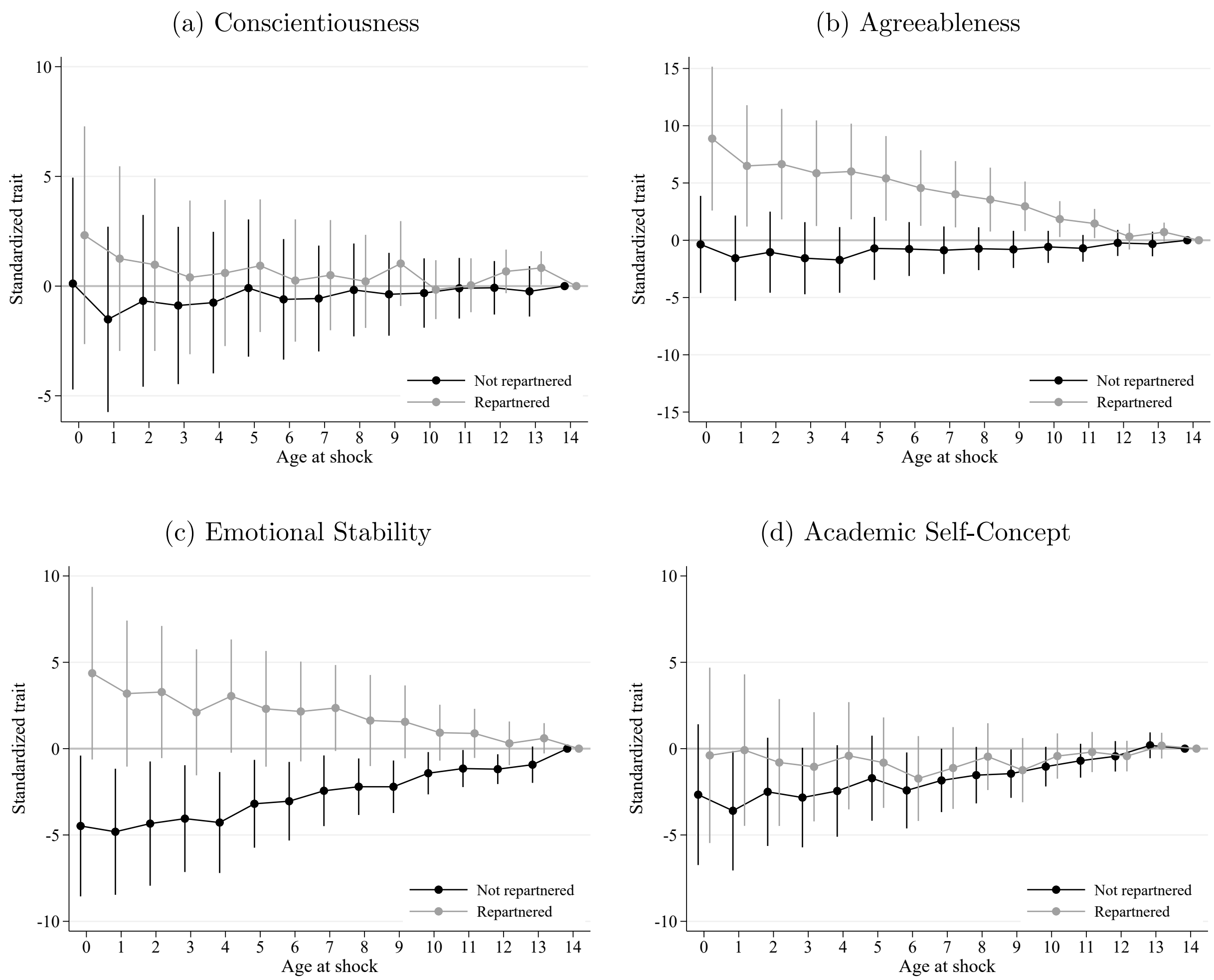
IV. Additional Results on Long-Run Effects

Figure 5: Long Run Effect of Experiencing a Parental Death at Different Ages



Note: These graphs report the β_s coefficients from Eq. (3), where each coefficient identifies the causal effect of experiencing a parental death at a given age relative to experiencing the same parental death at age 14. Identification comes from comparing siblings who both experienced the same parental death but at different ages. We report confidence intervals at the 95% level from clustered standard errors at the parental level.

Figure 6: Long Run Effect of Experiencing a Parental Death at Different Ages. Split by Repartnering



Note: These graphs report the β_s coefficients from Eq. (3), where each coefficient identifies the causal effect of experiencing a parental death at a given age relative to experiencing the same parental death at age 14. Identification comes from comparing siblings who both experienced the same parental death but at different ages. We report confidence intervals at the 95% level from clustered standard errors at the parental level.