

Intergenerational Mobility in Socio-emotional Skills

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**IFS: Intergenerational Transfers, Insurance and the
Transmission of Inequality**

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Motivation and Research Question

Motivation:

- 1 **Different types of skills** are important determinants of many life outcomes. (e.g., Almlund et al. (2011))
- 2 **Parental skill endowments and investment** play an important role in determining their children's skills. (e.g., Cunha and Heckman (2007))

Research question:

- Are **parental skills** *during childhood* transmitted to their children *during childhood*?
- Are **grandmothers' skills** transmitted too?

Preview of the Findings

In the United Kingdom:

- 1 **Parental** skills *at ages 5, 10 and 16* **predict** their **children's** socio-emotional skills **during childhood**
- 2 Persistence **increases** if we measure parental skills at **later ages**
- 3 **Stronger** transmission from **mothers to children**
- 4 Evidence on **multigenerational mobility** in socio-emotional skills.

Overview

Data

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Measuring Mobility in Skills

Mobility Estimates

Multi-generational Mobility

Conclusion

Data: 1970 British Cohort Study

- **Longitudinal database** following the lives of people born in a single week of 1970 in England, Scotland and Wales.
- Cohort members have been **interviewed ten times** since 1970.
 - Parents' socio-emotional skills *during childhood* (**Age-5, 10, and 16 waves**).
 - Parents' socio-emotional skills *during adulthood* (**Age-26 ad 34 waves**).
- **Link** parents to their **children (aged 3-16)** from the **age-34 wave**.

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Literature on intergenerational and multigenerational mobility in skills.

Anger (2012), Dohmen et al. (2011), Gronqvist et al. (2016), Alana et al. (2017), Loehlin (2005), Johnson et al. (2013) and many others...

This paper:

- 1 We use **multiple measures** of socio-emotional skills collected **in different waves** during childhood and during adulthood.
- 2 Parents' and children's skills **are not contemporaneously measured**.

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Modelling the Dimensions of Socio-emotional Skills

- 1 Focus on two dimensions of socio-emotional skills EFA
 - **internalising**: ability to focus attention
 - **externalising**: ability to engage in interpersonal activities
- 2 Use **questionnaire items** from Rutter A (parents) and Strengths and Difficulties (children) Questionnaires. Rutter SDQ

Dimensions of Socio-emotional Skills

| Factor | Cat. | Title | Rutter Wording (Parents during childhood) | SDQ Wording (Children aged 3-16) |
|--------|------|------------------------|---|--|
| EXT | 3 | <i>Restless</i> | Very restless. Often running about or jumping up and down. Hardly ever still | Restless, overactive and not able to sit still for long |
| EXT | 3 | <i>Squirmy/fidgety</i> | Is squirmy or fidgety. | Constantly fidgeting and squirming |
| EXT | 3 | <i>Fights/bullies</i> | Frequently fights other children | Has often had fights with other children or bullied them |
| EXT | 3 | <i>Distracted</i> | Cannot settle to anything for more than a few moments. | Easily distracted, concentration wandered |
| EXT | 2/3 | <i>Tantrums</i> | Has temper tantrums (that is, complete loss of temper with shouting, angry movements, etc.) | Has often had temper tantrums or hot tempers |
| EXT | 3 | <i>Disobedient</i> | Is often disobedient | (+) Generally obedient, usually doing what adults requested |
| INT | 3 | <i>Worried</i> | Often worried, worries about many things | Many worries, often seeming worried |
| INT | 3 | <i>Fearful</i> | Tends to be fearful or afraid of new things or new situations | Nervous or clingy in new situations, easily loses confidence |
| INT | 3 | <i>Solitary</i> | Tends to do things on his/her own, is rather solitary | Rather solitary, tending to play alone |
| INT | 3 | <i>Unhappy</i> | Often appears miserable, unhappy, tearful or distressed | Often unhappy, downhearted or tearful |
| INT | 2/3 | <i>Aches</i> | Complains of headaches + stomach-ache or has vomited | Often complaining of headaches, stomach-aches or sickness |

Modelling the Dimensions of Socio-emotional Skills

- 1 Focus on two dimensions of socio-emotional skills EFA
 - **internalising**: ability to focus attention
 - **externalising**: ability to engage in interpersonal activities
- 2 Use **questionnaire items**, Z_{ijc} , from Rutter A (parents) and Strengths and Difficulties (children) Questionnaires. Rutter SDQ
- 3 Multigroup **factor model** with categorical items Model

$$Z_{ijc}^* = v_{jc} + \lambda_{jc}^\top Y_{ic} + u_{ijc}.$$

$$Z_{ijc} = \begin{cases} 0 & \text{if } Z_{ijc}^* < \tau_{1,jc} \\ 1 & \text{if } Z_{ijc}^* \in [\tau_{1,jc}, \tau_{2,jc}] \\ 2 & \text{if } Z_{ijc}^* > \tau_{2,jc} \end{cases}$$

Exploratory Factor Analysis: Factor Loadings

| Item | Parents (age 5) | | Parents (age 10) | | Parents (age 16) | | Children | |
|------------------------|-----------------|---------------|------------------|---------------|------------------|---------------|---------------|---------------|
| | EXT | INT | EXT | INT | EXT | INT | EXT | INT |
| <i>Restless</i> | 0.8648 | -0.1281 | 0.8108 | -0.1640 | 0.8000 | -0.1228 | 0.6040 | 0.0785 |
| <i>Squirmy/fidgety</i> | 0.7816 | 0.0100 | 0.6919 | 0.0263 | 0.7286 | 0.0103 | 0.6166 | 0.1066 |
| <i>Fights/bullies</i> | 0.4830 | 0.2039 | 0.4955 | 0.0021 | 0.6111 | 0.0058 | 0.6875 | -0.0050 |
| <i>Distracted</i> | 0.6431 | 0.0556 | 0.5927 | 0.0705 | 0.6493 | 0.0709 | 0.7113 | 0.0553 |
| <i>Tantrums</i> | 0.5466 | 0.1570 | 0.4892 | 0.1756 | 0.4998 | 0.1262 | 0.7244 | -0.0164 |
| <i>Disobedient</i> | 0.5732 | -0.0575 | 0.6684 | 0.0288 | 0.6890 | -0.0016 | 0.8162 | -0.1781 |
| <i>Worried</i> | -0.1092 | 0.7993 | -0.0981 | 0.7030 | -0.0055 | 0.7953 | -0.0701 | 0.7747 |
| <i>Fearful</i> | 0.0657 | 0.4692 | -0.0921 | 0.5659 | -0.1245 | 0.7277 | -0.0798 | 0.6837 |
| <i>Solitary</i> | -0.0391 | 0.4794 | 0.0989 | 0.2828 | 0.0463 | 0.3125 | 0.1060 | 0.4432 |
| <i>Unhappy</i> | 0.0492 | 0.7948 | 0.2346 | 0.5117 | 0.2664 | 0.5016 | 0.3889 | 0.4102 |
| <i>Aches</i> | -0.0078 | 0.5367 | -0.0492 | 0.4103 | -0.0360 | 0.3897 | 0.1322 | 0.1758 |

Note. The table displays the factors loadings obtained from exploratory factor analysis (EFA) by sample. The EFA is based on the decomposition of the polychoric correlation matrix, and uses oblimin rotation. Since they are all behaviours indicating lower skills, we recode all of them in reverse, i.e. 'Certainly applies' = 0, 'Somewhat applies' = 1, 'Does not apply' = 2.

Modelling the Dimensions of Socio-emotional Skills

- 1 Focus on two dimensions of socio-emotional skills EFA
 - **internalising**: ability to focus attention
 - **externalising**: ability to engage in interpersonal activities
- 2 Use **questionnaire items**, Z_{ijc} , from Rutter A (parents) and Strengths and Difficulties (children) Questionnaires. Rutter SDQ
- 3 Multigroup **factor model** with categorical items Model

$$Z_{ijc}^* = v_{jc} + \lambda_{jc}^\top Y_{ic} + u_{ijc}.$$

$$Z_{ijc} = \begin{cases} 0 & \text{if } Z_{ijc}^* < \tau_{1,jc} \\ 1 & \text{if } Z_{ijc}^* \in [\tau_{1,jc}, \tau_{2,jc}] \\ 2 & \text{if } Z_{ijc}^* > \tau_{2,jc} \end{cases}$$

- 4 Test for measurement invariance Measurement invariance

Relative Mobility in Socio-emotional Skills

$$Y_i^C = \alpha + \beta^T \mathbf{Y}_i^P + \rho^T \mathbf{X}_i + \epsilon_i \quad (1)$$

- Y_i^C : **Child's** socio-emotional skills during childhood
- Y_i^P : **parent's** skills (internalising, externalising and cognitive) during childhood
- \mathbf{X}_i : Vector of **controls**, which include the region of birth fixed effects, the parent's gender, the child's gender and age, the number of children in the household, the mother's age at the parent's birth, a dummy equal to 1 if the parent is the first born, the parent's employment status at the age of 34, the grandparent's employment status and education in 1975 and the number of children in the parent's household when the parent is 5 years old.
- ϵ_{it} : error term
- **Higher values** of the coefficient β correspond to **lower mobility**.

Absolute Mobility in Socio-emotional Skills

Estimate the children's outcomes (R_i^C) from parents (R_i^P) at a given quintile in the distribution. For example,

$$LH = Pr(R_i^C \geq 80 | R_i^P < 20). \quad (2)$$

Produce **matrices of transition probabilities** across quintile of skill distribution.

To **facilitate comparisons** across the several matrices, we propose:

- *'spectral gap mobility index'*: (1 - second largest eigenvalue)
- **How far** the intergenerational transition matrices are **from an identity matrix**, which corresponds to no mobility.

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Relative Mobility in Socio-emotional Skills

| Dependent variable: | Child's | | | |
|---------------------------------|---------------------|---------------------|---------------------|-----|
| | Internalising (INT) | | Externalising (EXT) | |
| | (1) | (2) | (3) | (4) |
| Parent's INT (during childhood) | 0.168*** (0.050) | 0.192*** (0.067) | | |
| Parent's EXT (during childhood) | | -0.082 (0.071) | | |
| Parent's COG (during childhood) | | 0.157** (0.052) | | |
| Observations | 1035 | 1035 | | |
| R^2 | 0.027 | 0.135 | | |
| Region of birth FE (BCS70 5y) | No | Yes | | |
| Child's age FE | No | Yes | | |
| Other controls | No | Yes | | |

Note. The measurement system and the intergenerational mobility equation are estimated jointly. All standard errors in parentheses are obtained using 200 bootstrap repetitions (***) $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

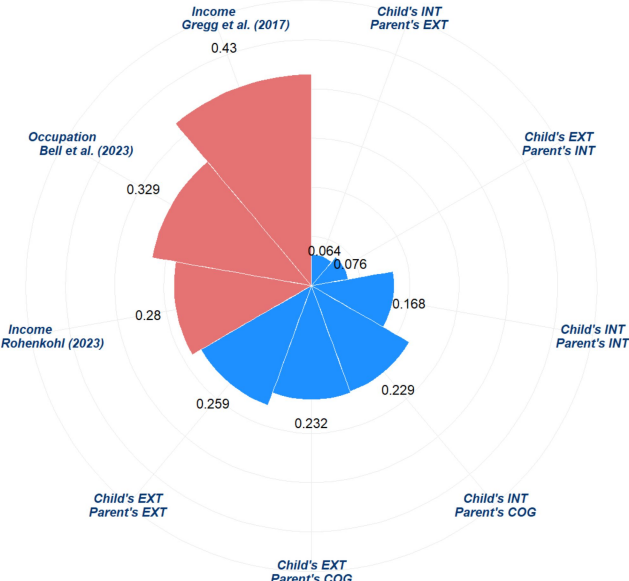
Relative Mobility in Socio-emotional Skills

| Dependent variable: | Child's | | | |
|---------------------------------|----------------------------|----------------------------|----------------------------|----------------------------|
| | Internalising (INT) (1) | Internalising (INT) (2) | Externalising (EXT) (3) | Externalising (EXT) (4) |
| Parent's INT (during childhood) | 0.168*** (0.050) | 0.192*** (0.067) | | -0.040 (0.057) |
| Parent's EXT (during childhood) | | -0.082 (0.071) | 0.259*** (0.047) | 0.243*** (0.054) |
| Parent's COG (during childhood) | | 0.157** (0.052) | | 0.153*** (0.041) |
| Observations | 1035 | 1035 | 1035 | 1035 |
| R^2 | 0.027 | 0.135 | 0.063 | 0.165 |
| Region of birth FE (BCS70 5y) | No | Yes | No | Yes |
| Child's age FE | No | Yes | No | Yes |
| Other controls | No | Yes | No | Yes |

Note. The measurement system and the intergenerational mobility equation are estimated jointly. All standard errors in parentheses are obtained using 200 bootstrap repetitions (***) $p < 0.01$, ** $p < 0.05$, * $p < 0.1$).

Teachers' measures

Comparison of Mobility Measures in the UK



Higher values of the coefficient β correspond to lower mobility.

Mobility in Skills with Contemporaneous Measures

| Dependent variable: | Internalising (INT) Skill | | |
|---|---------------------------|---------------------|---------------------|
| | Child (1) | Child (2) | Child (3) |
| Parent's INT (during childhood) | 0.208*** (0.067) | | 0.137* (0.078) |
| Parent's INT (contemporaneous - age 34) | | 0.426*** (0.077) | 0.393*** (0.090) |
| Observations | 919 | 919 | 919 |
| R^2 | 0.093 | 0.198 | 0.208 |
| Region of birth FE (BCS70 5y) | Yes | Yes | Yes |
| Child's age FE | Yes | Yes | Yes |
| Other controls | Yes | Yes | Yes |

Note. The measurement system and the intergenerational mobility equation are estimated jointly. The internalising skill is derived by a factor model that considers 3 items (unhappy, worried and fearful) common across the 4 different sweeps. All standard errors in parentheses are obtained using 200 bootstrap repetitions (***) $p < 0.01$, ** $p < 0.05$, * $p < 0.1$).

Scatter plots

Mobility in Socio-emotional Skills by Gender

| Panel A: Mother-child | | | | |
|---------------------------------|-----------------------------------|---------------------|-----------------------------------|---------------------|
| Dependent variable: | Child's Internalising (INT) Skill | | Child's Externalising (EXT) Skill | |
| | (1) | (2) | (3) | (4) |
| Parent's INT (during childhood) | 0.219*** (0.062) | 0.221*** (0.081) | | -0.065 (0.074) |
| Parent's EXT (during childhood) | | -0.096 (0.079) | 0.300*** (0.054) | 0.288*** (0.072) |
| Parent's COG (during childhood) | | 0.173** (0.063) | | 0.190*** (0.058) |
| Observations | 752 | 752 | 752 | 752 |
| R ² | 0.046 | 0.159 | 0.083 | 0.182 |
| Region of birth FE (BCS70 5y) | No | Yes | No | Yes |
| Child's age FE | No | Yes | No | Yes |
| Other controls | No | Yes | No | Yes |

| Panel B: Father-child | | | | |
|---------------------------------|-----------------------------------|-------------------|-----------------------------------|------------------|
| Dependent variable: | Child's Internalising (INT) Skill | | Child's Externalising (EXT) Skill | |
| | (1) | (2) | (3) | (4) |
| Parent's INT (during childhood) | -0.011 (0.109) | 0.152 (0.158) | | 0.070 (0.171) |
| Parent's EXT (during childhood) | | -0.099 (0.150) | 0.094 (0.104) | 0.045 (0.159) |
| Parent's COG (during childhood) | | 0.164 (0.145) | | 0.114 (0.114) |
| Observations | 283 | 283 | 283 | 283 |
| R ² | 0.000 | 0.165 | 0.009 | 0.174 |
| Region of birth FE (BCS70 5y) | No | Yes | No | Yes |
| Child's age FE | No | Yes | No | Yes |
| Other controls | No | Yes | No | Yes |

Note. The measurement system and the intergenerational mobility equation are estimated jointly. All standard errors in parentheses are obtained using 200 bootstrap repetitions (***) $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Mobility in Socio-emotional Skills by Gender

| Panel A: Parent-child same gender | | | | |
|--|-----------------------------------|---------------------|-----------------------------------|---------------------|
| Dependent variable: | Child's Internalising (INT) Skill | | Child's Externalising (EXT) Skill | |
| | (1) | (2) | (3) | (4) |
| Parent's INT (during childhood) | 0.233*** (0.069) | 0.271*** (0.091) | | -0.032 (0.073) |
| Parent's EXT (during childhood) | | -0.106 (0.096) | 0.241*** (0.059) | 0.187*** (0.077) |
| Parent's COG (during childhood) | | 0.073 (0.089) | | 0.163*** (0.065) |
| Observations | 539 | 539 | 539 | 539 |
| R ² | 0.051 | 0.218 | 0.167 | 0.189 |
| Region of birth FE (BCS70 5y) | No | Yes | No | Yes |
| Child's age FE | No | Yes | No | Yes |
| Other controls | No | Yes | No | Yes |

| Panel B: Parent-child different gender | | | | |
|---|-----------------------------------|---------------------|-----------------------------------|---------------------|
| Dependent variable: | Child's Internalising (INT) Skill | | Child's Externalising (EXT) Skill | |
| | (1) | (2) | (3) | (4) |
| Parent's INT (during childhood) | 0.078 (0.088) | 0.072 (0.114) | | -0.055 (0.095) |
| Parent's EXT (during childhood) | | -0.036 (0.140) | 0.280*** (0.063) | 0.300*** (0.096) |
| Parent's COG (during childhood) | | 0.253*** (0.114) | | 0.140* (0.077) |
| Observations | 496 | 496 | 496 | 496 |
| R ² | 0.006 | 0.083 | 0.073 | 0.148 |
| Region of birth FE (BCS70 5y) | No | Yes | No | Yes |
| Child's age FE | No | Yes | No | Yes |
| Other controls | No | Yes | No | Yes |

Note. The measurement system and the intergenerational mobility equation are estimated jointly. All standard errors in parentheses are obtained using 200 bootstrap repetitions (***) $p < 0.01$, ** $p < 0.05$, * $p < 0.1$).

Absolute Mobility in Socio-emotional Skills

| Child's EXT - Parent's EXT (during childhood) | | | | | | |
|---|---|-----------------|------|------|------|------|
| | | Parent quintile | | | | |
| | | 1 | 2 | 3 | 4 | 5 |
| Child quintile | 1 | 33.5 | 15.9 | 19.3 | 14.9 | 12.5 |
| | 2 | 21.3 | 21.7 | 21.7 | 17.8 | 19.9 |
| | 3 | 18.3 | 21.3 | 22.2 | 18.3 | 19 |
| | 4 | 12.7 | 21.3 | 13.5 | 24.0 | 26.9 |
| | 5 | 14.2 | 19.8 | 23.2 | 25.0 | 21.8 |
| Spectral gap mobility index: 0.800 (0.038) | | | | | | |

| Child's INT - Parent's INT (during childhood) | | | | | | |
|---|---|-----------------|------|------|------|------|
| | | Parent quintile | | | | |
| | | 1 | 2 | 3 | 4 | 5 |
| Child quintile | 1 | 22.7 | 20.4 | 18.8 | 16.9 | 16.6 |
| | 2 | 21.2 | 25.7 | 17.4 | 19.8 | 17.1 |
| | 3 | 22.2 | 18.4 | 24.2 | 18.8 | 16.6 |
| | 4 | 18.7 | 18.4 | 20.3 | 21.7 | 23 |
| | 5 | 15.2 | 17 | 19.3 | 22.7 | 26.7 |
| Spectral gap mobility index: 0.885 (0.034) | | | | | | |

Note. All standard errors of the spectral gap mobility index in parentheses are obtained using 200 bootstrap repetition, taking into account the factor estimation stage that precedes the estimation of the transition matrix and its respective eigenvalues.

Correlation between relative mobility and spectral gap mobility index = -0.898

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Multigenerational Mobility in Socio-emotional Skills

- **Grandmothers** (aged around 25 years old) completed the Mother Malaise Questionnaire at age-5, 10 and 16 waves.
- Use **comparable** questionnaires items across 3 generation to derive:
 - ⇒ **Internalising skill** from items: (i) worried, (ii) fearful, (iii) unhappy, (iv) aches, and (v) solitary.

Multigenerational Mobility in Socio-emotional Skills

| Dependent variable: | Grandchild's Internalising | | Grandchild's Externalising | |
|---------------------------------|----------------------------|---------------------|----------------------------|-----|
| | (1) | (2) | (3) | (4) |
| Grandmother's INT | 0.138*** (0.053) | 0.074 (0.075) | | |
| Parent's COG (during childhood) | | 0.184*** (0.049) | | |
| Parent's EXT (during childhood) | | -0.094 (0.063) | | |
| Parent's INT (during childhood) | | 0.145* (0.075) | | |
| Observations | 994 | 994 | | |
| R^2 | 0.078 | 0.115 | | |
| Region of birth FE (BCS70 5y) | Yes | Yes | Yes | Yes |
| Child's age FE | Yes | Yes | Yes | Yes |
| Other controls | Yes | Yes | Yes | Yes |

Note. The measurement system and the mobility equation are estimated jointly. Other controls include the cohort member's gender, the age of the cohort member's mother at birth, the grandchild's gender. All standard errors in parentheses are obtained using 200 bootstrap repetitions (** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$).

Multigenerational Mobility in Socio-emotional Skills

| Dependent variable: | Grandchild's Internalising | | Grandchild's Externalising | |
|---------------------------------|----------------------------|---------------------|----------------------------|---------------------|
| | (1) | (2) | (3) | (4) |
| Grandmother's INT | 0.138*** (0.053) | 0.074 (0.075) | 0.159*** (0.043) | 0.108* (0.057) |
| Parent's COG (during childhood) | | 0.184*** (0.049) | | 0.191*** (0.044) |
| Parent's EXT (during childhood) | | -0.094 (0.063) | | 0.221*** (0.051) |
| Parent's INT (during childhood) | | 0.145* (0.075) | | -0.106* (0.062) |
| Observations | 994 | 994 | 994 | 994 |
| R^2 | 0.078 | 0.115 | 0.063 | 0.141 |
| Region of birth FE (BCS70 5y) | Yes | Yes | Yes | Yes |
| Child's age FE | Yes | Yes | Yes | Yes |
| Other controls | Yes | Yes | Yes | Yes |

Note. The measurement system and the mobility equation are estimated jointly. Other controls include the cohort member's gender, the age of the cohort member's mother at birth, the grandchild's gender. All standard errors in parentheses are obtained using 200 bootstrap repetitions (** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$).

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Examine how skills are transmitted **across generations** during **childhood**.

- Main findings:
 - ① **Parental skills** *during childhood* **predict** their **child's socio-emotional** development *during childhood*
 - ② **Grandmothers'** internalising skill predicts their **grandchildren's** socio-emotional development.
- Heterogeneity:
 - ① Skill transmission becomes more persistent as parents age
 - ② Skill transmission occurs mostly from mothers to children.

Rutter A questionnaire

Rutter A scale administered to parents when they were 5, 10 and 16 years old

- | | |
|--|---|
| 1. Very restless. Often running about or jumping up and down. Hardly ever still.* | 2. Is squirmy or fidgety.* |
| 3. Often destroys own or others' belongings. | 4. Frequently fights other children.* |
| 5. Not much liked by other children. | 6. Often worried, worries about many things.* |
| 7. Tends to do things on his/her own, is rather solitary.* | 8. Irritable. Is quick to fly off the handle. |
| 9. Often appears miserable, unhappy, tearful or distressed.* | 10. Sometimes takes things belonging to others. |
| 11. Has twitches, mannerisms or tics of the face or body. | 12. Frequently sucks thumb or finger. |
| 13. Frequently bites nails or fingers. | 14. Is often disobedient.* |
| 15. Cannot settle to anything for more than a few moments.* | 16. Tends to be fearful or afraid of new things or new situations.* |
| 17. Is over fussy or over particular. | 18. Often tells lies. |
| 19. Bullies other children.* | A. Complains of headaches.* |
| B. Complains of stomach-ache or has vomited.* | C. Complains of biliousness |
| D. Has temper tantrums (that is, complete loss of temper with shouting, angry movements, etc.).* | |
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Strengths and Difficulties Questionnaire

Strengths and Difficulties Questionnaire scale administered to children when they were between the age 3-16

- | | |
|--|---|
| 1. Considerate of other people's feelings [†] | 2. Restless, overactive and not able to sit still for long [*] |
| 3. Often complaining of headaches, stomach-aches or sickness [*] | 4. Sharing readily with other children (treats, toys, pencils etc.) [†] |
| 5. Has often had temper tantrums or hot tempers [*] | 6. Rather solitary, tending to play alone [*] |
| 7. Generally obedient, usually doing what adults requested [*] [†] | 8. Many worries, often seeming worried [*] |
| 9. Helpful if someone was hurt, upset or feeling ill [†] | 10. Constantly fidgeting and squirming [*] |
| 11. Has had at least one good friend [†] | 12. Has often had fights with other children or bullies them [*] |
| 13. Often unhappy, downhearted or tearful [*] | 14. Generally liked by other children [†] |
| 15. Easily distracted, concentration wandered [*] | 16. Nervous or clingy in new situations, easily loses confidence [*] |
| 17. Kind to younger children [†] | 18. Often lied or cheated [†] |
| 19. Picked on or bullied by other children | 20. Has often volunteered to help others (parents, teachers, other children) [†] |
| 21. Able to think things out before acting [†] [†] | 22. Stole from home, school or elsewhere [†] |
| 23. Getting on better with adults than with other children | 24. Many fears, easily scared |
| 25. Has seen tasks through to the end, good attention span [†] | |
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Exploratory Factor Analysis: Factor Loadings

| Item | Parents (age 5) | | Parents (age 10) | | Parents (age 16) | | Children | |
|------------------------|-----------------|---------------|------------------|---------------|------------------|---------------|---------------|---------------|
| | EXT | INT | EXT | INT | EXT | INT | EXT | INT |
| <i>Restless</i> | 0.8648 | -0.1281 | 0.8108 | -0.1640 | 0.8000 | -0.1228 | 0.6040 | 0.0785 |
| <i>Squirmy/fidgety</i> | 0.7816 | 0.0100 | 0.6919 | 0.0263 | 0.7286 | 0.0103 | 0.6166 | 0.1066 |
| <i>Fights/bullies</i> | 0.4830 | 0.2039 | 0.4955 | 0.0021 | 0.6111 | 0.0058 | 0.6875 | -0.0050 |
| <i>Distracted</i> | 0.6431 | 0.0556 | 0.5927 | 0.0705 | 0.6493 | 0.0709 | 0.7113 | 0.0553 |
| <i>Tantrums</i> | 0.5466 | 0.1570 | 0.4892 | 0.1756 | 0.4998 | 0.1262 | 0.7244 | -0.0164 |
| <i>Disobedient</i> | 0.5732 | -0.0575 | 0.6684 | 0.0288 | 0.6890 | -0.0016 | 0.8162 | -0.1781 |
| <i>Worried</i> | -0.1092 | 0.7993 | -0.0981 | 0.7030 | -0.0055 | 0.7953 | -0.0701 | 0.7747 |
| <i>Fearful</i> | 0.0657 | 0.4692 | -0.0921 | 0.5659 | -0.1245 | 0.7277 | -0.0798 | 0.6837 |
| <i>Solitary</i> | -0.0391 | 0.4794 | 0.0989 | 0.2828 | 0.0463 | 0.3125 | 0.1060 | 0.4432 |
| <i>Unhappy</i> | 0.0492 | 0.7948 | 0.2346 | 0.5117 | 0.2664 | 0.5016 | 0.3889 | 0.4102 |
| <i>Aches</i> | -0.0078 | 0.5367 | -0.0492 | 0.4103 | -0.0360 | 0.3897 | 0.1322 | 0.1758 |

Note. The table displays the factors loadings obtained from exploratory factor analysis (EFA) by sample. The EFA is based on the decomposition of the polychoric correlation matrix, and uses oblimin rotation. Since they are all behaviours indicating lower skills, we recode all of them in reverse, i.e. 'Certainly applies' = 0, 'Somewhat applies' = 1, 'Does not apply' = 2.

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Multigroup Factor Model

The relationship between the **latent factors** θ_{ic} and the available **measures** X_{ijc} is characterised by item- and group-specific intercepts v_{jc} and loadings λ_{jc} and is affected by an independent measurement error term u_{ijc} :

$$Z_{ijc}^* = v_{jc} + \lambda_{jc}^\top \theta_{ic} + u_{ijc} \quad (3)$$

- **Dedicated factor structure**, where each item loads only on one latent dimension
- **Categorical variables** $Z_{ijc} \in \{1, 2, \dots, L\}$:
 $Pr\{X_{ijc} = l\} = Pr\{\tau_{l-1} \leq Z_{ijc}^* \leq \tau_l\}$, where $\tau_0 = -\infty$;

- $$\theta_{ic} \sim \mathcal{N}(\kappa_c, \sigma_{\theta_c}^2) \quad \text{and} \quad u_{ijc} \sim \mathcal{N}(0, \sigma_c^2) \quad (4)$$

- **Normalisation assumption** needed to deal with factor indeterminacy by setting the mean κ_c and the variance $\sigma_{\theta_c}^2$ of the factor equal to 0 and 1. In addition, the intercepts v_{jc} are equal to zero and the error variance σ_c^2 to 1, while the loadings λ_{jc} and threshold τ_{jc} are free to vary.

Measurement invariance Back

- Estimate **three models with additional restrictions** that we can compare with the baseline model.
 - 1 **Threshold invariant model**: observationally equivalent to the baseline model **when each item is a categorical variable with three categories** (Wu et al. 2016)
 - 2 **Loading- and threshold-invariant model**: impose that the factor loadings λ_{ic} and the threshold on the parameters must be the same between parents and children
 - 3 **Loading-, threshold-, and intercept-invariant model**: impose that the factor loadings λ_{ic} , the intercepts ν_{jc} and the threshold be the same between parents and children.

| Model | Number of parameters | χ^2 | RMSEA | CFI | TLI |
|--|----------------------|----------|-------|-------|-------|
| Baseline model/ Threshold Invariance | 136 | 1876.094 | 0.060 | 0.959 | 0.948 |
| Threshold and loading invariance | 108 | 2803.019 | 0.069 | 0.938 | 0.932 |
| Threshold, loading, and intercept invariance | 81 | 6457.661 | 0.100 | 0.851 | 0.856 |

Note. RMSEA stands for the root mean squared error of approximation, CFI for the comparative fit index, and TLI for the Tucker-Lewis index.

Transition matrices

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Child's EXT - Parent's EXT (during childhood)

| | | Parent quintile | | | | |
|----------------|---|-----------------|------|------|------|------|
| | | 1 | 2 | 3 | 4 | 5 |
| Child quintile | 1 | 33.5 | 15.9 | 19.3 | 14.9 | 12.5 |
| | 2 | 21.3 | 21.7 | 21.7 | 17.8 | 19.9 |
| | 3 | 18.3 | 21.3 | 22.2 | 18.3 | 19 |
| | 4 | 12.7 | 21.3 | 13.5 | 24 | 26.9 |
| | 5 | 14.2 | 19.8 | 23.2 | 25 | 21.8 |

Spectral gap mobility index: 0.800 (0.038)

Child's EXT - Parent's INT (during childhood)

| | | Parent quintile | | | | |
|----------------|---|-----------------|------|------|------|------|
| | | 1 | 2 | 3 | 4 | 5 |
| Child quintile | 1 | 17.2 | 21.4 | 18.8 | 20.3 | 17.5 |
| | 2 | 24.2 | 21.4 | 15.5 | 24.6 | 17.1 |
| | 3 | 18.7 | 19.4 | 20.3 | 17.4 | 23 |
| | 4 | 22.2 | 19.4 | 23.2 | 18.8 | 15.7 |
| | 5 | 17.7 | 18.4 | 22.2 | 18.8 | 26.7 |

Spectral gap mobility index: 0.898 (0.031)

Child's INT - Parent's EXT (during childhood)

| | | Parent quintile | | | | |
|----------------|---|-----------------|------|------|------|------|
| | | 1 | 2 | 3 | 4 | 5 |
| Child quintile | 1 | 25.4 | 13.5 | 18.8 | 15.4 | 22.2 |
| | 2 | 26.9 | 21.7 | 21.3 | 17.8 | 13.9 |
| | 3 | 18.8 | 19.8 | 17.4 | 22.6 | 21.3 |
| | 4 | 15.2 | 21.3 | 20.8 | 23.1 | 21.8 |
| | 5 | 13.7 | 23.7 | 21.7 | 21.2 | 20.8 |

Spectral gap mobility index: 0.913 (0.025)

Note. All standard errors of the spectral gap mobility index in parentheses are obtained using 200 bootstrap repetition, taking into account the factor estimation stage that precedes the estimation of the transition matrix and its respective eigenvalues.

Transition matrices [Back](#)

Child's INT - Parent's INT (during childhood)

| | | Parent quintile | | | | |
|----------------|---|-----------------|------|------|------|------|
| | | 1 | 2 | 3 | 4 | 5 |
| Child quintile | 1 | 22.7 | 20.4 | 18.8 | 16.9 | 16.6 |
| | 2 | 21.2 | 25.7 | 17.4 | 19.8 | 17.1 |
| | 3 | 22.2 | 18.4 | 24.2 | 18.8 | 16.6 |
| | 4 | 18.7 | 18.4 | 20.3 | 21.7 | 23 |
| | 5 | 15.2 | 17 | 19.3 | 22.7 | 26.7 |

Spectral gap mobility index: 0.885 (0.034)

Child's EXT - Parent's COG (during childhood)

| | | Parent quintile | | | | |
|----------------|---|-----------------|------|------|------|------|
| | | 1 | 2 | 3 | 4 | 5 |
| Child quintile | 1 | 26.3 | 22.8 | 17.3 | 20.3 | 9.3 |
| | 2 | 23.2 | 19.9 | 21.6 | 19.3 | 18.5 |
| | 3 | 19.7 | 24.3 | 14.9 | 21.3 | 19 |
| | 4 | 15.7 | 17 | 23.1 | 15.5 | 27.3 |
| | 5 | 15.2 | 16 | 23.1 | 23.7 | 25.9 |

Spectral gap mobility index: 0.844 (0.035)

Child's INT - Parent's COG (during childhood)

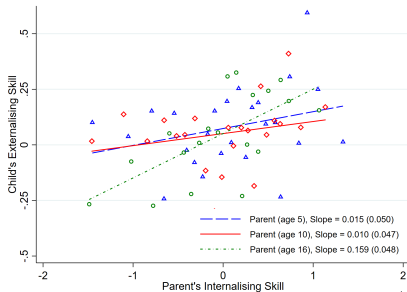
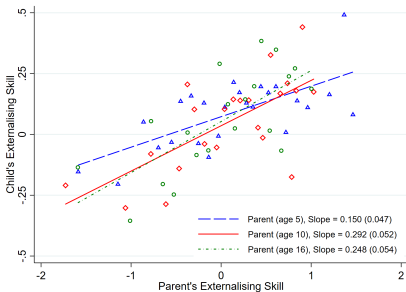
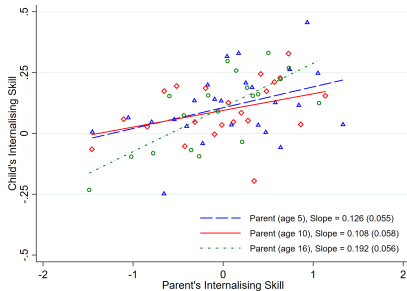
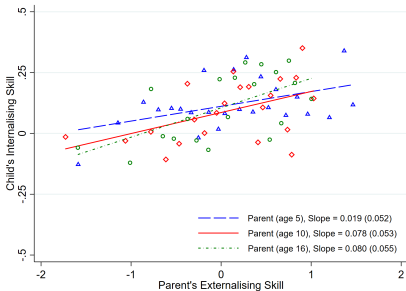
| | | Parent quintile | | | | |
|----------------|---|-----------------|------|------|------|------|
| | | 1 | 2 | 3 | 4 | 5 |
| Child quintile | 1 | 25.8 | 20.4 | 17.8 | 18.4 | 13.4 |
| | 2 | 25.8 | 22.3 | 20.2 | 20.3 | 13 |
| | 3 | 16.2 | 22.8 | 19.7 | 20.3 | 20.8 |
| | 4 | 19.2 | 15 | 18.8 | 23.2 | 25.9 |
| | 5 | 13.1 | 19.4 | 23.6 | 17.9 | 26.9 |

Spectral gap mobility index: 0.862 (0.038)

Note. All standard errors of the spectral gap mobility index in parentheses are obtained using 200 bootstrap repetition, taking into account the factor estimation stage that precedes the estimation of the transition matrix and its respective eigenvalues.

Mobility without Controls

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Mobility estimates - age-10 questionnaire administered to teachers of parents

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| Dependent variable: | Internalising (INT) Skills | | | Externalising (EXT) Skills | | |
|---------------------------------|----------------------------|---------------------|---------------------|----------------------------|---------------------|---------------------|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| Parent's INT (during childhood) | 0.213*** (0.051) | | 0.231*** (0.059) | 0.127*** (0.046) | | 0.055 (0.051) |
| Parent's EXT (during childhood) | | 0.038 (0.048) | -0.044 (0.060) | | 0.233*** (0.046) | 0.213*** (0.055) |
| Parent's COG (during childhood) | 0.114** (0.053) | 0.135*** (0.049) | 0.124** (0.059) | 0.189*** (0.041) | 0.143*** (0.046) | 0.140*** (0.052) |
| Observations | 1144 | 1144 | 1144 | 1144 | 1144 | 1144 |
| R^2 | 0.115 | 0.079 | 0.118 | 0.128 | 0.157 | 0.159 |
| Region of birth FE (BCS70 5y) | Yes | Yes | Yes | Yes | Yes | Yes |
| Child's age FE | Yes | Yes | Yes | Yes | Yes | Yes |
| Other controls | Yes | Yes | Yes | Yes | Yes | Yes |

Note. The measurement system and the intergenerational mobility equation are estimated jointly. All standard errors in parentheses are obtained using 200 bootstrap repetitions (***) $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.