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Contribution

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Abstract: Investigating the impact of family instability is important as more and more children experience different family changes in many industrialized countries. In this paper we examine the dynamics of family structure, looking at the potential effect of yearly maternal partnership transitions on adolescents' locus of control. We aim at combining research on family instability with research on non-cognitive skill formation. We use rich and nationwide German data to identify the relationship between family instability and adolescent locus of control. Combining entropy balancing with a novel econometric method to assess potential bias from omitted variables, we find that experiencing maternal partnership transitions is negatively associated with adolescents' belief in self-determination and that internal locus of control is reduced by about a fifth of a standard deviation among those affected, even after conditioning on a large number of covariates. This is particularly true if the transitions take place during "middle childhood."

Keywords: family dynamics, locus of control, matching
JEL classifications: J10, J12, J13

1 Introduction

Family instability is increasing in many industrialized countries, with children experiencing different family changes: whether separation, divorce, or widowing, and subsequence re-partnering; resulting in parental-like figures moving into (and out of) the household (see for example Cherlin 2009). 2012 figures for Germany show that 143,022 children experienced parental divorce, a jump from 1991 when 99,268 children experienced parental divorce (Statistisches Bundesamt – *Federal Statistical Office* 2012). As of 2009, single parent families

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make up 17 % of all families in West Germany and almost one-third of East Germany families. In comparison to 1996, these numbers represent an increase in West Germany of 31 % and in East Germany of 50 %. More than 40 % of all single mothers have to move on from a divorce, 18 % live separated from their married partner and 4 % have lost their partner (Statistisches Bundesamt – *Federal Statistical Office* 2010). Thus, an increasing number of children experience family instability. From a human development perspective, it is unclear how these instabilities affect children's outcomes, the subject of this paper.

There is a large literature in economics and the social sciences investigating the impact of family structure on children's well-being, examining health, education, and behavioral outcomes (see e. g., Del Bono, Ermisch, and Francesconi 2012; Francesconi, Jenkins, and Siedler 2010; Sigle-Rushton et al. 2014). This literature finds that, on average, marriage or cohabitation is associated with better outcomes for children in most circumstances (for summaries see Ribar 2004 or Waldfogel, Craigie, and Brooks-Gunn 2010). Family structure is traditionally measured as a status quo, strictly speaking, at one point in time. However, the growing literature on family structure dynamics focuses on the effects of repeated changes to the family household structure (see Section 3).

Another strand of literature – mainly in economics – focuses on child skill formation. This literature shows that family-related factors forming a child's environment are particularly important, even more important than the influence of schools or other institutions (for instance, Carneiro and Heckman 2003). The underlying theory on skill formation assumes that children develop cognitive and non-cognitive skills at different developmental stages (see Cunha and Heckman 2007, 2008). For children exposed to adverse (family) environments during childhood, remediation to both sets of skills is more effective if applied early (Cunha, Heckman, and Schennach 2010). Non-cognitive skills are traits describing a person's emotional maturity and social skills (see Heckman 2008). In economics, research focusing on the development of non-cognitive skills in early and late childhood is emerging. For example, studies look at the effects of parental time inputs (e. g. Fiorini and Keane 2014 or Del Bono et al. 2014) and formal daycare experiences (e. g. Datta Gupta and Simonsen 2010; Baker, Gruber, and Milligan 2008; Peter, Schober, and Spiess 2015) on children's socio-emotional behavior, as one measure of non-cognitive skills. The analysis of such skills of children has promise, as the economic literature on non-cognitive skills suggests that these skills are important predictors of other outcomes later in life, including education outcomes, health outcomes, and adult labor market success (e. g., Blanden, Gregg, and Macmillan 2007; Carneiro, Crawford, and Goodman 2007; Heineck and Anger 2010; Prevoo and ter Weel 2015; Silles 2010; Wichert and Pohlmeier 2010; Heckman, Pinto, and Savelyev 2013). In conjunction with self-esteem,

non-cognitive skills appear to be equally strong in its effects as cognitive skills (Heckman, Stixrud, and Urzua 2006).

In this paper, we examine how family instabilities during childhood relate to non-cognitive skills at 17 years of age. We investigate the potential impact of family instability, captured as maternal partnership transitions, on one specific non-cognitive skill measure, locus of control. Various studies show that locus of control is a particularly important non-cognitive skill that explains an individual's educational attainment, health, and future labor market outcomes, including earnings or length of unemployment (see e. g. Caliendo et al. 2015; Kaestner and Callison 2011 as well as reviews by Almlund et al. 2011; Cobb-Clark and Schurer 2013; Cobb-Clark 2014). The results of Barón and Cobb-Clark (2010) indicate that having an internal locus of control is associated with more positive educational outcomes. They find that adolescents' internal locus of control is positively associated with students' probability of completing secondary schooling. Caliendo et al. (2015) also find that a higher internal locus of control is beneficial for the search strategies of those who become unemployed. As summarized by Cobb-Clark (2014), workers with an internal locus of control seek out more complex jobs and have better job performance. Those with an internal locus of control also tend to set more challenging goals, persist in the face of adversity, and experience less job stress.[1]

We investigate the locus of control of adolescents, as adolescence is an important phase of life, during which individuals transition to adulthood; a meaningful junction in the course of life. Although 17-year-olds typically still live with their parents; most are on the verge of moving out, whether for college or another reason. Moreover, Cobb-Clark and Schurer (2013), along with others, show that changes in individual's locus of control are rather concentrated among young (or very old) people.

For our analysis we focus on family changes with respect to parents – rather than siblings or other persons in the household – as parents are first, and foremost, the primary attachment figures, in addition to being in charge of helping their children acquire non-cognitive skills (e. g. Cunha et al. 2006). We focus on short- to long-term relationships by examining the non-cognitive skills of adolescents and their family instability experiences since early childhood. Overall this paper seeks to bring together several research strands: the literature on effects of family instability, the literature on children's non-cognitive skills, and research on locus of control.

1 A study by Schnitzlein and Stephani (2013) using the same data set as this paper shows that individuals with an internal locus of control have a significantly higher probability of moving to higher paid employment than individuals with an external locus of control.

This study shows that family instability is negatively associated with the non-cognitive skills of adolescents. Experiencing maternal partnership changes decreases adolescents' internal locus of control by around 20 % of a standard deviation. The results further show that instabilities in later childhood matter more than ones in earlier childhood: each additional partnership transition experienced from age 10 onward is associated with a decreased internal locus of control by around 22 % of a standard deviation.

The remainder of the paper is structured as follows: Section 2 discusses theoretical links of family instability and adolescents' non-cognitive skills. Section 3 addresses the related literature and Section 4 outlines the empirical strategy. In Section 5 the data set is described, followed by a discussion of estimation results in Section 6. Section 7 presents several robustness tests and Section 8 concludes.

2 Theoretical Considerations of Family Instability

In principle, the connection between family instability and non-cognitive skills could be the result of two causal relationships. First, one might argue that family instability influences child outcomes. Second, it could be that child outcomes affect the stability of the family life, which could lead to parental separation.

To explain potential mechanism of family instability influencing child outcomes, we draw on the household production (e. g., Becker 1981 and 1993) and skill formation (Cunha and Heckman 2007) frameworks: Children's skills are the result of a production process in which parents contribute inputs of time and goods.[2] Moreover, the skills of one period depend on the skills of previous periods, which also depend on these inputs. Another important consideration is timing, or the notion that specific inputs matter more in specific childhood stages than in others. In such a framework, a two-parent household has more time available to distribute between child and employment than a single parent household. *Ceteris paribus*, two-parent households should have more financial resources. This production function can be extended in such a way that family structure changes matter directly. This is the case when disruptions in the family could be the source of instability or stress, which may have negative consequences for the child. This stress has a variety of potential sources (see below for an elaborate list). Such reasoning goes in line with the argument that transitions, *per se*, might be harmful for a child, not only when parents separate but

2 Todd and Wolpin (2007) show that the production function of cognitive achievement depends not just on home and school inputs but also parental ability and other unobserved factors.

also when partners previously not living together move in together (see for a summary, e. g. Ribar 2004).

Apart from this, Heckman and his co-authors suggest that inputs to the skill formation process of children have different effects at different stages of a child's life course, with cognitive skills affected at early ages and non-cognitive skills at later ages (see e. g. Cunha et al. 2006 and Cunha and Heckman 2008). Given this, we expect a larger effect of instabilities in later childhood on non-cognitive skills, as these are shaped later in life than cognitive skills, which are learned earlier in life. Nevertheless, more recent studies, including Del Bono et al. (2014), suggest that malleability of non-cognitive skills is also likely to be important during the early stages of a child's life course, not just when the child grows older.

In addition to these pure economic theoretical considerations, different theories, such as stress theory proposed by social scientists, explain how changes in family environments affect child outcomes (for an overview, see e. g., Hill, Yeung, and Duncan 2001). Stress theory states that family reorganization, triggered by parental separation or new partnering, imposes stress on parents and children, results in alteration of emotional bonds and might encourage problematic behavior of children (Fomby and Cherlin 2007; Sweeney 2007). There are widely different sources of stress: For example, childhood stress may arise from domestic hostility between parental partners or the need to establish new bonds with new parental figures. Further, in addition to such direct effects, indirect influences are also likely. In fact, family separation might decrease household income, which, in turn, causes further stress for the parent taking care of the children. Fomby and Bosick (2013) argue that mechanisms might differ across age groups. They summarize the results of existing studies showing that early family instability may affect outcomes due to family stress, while later family instability may shape outcomes through the availability of resources and school attachment. Moreover, mechanisms may differ by gender, as the presence of a male role model may be more important for boys' identity, boys may be harder to manage than girls, and/or mothers may treat sons differently than daughters because of negative emotions toward the father (see Allison and Furstenberg 1989; Hetherington and Arasteh 1988).

Independent of the occurrence of instability, it is difficult to distinguish the effects of family structure transitions that originate from stress among family members, from new adults living in the household, or from other indirect influences, e. g., household income, without precise and comprehensive measures of *all* mediating factors for the entire childhood period. This is true for the present study as well, since we cannot separate possible mechanisms, although we control for a variety of potential factors.

The second potential direction of family instability and non-cognitive skills is that parental separation could be induced by children's non-cognitive skills. This relationship is rarely discussed in the literature and we argue that this "reverse" direction is less plausible given the skill measure we use. The locus of control does not measure clinically severe problems, which might lead to a separation of parents.

3 Related Literature

As noted before, there are few studies explicitly addressing family instability dynamically, with most using static family structure. Most studies are based on US data and differ by the definition of instability and the outcome measures used. For instance, Sun and Li (2011) find that when math and reading performances are analyzed, children of non-disrupted families make greater progress than those from disrupted families. The study of Fomby and Bosick (2013) shows that early and later family instability is associated with low rates of college completion, early union formation, and childbearing, as well as early labor force entry.[3]

There are other studies that are more comparable to our analysis as they use outcome measures of behavior that are similar – although not identical – to our measure of non-cognitive skills, based on US data. Among them is the study by Osborne and McLanahan (2007), which finds a positive link between number of family transitions experienced and problematic behavior. A study by Waldfogel, Craigie, and Brooks-Gunn (2010) shows that behavioral problems and cognitive or health outcomes are differently affected by how family life is operationalized: whether as a static structure or dynamic. They find that instability seems to matter more than family structure for cognitive and health outcomes, whereas growing up with a single mother (whether this particular family structure is stable or unstable over time) seems to matter more for behavioral problems. Fomby and Cherlin (2007) analyze cognitive and non-cognitive measures, showing for the latter that the externalizing behavior of white children is negatively associated with multiple changes. Magnuson and Berger (2009) suggest that

3 Other studies focus on health outcomes, such as Hernandez et al. (2014), which explores the relationship between the number of family structure transitions and adolescent weight status. As the number of family structure transitions children experience from birth through 18 increases, females face a greater risk of being overweight/obese in young adulthood. This does not hold for males. Brown (2006) shows that adolescents experiencing a family transition report, on average, decreased well-being relative to those in stable, two-biological-parent families.

children's behavioral problems increase if they experience more than one transition in their family structure.[4]

There are few studies using European data and applying sequential analysis of family structure status. One is a study using Danish data that estimates the effect of divorce and remarriage on the socio-emotional behavior of children at 7 years of age (Andersen, Deding, and Lautsen 2007). It finds that if a separation is followed by remarriage, children's behavioral problems increase compared to a one-time transition.[5] An analysis by Ermisch, Peter, and Spiess (2012) uses a comparative perspective based on the British Millennium Cohort Study and the data used in this paper, the German Socio Economic Panel Study (SOEP). They focus on family instability and the socio-emotional behavior of children. Their analysis shows that changes in family structure are significantly correlated with the socio-emotional behavior of preschoolers. We note that the literature is increasingly addressing family instability sequentially, but few papers relate these sequences to non-cognitive skills. Moreover, to the best of our knowledge no other study examines locus of control of adolescents in conjunction with family instability during childhood.[6]

4 Empirical Strategy

Our empirical strategy aims at identifying a potential effect of family instability on the locus of control in adolescence. Some studies try to identify the effect of divorce using reforms as an instrument (e. g., Francesconi, Jenkins, and Siedler 2010). Yet, it remains difficult to find reasonable instruments. In this study we propose a different approach to solve the missing counterfactual problem by applying matching methods, notably entropy balancing. Entropy balancing is, similar to other matching methods, a pre-processing step to estimate a treatment

4 Waldfogel, Craigie, and Brooks-Gunn (2010) provide a summary of other papers focusing on the same research question and using the same data as Magnuson and Berger (2009). Another literature overview on family instability and adolescence outcomes is Fomby and Bosick (2013).
5 Also using Danish data, Würtz-Rasmussen (2009) estimates the causal effect of family structure changes on children's health outcomes. She concludes that children experiencing family instability have worse health outcomes than children from stable backgrounds.
6 In addition to these strands of the literature on family instability, a small economic literature addresses how changes in life events affect the locus of control for individuals starting at age 15. A well-known study in this context is Cobb-Clark and Schurer (2013): One life event analyzed in their paper is the event "got back together with spouse." However, they look at adults affected by this event and not at the potential spillover effects on children.

effect under the assumption of selection on observables.[7] Using a matching technique allows us, unlike many other studies on family structure, to avoid limiting the analysis to those subject to a reform (compliers) or to siblings (as done by Ermisch and Francesconi 2001; Ginther and Pollak 2003; Rees and Sabia 2009). It is not clear how to implement the common support assumption, known from matching methods such as propensity score matching, with entropy balancing. But children of the control group can only be reweighted to match the treatment group if all included variables have non-missing information. Therefore, estimates based on entropy balancing also refer to a subpopulation of the sample, albeit this population is less restrictive than compliers or siblings.[8]

The major challenge for analyses within the counterfactual framework is that an individual can either receive the treatment at a given point in time (here, experiencing family change) or not, but cannot be in both states simultaneously. Thus, for our purpose we need to exclude the possibility that unobserved characteristics on the child or maternal level exist that simultaneously affect adolescents' non-cognitive development and the probability of experiencing family changes. This assumption is similar if we were to use ordinary least squares (OLS). Yet, OLS renders consistent estimates of the relationship between family instability and internal locus of control if the underlying association is linear. An advantage of matching is that estimates are less dependent on the functional form assumption in the model (Dehejia and Wahba 2002).

By applying matching methods, we compare the locus of control of adolescents who experience family instability to those of nearly identical adolescents living in stable families. A common method to increase similarity between two groups is propensity score matching (Blundell and Costa Dias 2000; Rosenbaum and Rubin 1983). Another method to establish such a quasi-experimental sample is the reweighting technique: entropy balancing (Hainmueller 2012). This method directly balances the conditioning variables between treatment and control groups without using the propensity score. It reweights the control group observations (adolescents of stable families) in such a way that the reweighted control group has the same mean and variance[9] for all conditioning

7 We implement entropy balancing in Stata using the program ebalance provided by Hainmueller and Xu (2013).

8 Common support usually drops treated observations with higher propensity score values than control group observations (Caliendo and Kopeinig 2008). However this condition is not binding here, since we find the highest propensity score value in the control group, thus suggesting overlap between treatment and control group.

9 Table 8 in the Appendix shows that all conditioning variables have a standardized bias close to 0 %, thus suggesting that after entropy balancing treatment and control group have similar mean and variance in the set of matching variables.

variables as the treatment group.[10] Entropy balancing has some advantages over propensity score methods as (1) it never produces a worse balance between the treatment and control groups; (2) it is fully non-parametric; and (3) it balances covariates not only for the means but also for the variance of each variable. Yet, like propensity score matching, estimates can only be interpreted as causal if the set of conditioning variables includes all variables that simultaneously affect the probability to experience family instability as well as children's post-treatment locus of control.

After obtaining the weights from entropy balancing, we estimate the relationship of adolescents' locus of control with the treatment indicator using these sampling weights and controlling for all conditioning variables. This regression-adjustment avoids further potential bias if matching is not exact and it also increases the precision of the estimates if the conditioning variables help to explain variation in the outcome variable. Equation [1] depicts the average treatment effect of the treated (ATT):

$$\mathrm{ATT} = \sum_{i \in T} W_i \left[(Y_{1i} - x_i\beta) - \sum_{i \in C} W_{i,j} \left(Y_{0j} - x_j\beta \right) \right] \qquad [1]$$

In eq. [1], $W_{i,j}$ is the weight placed on *individual j* (of the control group) in order to be comparable to *individual i* (of the treatment group).[11] The weight $W_{i,j}$ includes values obtained from entropy balancing.

However, in order to causally interpret our estimations, the method assumes that there are no unobserved variables that simultaneously influence adolescents' locus of control and the probability of experiencing family instability. Meaning that, in absence of family instability, the locus of control of treated adolescents and matched control adolescents would be identical (see eq. [2]).

$$E[Y_0 | EB(X), D = 1] = E[Y_0 | EB(X), D = 0] \qquad [2]$$

If this unconfoundedness assumption (eq. [2]) is violated, i. e. if families who are treated differ systematically from families who are not treated in terms of unobservable characteristics, our model suffers from endogeneity. To address this potential problem of unobserved heterogeneity, we also perform entropy balancing incorporating maternal non-cognitive skills into the set of conditioning variables,[12]

10 If there is more than one weighting scheme with only non-negative weights that fulfills the balancing criteria, entropy balancing selects the weighting scheme with the smallest deviation from a uniform weighting scheme.

11 In the estimation of the ATT Wi equals one for members of the treatment group.

12 Table 8 in the Appendix also shows that the approximation of variables to have same mean and variance for treated and control individuals is also valid for maternal non-cognitive skills (although these are measured post-treatment).

which might influence both adolescents' locus of control and maternal partnership instability. Since the data comprise only post-treatment non-cognitive skills of mothers, we also estimate the robustness of our results to omitted variables bias by applying a novel econometric method proposed by Oster (2013). This method allows assessing the bias resulting from unobservables. In addition, we also use different sets of conditioning variables to highlight the robustness of our results. Given potential gender differences (see Section 2) in the effects, we run separate regressions for girls and boys. However, since the sample size of this differential analysis, and in particular the number of treated girls, is very small, we only briefly mention the results, without going into further details.

5 Data

We use data from the German Socio-Economic Panel Study (SOEP). Starting in 1984, this annual nationwide household panel surveys around 12,000 households from across Germany.[13] We use waves from 1986 to 2012. The SOEP includes supplementary tools to survey the development of children. The supplement on youth-specific topics was implemented in 2000 and surveys adolescents at 17 years of age.[14] Vast information on non-cognitive skills, household composition, parental background, school history, and subjective well-being is collected.

As we are interested in mapping childhood family stability, we restrict the analysis to approximately 1,200[15] adolescents for whom parental background information is available from around birth through 17 years of age. We include all adolescents with mothers who have at least 10 valid partner identifiers, which means that the partner information is available in at least 10 waves of our panel, although the waves need not be sequential. This allows us to keep cases where the partner information is missing in one wave but is available in waves before and after. We focus on partner changes related to mothers for two reasons: First, mothers are still typically the primary caregivers of children and,

13 A detailed description of the SOEP is provided by Wagner, Frick, and Schupp (2007).

14 For more information about the youth questionnaire in the SOEP, see Frick and Lohmann (2010) or Weinhardt and Schupp (2011).

15 Within this sample we perform entropy balancing. The final sample size comprises 1,034 observations, as only treated and control group adolescents with a valid weight obtained from entropy balancing, i. e. non-missing information on matching variables, are included.

second, following parental separation, most children stay with their mothers, not their fathers.

5.1 Measures of Family Instability

Based on the information about the partner of a mother, we code a numerical variable counting the changes in the household composition between interviews. We count partner changes starting from 2 years of age[16] through 17. Moreover, we distinguish maternal partner changes in two childhood stages from 2 to 9 years of age and then from 10 to 17 years of age. These two stages are related to different periods in a child's life. Until the age of 9, children either attend daycare or go to primary school. Then, in Germany, at around age 10 sorting into school tracks starts, with families deciding which track to choose. Moreover, in the early phase children spent more time at home with their parents than in the second phase, when peers become increasingly important (e. g. BMFSFJ 2013). With this distinction we can infer whether transitions experienced later in life are more or less strongly correlated with adolescent outcomes than those changes experienced earlier in life.

Further, we also code three binary indicators of family instability. The first variable equals one if the adolescent experienced any, i. e. one, two or more maternal partner changes and zero if no change occurred (overall change). This binary variable is used to balance the treatment and control groups. The second indicator is equal to one if the adolescent experiences one family change (either a separation or a new partner) and zero otherwise. The third binary variable is equal to one if the adolescent experienced two or more family changes and zero otherwise.[17] These two measures allow us to distinguish the impact of one change and various changes on the locus of control in adolescence. We identify up to five changes in maternal partnerships for the complete childhood period of adolescents (see Table 1). Approximately 15 % of the adolescents in our sample experience a family change: for nearly 10 % only one change, while 6 % experience more than one change. More transitions are observed after the tenth birthday.[18]

16 We do not cover changes from the very beginning as, firstly, there are very few changes during the first two years of a child's life and, second, this allows us to increase our sample size as we do not have to rely on valid information of two additional waves.

17 We denote the coefficient of this measure under "multiple changes" in our tables.

18 In our sample, 157 adolescents are treated, i. e. experience a family change, and 877 adolescents live in stable families.

Table 1: Family instability – matched sample.

	Mean	Std. Dev.	Min.	Max.
Types of family instability				
Family change (yes/no)	0.15	0.359	0	1
Number of transitions (age 2–17)	0.23	0.626	0	5
Number of transitions (age 2–9)	0.09	0.343	0	3
Number of transitions (age 10–17)	0.13	0.407	0	3
One change	0.09	0.296	0	1
Multiple changes	0.06	0.228	0	1
N		1,034		

Source: SOEP v29 (1986–2012), own calculations.

5.2 Measure of Locus of Control

The non-cognitive skill measure we use is the *locus of control*, based on the concept developed by Rotter (1966). The SOEP youth supplement maps the *locus of control* through eight statements about life, with which the 17-year olds are asked to agree or disagree (for a detailed discussion, see e. g. Weinhardt and Schupp 2011). First, we apply a factor analysis to these eight statements and, similar to other studies using SOEP youth data (e. g. Piatek and Pinger 2015; Pfeiffer and Seiberlich 2010; Anger 2012), we extract two factors – one external locus of control factor (beliefs that life is determined by others or by fate) and one internal locus of control factor (beliefs that life depends on own actions). The scale to indicate agreement with the eight statements describing adolescents' locus of control changed between 2005 and 2006 in the SOEP youth questionnaire. In order to enable comparison of the locus of control measures between the two periods, we project the shorter scale ranging from 1 to 4 on the scale ranging from 1 to 7 following Specht, Egloff, and Schmuckle (2013).[19] This transformation is valid if there are no systematic interactions between survey participants and type of response scales. We estimate both factors as dependent variables. However, some studies using this measure (such as Weinhardt and Schupp 2011; Piatek and Pinger 2015) point out that the reliability of both scales

19 Adolescents are asked to indicate their agreement on a scale ranging from 1 (strongly agree) to 4 (strongly disagree) between 2001 and 2005, and on a scale ranging from 1 (strongly disagree) to 7 (strongly agree) from 2006 through 2012. The scale from 2001–2005 is projected on the scale from 2006–2012 by recoding values 1, 2, 3, 4 in 2001–2005 to values 7, 5, 3, 1, respectively. Using a different strategy to map the values of the shorter scale on the longer scale does not change the results.

is debatable, although they use different subsamples than we use. Thus, we also assess a single index of locus of control. Following Cobb-Clark and Schurer (2013), we generate a combined index of both locus of control measures. Specifically, we sum the three internal items and subtract the sum of the five external items to obtain an index increasing in internalizing behavior,[20] as we argue that children might be less likely to believe that they determine their own life after experiencing family instability. Moreover, some studies show that if individuals do not believe in self-determination (they are less likely of having an internal locus of control), this is associated with negative outcomes later in life (see above, for further examples see Coleman and DeLeire 2003 or Cebi 2007; Heineck and Anger 2010; Piatek and Pinger 2015; Uhlendorff 2004). In all specifications we use standardized measures that are interpreted in terms of percent of a standard deviation.

5.3 Treatment and Control Group

For our empirical strategy we predict the likelihood of occurrence of any change in maternal partnership. The maternal partnership transition can take place at any time between 2 and 17 years of age. We observe the treatment group at least for 10 years. This time varies between 10 and 15 years for the overall sample; thus, the estimates should be interpreted as average. The conditioning variables – apart from maternal non-cognitive skills[21] – are measured pre-treatment.

5.4 Conditioning Variables

The empirical strategy, discussed in the previous section, relies on the assumption that the variables to predict any occurrence of family change are observable. The set of variables used to reweight adolescents of the control group (adolescents without experience of family change) to match adolescents of the

20 If we obtain a single index of internalizing behavior, as proposed by Specht, Egloff, and Schmuckle (2013), the mean of this combined measure in the final sample as well as the means differentiated by family instability are nearly identical to those of the combined measure used by Cobb-Clark and Schurer (2013).

21 This is due to data restrictions, as we have no information from earlier stages. However, there is significant evidence that personality traits remain stable once individuals turn 30 (McCrae and Costa 1996) and are not affected by major events in life, i. e. divorce (Cobb-Clark and Schurer 2012). Thus, we are confident in using a post-treatment measure in this case.

treatment group is crucial for our identification strategy. We base our choice of observables on other empirical studies, which estimate family structure and its effect on child outcomes (see Section 3).

In all OLS and regression-adjusted matching models we use maternal age at birth, level of education (mother), employment history (mother), log of household income, adolescent gender, adolescent migration background, region of residence (East Germany vs. West Germany), birth order, time dummies, and federal state dummies as covariates. In addition, in different sensitivity analyses we further include maternal non-cognitive skills (locus of control and personality traits) as conditioning variables, which are often presumed to be unobservable. Maternal personality traits are surveyed by the German Socio-Economic Panel Study using the so-called Big-Five measures (McCrae and Costa 1996). We do this for two reasons. First, studies show that an intergenerational correlation between skills exists (see e. g., Anger 2012 and De Coulon, Meschi, and Vignoles 2011). Second, we find significant mean differences of maternal non-cognitive skills by family instability, i. e. between treatment and control group (see e. g. Table 8 in the Appendix). A descriptive summary of all conditioning variables is given in Table 8 in the Appendix.

6 Results

An initial bivariate analysis shows that adolescents who do not experience any family changes at all have a significantly higher internal locus of control than those experiencing a family change (see Table 2). This relationship is also found for the combined index, while we find no significant differences for external locus of control by family instability.

Table 2: Locus of control by family instability.

	Mean		Mean differences
	No family change	Family change	
Internal locus of control	0.06	−0.17	0.22**
External locus of control	−0.04	0.06	−0.10
Combined index of locus of control (increasing in internalizing behavior)	0.05	−0.09	0.15*
N		1034	

Source: SOEP v29 (1986–2012), own calculations, * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

These differences in means remain if we control for other characteristics. We present the effect of family instability on adolescents' locus of control using OLS and different weighted post-matching estimations.[22] The models labeled "OLS Mean" present effects of OLS estimations of family instability on adolescents' locus of control including all conditioning variables as covariates. Second, the columns labeled "Matching Mean" comprise a weighted post-matching estimation of family instability on our outcome without any further controls. Our last specification labeled "Adjusted Mean" is a weighted regression-adjusted post-matching estimation including all conditioning variables as explanatory variables. This regression-adjustment avoids further potential bias if matching is not exact and hence is our preferred specification. We mainly interpret the results of this specification.[23]

Although the latter is our preferred specification, the results of the different models are very similar. This is particularly true in terms of effect size and significance level, yet the standard errors are slightly smaller in the weighted post-matching column. These minimal differences between the associations are related to our choice of conditioning variables, as we control for all conditioning variables in the "OLS Mean" as well as in the "Adjusted Mean" models. Moreover, our OLS models are estimated in the matched sample and thus are run in a "common support" sample.[24] However, in order to use OLS to estimate the effect of family instability, its relationship with locus of control is assumed to be linear, which constrains the impact to be the same for all children, i. e. to be homogenous. In contrast matching or weighted post-matching does not require linearity.[25]

First, we present models in which we examine whether any change in maternal partnership between age 2 and the age of 17 is associated with adolescents' locus of control; looking at all three measures of locus of control discussed in Section 5. Table 3 shows that adolescents experiencing any transition (overall change) are less likely to believe that working hard will help them to achieve their own goals. If a child experiences a transition, she has a lower internal locus of control by 20 % of a standard deviation. In comparison having

22 All models with all covariates are available from the authors upon request. For Panel A of Table 4 we include the full model regressions in the Appendix (see Table 9).

23 In addition we incorporate time dummies as well as federal state dummies as conditioning variables, since our sample consists of pooled cross-sectional data.

24 By default the final sample after balancing only comprise treated and control individuals with a valid weight. In addition, we perform propensity score matching explicitly using only common support individuals, and the estimates obtained using entropy balancing remain stable.

25 Yet, the minimal difference across specifications suggests that the relationship between family instability and locus of control might in fact be linear.

Table 3: Estimates of family instability on locus of control measures – matched sample (w/o maternal non-cognitive skills).

	Internal LOC	External LOC	Combined LOC	Internal LOC	External LOC	Combined LOC
Baseline: No family change						
Overall change	–0.196**	0.090	–0.133			
	(0.095)	(0.094)	(0.093)			
One change				–0.111	0.033	–0.037
				(0.111)	(0.110)	(0.117)
Multiple changes				–0.347**	0.193	–0.304**
				(0.156)	(0.157)	(0.140)
N	1034	1034	1034	1034	1034	1034
R^2	0.075	0.057	0.062	0.076	0.057	0.065
adj. R^2	0.035	0.017	0.023	0.036	0.016	0.024

Note: Each cell depicts the effect of experiencing a change in family instability on internal locus of control in adolescence. All regressions include year and state fixed effects. The models are based on ordinary least squares estimations and include all conditioning variables as controls. Source: SOEP v29 (1986–2012), own calculations. Robust standard errors in parentheses, * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

a mother with a university degree leads to a higher internal locus of control by 25 % of a standard deviation (see Table 9). Table 3 suggests that any change in family composition is significantly correlated with the internal locus of control factor, but does not impact the external locus of control measure or the combined index of locus of control for that matter. If we differentiate whether one or multiple changes are correlated with adolescents' internal locus of control, we see that multiple partnership transitions decrease the coefficient of adolescents' belief in self-determination compared to no family transition. The combined index also suggests that the experience of more than one partnership change matters. Given this, the following tables refer only to the internal locus of control as outcome measure, with which family instability seems to be associated.

In Table 4 (Panel A) we address the problem of selection bias using weights obtained from entropy balancing. The results of family instability on adolescents' internal locus of control using the binary measures of instability remain robust (see column 2 and 3 of Table 4, Panel A). Even the economic significance of the effect is very stable over all estimations. Panel B of Table 4 depicts estimates using the numerical measures of instability, namely the number of transitions across childhood stages. These models allow us to assess whether long-term correlations between number of family structure transitions and the locus of control exist. First, the results show that the more transitions an

Table 4: Estimates of family instability on internal locus of control – matched sample (w/o maternal non-cognitive skills).

	OLS mean	Matching mean	Adjusted matching	OLS mean	Matching mean	Adjusted matching
Panel A: Change measures binary						
Baseline: No family change						
Overall change	−0.196**	−0.176*	−0.176*			
	(0.095)	(0.102)	(0.094)			
One change				−0.111	−0.094	−0.103
				(0.111)	(0.116)	(0.108)
Multiple changes				−0.347**	−0.321**	−0.304**
				(0.156)	(0.164)	(0.145)
N	1034	1034	1034	1034	1034	1034
R^2	0.075	0.007	0.136	0.076	0.012	0.139
adj. R^2	0.035	0.006	0.099	0.036	0.010	0.102
Panel B: Change measures numerical						
No. of transitions	−0.144**	−0.139**	−0.132**			
(age 2–17)	(0.058)	(0.064)	(0.056)			
No. of transitions				−0.058	−0.067	−0.100
(age 2–9)				(0.105)	(0.106)	(0.099)
No. of transitions				−0.223**	−0.214**	−0.164*
(age 10–17)				(0.088)	(0.093)	(0.085)
N	1034	1034	1034	1034	1034	1034
R^2	0.078	0.015	0.142	0.079	0.019	0.142
adj. R^2	0.039	0.014	0.106	0.039	0.017	0.105

Note: Each cell depicts the effect of experiencing a change in family instability on internal locus of control in adolescence. All regressions include year and state fixed effects. The models "OLS Mean" and "Adjusted Matching" include all conditioning variables as controls. The models labeled "Matching Mean" only include the treatment variable (shown in the utmost left column) and is a weighted regression utilizing the weights obtained from entropy balancing. Source: SOEP v29 (1986–2012), own calculations. Robust standard errors in parentheses,
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

adolescent experiences, the less she believes in self-determination. Furthermore, we see that changes after the tenth birthday matter. One additional partnership transition experienced between 10 and 17 years of age is associated with a lower internal locus of control by around 22% of a standard deviation. Again, the results are very robust across different estimation methods. If we control for selection bias by matching, the results remain stable (in column 3 an additional transition increases the internal locus of control by 16% of a standard deviation). If we examine all models separately for girls and boys, the described

associations are only found for boys. Yet, as mentioned above the samples are too small, in particular for girls, to make a clear statement on differential gender effects.

7 Sensitivity Analysis

We perform several sensitivity analyses to address potential threats to our identification strategy. First, since the estimates of family instability draw on the assumption that we include all relevant variables (selection on observables), we test how robust our results are to different sets of matching variables. Table 5

Table 5: Estimates of family instability on internal locus of control using different matching variable sets.

	w/o Maternal non-cognitive skills	w/ Maternal non-cognitive skills	w/ Paternal years of education	Only maternal variables	Only child and household variables
Panel A: OLS Mean					
Baseline: No family change					
Overall change	−0.196**	−0.194**	−0.177*	−0.208**	−0.211**
	(0.095)	(0.094)	(0.107)	(0.095)	(0.093)
N	1034	1033	830	1034	1034
R^2	0.075	0.084	0.095	0.068	0.053
adj. R^2	0.035	0.050	0.045	0.033	0.023
Panel B: Adjusted Matching					
Baseline: No family change					
Overall change	−0.176*	−0.201**	−0.213**	−0.212**	−0.203**
	(0.094)	(0.095)	(0.104)	(0.094)	(0.091)
N	1034	1033	830	1034	1034
R^2	0.136	0.147	0.215	0.101	0.110
adj. R^2	0.099	0.115	0.171	0.067	0.081

Note: Each cell depicts the effect of experiencing a change in family instability on internal locus of control in adolescence. All regressions include year and state fixed effects. The first column comprises the set of matching variables without maternal non-cognitive skills (main effect of paper). The second column adds maternal non-cognitive skills to the set of matching variables; the third column adds paternal years of education (measured prior maternal partnership change) to the conditioning variables set. The fourth column uses a reduced set of matching variables, namely only maternal variables and in the last column treatment and control group are only matched on child and household variables. Source: SOEP v29 (1986–2012), own calculations. Robust standard errors in parentheses, *$p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

shows estimates of experiencing a change in family composition using ordinary least squares with different sets of conditioning variables (Panel A) as well as using regression-adjusted matching with varying sets of controls (Panel B). The first column comprises estimates from regressions including all matching variables specified in Section 5 without maternal non-cognitive skills. The second column adds maternal personality traits and locus of control measures to the first matching set. The size of the coefficient and its significance level remain the same in both specifications using OLS, namely around 20 % of a standard deviation (Panel A, Table 5). Using regression-adjusted matching without and with maternal non-cognitive skills we find a slight increase in size and significance level when maternal personality traits are included (Panel B, Table 5). Compared to these "full" specifications, column three to five consist of estimations where treated and control individuals are matched on sub-sets of all conditioning variables. In the third column paternal years of education[26] is added to the matching set used for analysis in column one. The fourth column comprises only maternal characteristics (without non-cognitive skills), and the fifth column contains estimates from only matching on child and household characteristics. In the regression-adjusted matching estimations these three different sets render similar results around 20 % of a standard deviation, using OLS paternal years of education slightly decreases size and significance level of overall change compared to no family change. Yet, across all estimations, the effect of overall family change remains around 20 % of a standard deviation for both estimation strategies (Panel A, OLS; Panel B, regression-adjusted matching), suggesting that we find robust estimates of family instability on internal locus of control using entropy balancing.

Another possibility to test whether the conditional independence assumption, i. e. assuming that we observe all variables affecting family change and adolescents' internal locus of control, is violated, is a novel econometric method proposed by Oster (2013).[27] She develops a method to assess a potential bias from omitted variables, which exploits the information on coefficients and R-squared values to compute the bounds of our estimated treatment effect. Since we realize that unobserved factors may affect both the selection into family change as well as our outcome variable, we investigate the sensitivity of our results in this dimension. As a first test to address the potential threat of

26 We use the earliest measure of paternal education in the panel data used. Doing this, we expect that we have the most likely information of children's biological fathers, i. e. utilize only partners of mothers around birth/age 2 of adolescents.

27 Although novel, this method is used in other studies (e. g. Freier, Schumann, and Siedler 2015) and also works with entropy balancing.

unobserved factors, we include maternal non-cognitive skills in the matching variables set (see column 2 of Table 5), which renders similar results to our preferred specification. Another way to assess the importance of unobservables is to estimate how strongly unobserved variables correlate with our treatment variable compared to observables. Oster (2013) suggests looking at differences in coefficients if additional variables are included in the model. Table 6 shows that estimating the treatment effect controlling only for year and state fixed effects (column 1) compared to regression-adjusted matching (column 3), yields very similar coefficient estimates, thus indicating that our results are unlikely to be

Table 6: Estimates of family instability on internal locus of control – assessing bias of unobservables.

	OLS mean w/o controls	OLS mean w/controls	Adjusted matching	Oster δ
Panel A: w/o maternal non-cognitive skills				
Baseline: No family change				
Overall change	−0.206**	−0.196**	−0.176*	2.69[a]
	(0.094)	(0.095)	(0.094)	
R^2	0.043	0.075	0.14	
N	1034	1034	1034	
Panel B: w/maternal non-cognitive skills				
Baseline: No family change				
Overall change	−0.209**	−0.194**	−0.201**	6.29[b]
	(0.094)	(0.094)	(0.095)	
R^2	0.018	0.084	0.15	
N	1033	1033	1033	

Note: Each cell depicts the effect of experiencing a change in family stability on internal locus of control in adolescence. All regressions include year and state fixed effects. The first column includes only the treatment variable overall change, the second column additionally considers a broad range of pre-treatment characteristics in the regression step, and the third column presents the regression-adjusted matching results. The reported standard errors are robust. The last column shows how strong the selection on unobserved variables has to be (in comparison to observed controls) in order to pull the effect to zero in the adjusted matching step (column 4, method proposed by Oster 2013). Panel A represents the estimation of family instability on internal locus of control w/o maternal non-cognitive skills as control variables for column 2 and 3 (similar to column 1 and 3 of Panel A in Table 4). Panel B comprises results of estimations with columns 2 and 3 including maternal non-cognitive skills as control variables. [a]R-squared$_{max}$ = 0.298, [b]R-squared$_{max}$ = 0.323. Source: SOEP v29 (1986–2012), own calculations. Robust standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

driven by omitted variable bias.[28] Yet, only comparing coefficients in different specifications is not sufficient to assess the stability of our treatment effect, because, as Oster points out, "the quality of the control variable will [also] be diagnosed by the movement in R-square when the control is included" (Oster 2013: 2). One important factor in calculating the bound of our treatment effect is *R*-squared from a hypothetical regression of the outcome on treatment, observables, and unobservables, which Oster (2013) labels "$R\text{-squared}_{max}$". By using this proposition we assume that if $R\text{-squared}_{max} = 1$ our outcome can be fully explained by our treatment variable and a complete set of controls, which comprises both observables and unobservables. In case of omitted variable bias our treatment effect (β) is not identified. We follow Oster's (2013) suggestion to report a value of proportionality (δ) for which our treatment effect equals zero ($\beta = 0$) with an assumed $R\text{-squared}_{max} = 2.2{*}R\text{-squared}_{estimated}$. Oster (2013) assumes that the results are robust to omitted variable bias if $\delta > 1$. For our regression-adjusted matching model[29] without maternal non-cognitive skills, we find a δ equal to 2.7, thus indicating that the selection on unobserved variables would have to be three times as important as the included control variables to render a treatment effect equal to zero.[30] Thus according to Oster's (2013) method our results can be considered robust against omitted variable bias.

Third, we use different outcome measures to see if our results are arbitrary or differ by skill measures. We use height of adolescents at age 17 to estimate a placebo analysis, since we would expect no effect at all of family instability on height. Height is a measure that is certainly determined by genetic factors in developed countries. For this measure it is very unlikely that environmental influences, such as family instability, affect adolescents' growth. As shown in Table 7 (Panel A), family instability has no significant effect on adolescents' height. Furthermore, we estimate the effect of family instability on the probability of attending a *Gymnasium* (the school track where children can earn a university entry degree) at age 17. Doing so, we aim at testing if family instability affects cognitive related outcome measures differently. In almost all German states, *Gymnasium* starts at the age of 10.[31] Thus, we expect that only changes in the family stability that occur prior the age of 10 will affect this attendance.

28 The comparison of coefficients in the parsimonious to the full model is slightly more reassuring in Panel B of Table 6 where maternal non-cognitive skills are also included.

29 If we use the models based on ordinary least squares with full controls, the estimated δ is equally large: $\delta = 5$ for the model w/o maternal non-cognitive skills and $\delta = 9$ w/maternal non-cognitive skills.

30 The coefficient of proportionality is even larger for our model with maternal non-cognitive skills (Panel B, Table 6), $\delta = 6.3$.

31 In three federal states, namely Berlin, Brandenburg, and Mecklenburg-West Pomerania, children start secondary schooling at an average age of 12 instead.

Often attending a *Gymnasium* is used as a rough measure for adolescents' cognitive ability. Table 7 (Panel B) shows that adolescents who experience more maternal partnership transitions in early childhood (prior age 10) are less likely to attend a *Gymnasium* at age 17. As expected, later changes do not affect the likelihood of attending such a school track. This adverse impact of early family instability is in line with the study by Francesconi, Jenkins, and Siedler (2010), which analyzes potential effects of family structure on schooling outcomes in Germany. This makes us certain that the models we estimate measure skill formation in a reasonable way. Furthermore it is remarkable that earlier transitions matter more than later changes for this outcome measure. This is in line with other studies finding that cognitive skills are more affected by earlier inputs than non-cognitive skills (see Section 2). We cannot examine other, later-stage, educational or labor market outcomes given the panel structure of our data, because this would reduce our sample to very few observations, as few adolescents in our sample have entered either higher education or the labor market.

Table 7: Estimates of family instability on height and school track – matched sample (w/o maternal non-cognitive skills).

	OLS mean	Matching mean	Adjusted matching	OLS mean	Matching mean	Adjusted matching
Panel A: Outcome = Height						
Panel A.1: Change measures binary						
Baseline: No family change						
Overall change	−0.145	−1.107	−0.490			
	(0.764)	(1.020)	(0.739)			
One change				0.324	−0.513	−0.117
				(1.030)	(1.320)	(0.993)
Multiple changes				−0.821	−1.939	−1.028
				(1.041)	(1.400)	(0.977)
N	862	862	862	862	862	862
R^2	0.515	0.003	0.506	0.516	0.006	0.506
adj. R^2	0.490	0.002	0.480	0.490	0.003	0.481
Panel A.2: Change measures numerical						
No. of transitions	−0.231	−0.547	−0.381			
(age 2–17)	(0.385)	(0.509)	(0.370)			
No. of transitions				0.195	0.129	−0.117
(age 2–9)				(0.751)	(0.925)	(0.640)
No. of transitions				−0.545	−1.042	−0.508
(age 10–17)				(0.602)	(0.841)	(0.593)
N	862	862	862	862	862	862
R^2	0.515	0.003	0.506	0.515	0.005	0.506
adj. R^2	0.490	0.002	0.481	0.490	0.003	0.480

(*continued*)

Table 7: (*continued*)

	OLS mean	Matching mean	Adjusted matching	OLS mean	Matching mean	Adjusted matching
Panel B: Outcome = School track/*Gymnasium* attendance						
Panel B.1: Change measures binary						
Baseline: No family change						
Overall change	−0.048	−0.028	−0.028			
	(0.038)	(0.042)	(0.037)			
One change				−0.016	0.036	0.010
				(0.047)	(0.052)	(0.046)
Multiple change				−0.105**	−0.139**	−0.093*
				(0.053)	(0.055)	(0.052)
N	1034	1034	1034	1034	1034	1034
R^2	0.195	0.001	0.225	0.196	0.018	0.230
adj. R^2	0.161	−0.000	0.192	0.161	0.016	0.197
Panel B.2: Change measures numerical						
No. of transitions (age 2–17)	−0.037*	−0.045**	−0.034*			
	(0.020)	(0.020)	(0.019)			
No. of transitions (age 2–9)				−0.060*	−0.072*	−0.069*
				(0.035)	(0.038)	(0.036)
No. of transitions (age 10–17)				−0.024	−0.031	−0.011
				(0.035)	(0.035)	(0.033)
N	1034	1034	1034	1034	1034	1034
R^2	0.196	0.008	0.229	0.196	0.011	0.231
adj. R^2	0.162	0.008	0.196	0.162	0.009	0.198

Note: The table presents the effect of family instability on height and the probability of attending the highest secondary school track in Germany (*Gymnasium*). All regressions include year and state fixed effects. The models "OLS Mean" and "Adjusted Matching" include all conditioning variables as controls. The models labeled "Matching Mean" only include the treatment variable (shown in the utmost left column) and is a weighted regression utilizing the weights obtained from entropy balancing. Source: SOEP v29 (1986–2012), own calculations. Robust standard errors in parentheses, * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Fourth, we use a more restricted sample to see if our assumption that we can include adolescents whose maternal partner information is missing for single waves might cause problems. Therefore, we restrict our analyses to a sample of adolescents for whom maternal partner information is observed in every wave between ages 4 and 17. This reduces the sample size to $N = 895$, of which $N = 751$ adolescents are matched using entropy balancing. The estimation results are similar to our preferred specification regarding multiple partnership changes. The estimate of experiencing any change compared to no family change decreases in size and is no longer statistically different from zero.

This might be related to the drop in sample size, as the estimates are close to the 10 % significance cut-off.

Last, we re-estimate our results using propensity score matching, an alternative matching method. For this sensitivity test we apply kernel matching based on the estimated propensity score, which uses weighted averages of the control group depending on differences in the propensity score. This procedure, compared to entropy balancing, differs in the weighting matrix, $W_{i,j}$, used to estimate the average treatment effect of the treated (see eq. [1]). Kernel matching reweights a control group member to match at treatment group member in terms of closeness of their propensity scores. In contrast to entropy balancing, propensity score matching requires the common support condition, which discards adolescents from the analysis who do not overlap: $0 < P(X) < 1, \ \forall X$.[32] The results are very similar to estimates from our preferred specification. The economic significance of the coefficients also remains comparable when using kernel matching instead of entropy balancing.

8 Conclusion

This paper contributes to the empirical economic literature on children's non-cognitive skill formation and the influence of the family environment on such skills, as parents are the first to help their children gain these skills. It adds to the growing literature on the effects of family instabilities in a dynamic setting, moving beyond static snapshots. To our knowledge, it is the first study using adolescent locus of control of as an outcome measure, an important non-cognitive skill affecting schooling, earnings and labor market outcomes.

We use German panel data that allows us to observe the stability of families; thus we do not have to rely on self-reported measures of partner changes. We distinguish between instabilities by early and late childhood stages. This is important as theories, among them the skill formation theory, emphasize that for various outcomes, inputs across childhood stages may vary in importance. Furthermore, we compare one and multiple partnership changes, which we relate to children's internal locus of control at age 17. This allows us to use a measure that can be considered to be a proxy for instability intensity.

To identify the relationship between family instability and subsequent skills, we apply entropy balancing to various confounding variables, including maternal non-cognitive skills. In contrast to studies addressing the problem of causality,

32 Only 17 observations compared to the entropy balancing sample are dropped. We apply propensity score matching in the final sample, i. e. the sample in which all observations have a valid balancing weight.

matching methods lead to results generalizable to all children affected by family instability and not just to compliers or siblings when using instrumental variable or sibling fixed effects approaches, respectively. Nevertheless our results can only be interpreted as causal if the assumption that no unobserved factors are biasing the results holds. Despite the richness of the data and different sensitivity analyses, we cannot entirely exclude that some adolescent or maternal characteristics that are difficult to measure might lead to maternal partnership changes. Thus, our findings may at least be interpreted as associations – showing that partner instability is a factor with predictive value for the locus of control in adolescence.

Using entropy balancing, we find that the non-cognitive skills of adolescents are negatively associated with number of family structure transitions experienced. Adolescents' perceived belief of whether life depends on others or not is correlated with maternal partner changes throughout childhood. Family instability decreases adolescents' belief in self-determination by nearly 20 % of a standard deviation. Although a comparison of our estimates to other studies is difficult, as different studies use different scales of locus of control, different samples or different data sets, we convey the size of our estimates in terms of other variables. First, we assess how our results translate to two studies using Australian and US data analyzing educational outcomes: Barón and Cobb-Clark (2010) find that a one standard deviation increase in internal locus of control is associated with a 4.5 percentage point increase in students' probability to complete secondary schooling and Coleman and DeLeire (2003) find a 2–3 percentage point increase. Given the results by Barón and Cobb-Clark (2010) or by Coleman and DeLeire (2003) of how internal locus of control affects students' probability to complete secondary schooling, our estimated decrease of 18 % of a standard deviation in internal locus of control due to family instability depicts a medium size effect. For example, a decrease of one-fifth of a standard deviation in internal locus of control would decrease the probability of completing secondary schooling by 1 percentage point. Caliendo et al. (2015) find that a one standard deviation increase in internal locus of control is associated with a 1.9 % increase in the reservation wage and a 5.3 % increase in the number of job applications submitted. Translating our estimates of a decrease in internal locus of control by nearly 20 % of a standard deviation implies adolescents with family change might have a decrease in the reservation wage of 0.4 % and a decrease in job applications by 1 %. Furthermore, a comparison with studies analyzing other factors influencing the internal locus of control of adolescents shows that the size of the association is similar to changes related to labor market shocks experienced by the mothers. Peter (2013), for instance, shows that adolescents whose mothers' experience a job loss are less likely to believe in self-determination. The experience of mothers' job loss decreases adolescents' internal locus of control by 23 % of a standard deviation.

Moreover, instabilities in later childhood matter more than ones in earlier childhood. This is consistent with other studies showing that non-cognitive skills are more malleable at later stages than cognitive skills. Although we are one of the first studies to focus on the locus of control as a non-cognitive outcome affected by family instability, our results are in line with the majority of other studies using other non-cognitive skill measures, e. g. behavioral problems. These studies show that family instabilities increase behavioral problems. However, Waldfogel, Craigie, and Brooks-Gunn (2010) find that instability only matters for cognitive skills and not for non-cognitive skills. For the latter, according to Waldfogel, Craigie, and Brooks-Gunn (2010), having a single parent or not is relevant. In this finding our studies differ.

Several robustness checks of our study make us confident that we measure a reasonable relationship between family inputs and skill formation. Applying a rather novel econometric method proposed by Oster (2013) to assess the potential influence of unobserved factors on our estimates shows that our results are robust to omitted variable bias. Moreover, when we use another skill proxy, namely the probability of attending a *Gymnasium*, our results are confirmed, as the number of transitions prior school tracking is negatively correlated with the probability of attending this particular school track. According to the skill formation theory of Cunha and Heckman (2007), we see that for a cognitive-related outcome, transitions during early childhood matter more than later transitions.

Although we cannot disentangle potential mechanisms, it seems reasonable that adolescents experiencing a maternal partner change in later childhood believe less than other adolescents that they can shape their life themselves, as the relevant "events" in their lives were primarily caused by others. Moreover, the events that are closer to the present and that occurred when the child is older are more significant for the belief in self-determination. Nevertheless, given the limited evidence on mechanisms driving the associations, more analyses using data facilitating the examination of potential mechanisms, e. g. stress or fewer resources, are clearly required.

From a policy perspective, we argue that support for children experiencing maternal partnership transitions should include addressing non-cognitive skills in order to mitigate their negative impact. Institutions, other than the family, can assist children and young adolescents who lack support at home. Here schools could play an important role in helping children's non-cognitive skill formation. Teachers aware of a child's family situation can tailor interactions in order to help them to cope with the stress and instability that results from changes in maternal partnerships (see e. g., Potter 2010). If society succeeds in absorbing the "shock" of instability phases in a positive way, the costs of future labor market activities may be reduced. This line of argument is reasonable if we, for instance, take into account the proven relationship between an individual's locus of control and their potential unemployment duration.

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Appendix

Table 8: Descriptive statistics of sample – before and after matching (w/maternal non-cognitive skills).

Variable	Mean	Means					
	Family change	No family change			Standardized Bias (%)		
		Unmatched	EB	PSM	Unmatched	EB	PSM
Child locus of control							
Internal locus of control	−0.17	0.06					
External locus of control	0.06	−0.04					
Child characteristics							
Gender (Female = 1)	0.46	0.49	0.46	0.46	−7.25	0.00	0.57
Migration background	0.22	0.23	0.22	0.24	−2.84	−0.00	−2.88
Birth order	1.79	1.83	1.79	1.78	−3.98	0.00	0.64
Household characteristics							
HH income at birth	4.58	5.23	4.58	4.65	−13.07	0.00	−1.44
East Germany	0.28	0.26	0.28	0.28	4.04	−0.00	1.71
Maternal characteristics							
Age at birth	27.10	27.69	27.10	27.07	−13.02	0.00	0.59
Place of childhood	2.55	2.86	2.55	2.54	−26.56	−0.00	0.96
Number of years not working	5.67	6.23	5.67	5.47	−10.83	0.00	4.04
Number of years working full-time	3.21	2.94	3.21	3.31	6.48	−0.00	−2.25
Number of years working part-time	4.20	3.86	4.20	4.31	7.61	0.00	−2.40
Schooling of father[a]	1.57	1.71	1.57	1.57	−9.10	−0.00	0.44
Schooling of mother[a]	1.61	1.76	1.61	1.61	−10.00	−0.00	−0.63
Years of education	5.57	6.29	5.57	5.64	−11.68	0.00	−1.14
Professional degree	0.60	0.61	0.60	0.59	−1.38	0.00	2.00
University degree	0.15	0.19	0.15	0.15	−9.08	−0.00	0.04

(*continued*)

Table 8: (*continued*)

Variable	Mean	Means					
	Family change	No family change			Standardized Bias (%)		
		Unmatched	EB	PSM	Unmatched	EB	PSM
Paternal years of education[a]	10.35	11.30	10.35	10.80	−23.05	0.012	−10.25
Maternal non-cognitive skills[a]							
Openness	0.27	−0.08	0.27	0.24	33.55	0.00	2.85
Extraversion	0.10	−0.02	0.10	0.10	11.72	0.00	−0.23
Conscientiousness	−0.16	0.02	−0.16	−0.15	−16.05	−0.00	−0.56
Neuroticism	0.07	−0.01	0.07	0.10	7.35	−0.00	−3.38
Agreeableness	0.03	−0.01	0.03	−0.02	3.48	−0.00	4.45
Internal locus of control	0.05	−0.02	0.05	0.06	7.14	0.01	−0.83
Time dummies							
Year 2002	0.03	0.10	0.03	0.03	−30.11	−0.00	−1.32
Year 2003	0.08	0.08	0.08	0.08	−0.16	0.00	−0.59
Year 2004	0.08	0.11	0.08	0.09	−9.04	0.00	−1.96
Year 2005	0.14	0.10	0.14	0.14	12.23	0.00	−0.71
Year 2006	0.09	0.10	0.09	0.09	−3.81	0.00	0.70
Year 2007	0.10	0.11	0.10	0.10	−3.18	0.00	−0.56
Year 2008	0.11	0.08	0.11	0.11	8.50	0.00	0.04
Year 2009	0.04	0.08	0.04	0.04	−15.83	0.00	1.25
Year 2010	0.10	0.06	0.10	0.11	14.27	0.00	−2.52
Year 2011	0.08	0.07	0.08	0.07	3.09	0.00	2.58
Year 2012	0.09	0.05	0.09	0.08	17.40	0.00	2.88
State dummies							
Schleswig-Holstein	0.01	0.03	0.01	0.03	−12.38	0.00	−13.85
Hamburg	0.00	0.01	0.00	0.00	−11.73	−1.46	−9.02
Bremen	0.02	0.00	0.02	0.00	14.86	0.00	13.21
Hesse	0.07	0.05	0.07	0.05	8.88	0.01	6.83
Rhineland-Palatinate	0.06	0.07	0.06	0.06	−1.90	0.01	2.45
Baden-Wuerttemberg	0.10	0.14	0.10	0.15	−10.44	0.01	−15.42
Bavaria	0.13	0.15	0.13	0.13	−6.36	0.01	−0.17
Saarland	0.00	0.01	0.00	0.01	−15.18	−1.87	−10.75
Berlin	0.05	0.02	0.05	0.03	14.23	0.01	12.57
Brandenburg	0.04	0.04	0.04	0.05	−0.29	0.01	−3.59
Saxony	0.08	0.08	0.08	0.09	−0.57	0.01	−2.85
Saxony-Anhalt	0.04	0.04	0.04	0.04	3.50	0.01	4.32
Thuringia	0.04	0.05	0.04	0.04	−6.84	0.01	−2.99
N	157	877					

Note: EB = entropy balancing, PSM = propensity score matching. Summary statistics of all conditioning variables for treated, unmatched and matched controls. The first two columns present the means of selected variables before treatment for treated and controls. The third column displays the standardized percent bias before matching. It is the percent difference of the sample means in the treatment and the matched control sample as a percentage of the square root of the average of the sample variances in both groups. The fourth column shows standardized percent bias after matching. [a]These measures are not used in all specifications. Source: SOEP v29 (1986–2012, own calculations.

Table 9: Full regression models of Table 4 Panel A – Overall family change and internal locus of control.

	OLS mean	Matching mean	Adjusted matching
Baseline: No family change			
Overall change	−0.196**	−0.176*	−0.176*
	(0.095)	(0.102)	(0.094)
Household characteristics			
Household income	−0.002		0.041
	(0.079)		(0.090)
East Germany	0.053		−0.647
	(0.222)		(0.395)
Maternal characteristics			
Age at birth	−0.017**		0.008
	(0.008)		(0.013)
Place of childhood	0.040		−0.001
	(0.027)		(0.039)
Number of years not working	0.003		0.037**
	(0.011)		(0.018)
Number of years working full-time	−0.004		0.002
	(0.012)		(0.019)
Number of years working part-time	0.018		0.035*
	(0.012)		(0.019)
Years of education	−0.035*		−0.029
	(0.020)		(0.026)
Baseline: No degree			
Vocational degree	0.079		0.026
	(0.094)		(0.132)
University degree	0.252**		0.290
	(0.126)		(0.184)
Child characteristics			
Gender	0.078		0.279***
	(0.063)		(0.101)
Migration background	0.195**		0.324***
	(0.082)		(0.104)
Birth order	−0.002		−0.130**
	(0.037)		(0.052)
Year FE	Yes	No	Yes
State FE	Yes	No	Yes
N	1034	1034	1034
R^2	0.075	0.007	0.136
adj. R^2	0.035	0.006	0.099

Note: This table depicts the same results as Panel A of Table 4 including the estimates of all conditioning variables. Column 2 (similar to all models labeled "Matching Mean") only includes the treatment variable overall family change and is a weighted regression utilizing the weights obtained from entropy balancing. Source: SOEP v29 (1986–2012), own calculations. Robust standard errors in parentheses, * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

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