Twin Research and Human Genetics
Volume 16 ▌ Number 1 ▌ pp. 173–178 ▌ © The Authors 2012 ▌ doi:10.1017/thg.2012.106

Current Twin Studies in Germany: Report on CoSMoS, SOEP, and ChronoS

Elisabeth Hahn, Juliana Gottschling, and Frank M. Spinath
Department of Psychology, Saarland University, Saarbruecken, Germany

This article summarizes the status of three recent German twin studies: CoSMoS, SOEP, and ChronoS. The German twin study on Cognitive Ability, Self-Reported Motivation, and School Achievement (CoSMoS) is a three-wave longitudinal study of monozygotic and dizygotic twins reared together, and aims to investigate predictors of and influences on school performance. In the first wave of the data collection in 2005, 408 pairs of twins aged between 7 and 11 as well as their parents participated in CoSMoS. The SOEP twin study is an extended twin study, which has combined data from monozygotic and dizygotic twins reared together with additional data from full sibling pairs, mother–child, and grandparent–child dyads who participated in the German Socio-Economic Panel (GSOEP) study. The SOEP twin project comprises about 350 twin and 950 non-twin pairs aged between 17 and 70. Data were collected between 2009 and 2010, with a focus on personality traits, wellbeing, education, employment, income, living situation, life-satisfaction, and several attitudes. The aim of the Chronotype twin study (ChronoS) was to examine genetic and environmental influences on chronotype (morningness and eveningness), coping strategies, and several aspects of the previous SOEP twin project in a sample of 301 twin pairs aged between 19 and 76 years, recruited in 2010 and 2011. Part of the ChronoS twin sample also participated in the earlier SOEP twin study, representing a second wave of assessments. We briefly describe the design and contents of these three studies as well as selected recent findings.

■ **Keywords:** extended twin designs, personality, circadian rhythm, cognitive ability, motivation, school achievement

Description and Major Findings of CoSMoS

Data Collection and Research Focus

The German twin study on Cognitive Ability, Self-Reported Motivation, and School Achievement (CoSMoS) is a longitudinally designed study aimed at identifying the predictors of and influences on school performance in a genetically sensitive design (Spinath & Wolf, 2006). CoSMoS was initially conceptualized to be in consonant with the Twins' Early Development Study (TEDS; Oliver & Plomin, 2007) in order to replicate results from TEDS in an independent German twin sample. To explore the underlying structure of the etiology of cognitive and especially non-cognitive predictors of school success, on the one hand, and to extend the knowledge about relevant family characteristics on the other, CoSMoS widened the palette of measures to different motivational constructs and specific environmental variables, as well as individual and familial characteristics (e.g. parental involvement and values; see Table 1 for an overview).

CoSMoS was initiated in 2005 and encompasses three waves of data collection with a 2-year period between each measurement, allowing genetic analyses of the causes of stability and change in the variables under study. For details of the recruitment procedure through individual inquiries at registrations offices in two German federal states, see Spinath and Wolf (2006). Zygosity was assessed by questionnaire measures (Oniszczenko et al., 1993) that typically yield accuracies in the magnitude of 95% (Price et al., 2000). The data set finally consists of 407 twin pairs ($M = 9.1$ years, $SD = 0.79$) and their parents for the first wave of data collection. In total, 283 pairs of children participated in at least two of the three measurements.

RECEIVED 31 August 2012; ACCEPTED 9 October 2012. First published online 16 November 2012.

ADDRESS FOR CORRESPONDENCE: Elisabeth Hahn, Department of Psychology, Saarland University, Campus, D-66041 Saarbruecken, Germany. E-mail: e.hahn@mx.uni-saarland.de

TABLE 1

Summary of Measures for CoSMoS

Measures	*N* of items	Wave 1 (2005)	Wave 2 (2007)	Wave 3 (2009)	Source
Parents					
General information (e.g., socio-economic status, everyday life of the twins, learning environment)	46	X		X	
Grades and school type		X	X	X	
School environment (e.g., teacher and peers)	23		X	X	
Parents' evaluation of the child's motivation[a]	72	X		X	Eccles et al. (1983); Elliot & McGregor (2001)
Personality (mother and father)	40 (each)	X			Borkenau & Ostendorf (1993)
Parenting style (mother and father)	32 (each)	X		X	Reitzle et al. (2001)
Values (mother and father)	40 (each)	X			Schwartz & Rubel (2005)
Achievement subscale			X	X	
Parental Involvement	39		X	X	Grolnick et al. (1991)
Twins					
Motivation (e.g., SPA, intrinsic values, and goals)	72	X	X	X	Eccles & Wigfield (1983); Elliot & McGregor (2001)
Personality	45	X		X	Little & Wanner (1998)
Parenting style (mother and father)	32 (each)	X		X	Reitzle et al. (2001)
Parental involvement	39		X	X	Grolnick et al. (1991)
Values	40	X			Schwartz & Rubel (2005)
Achievement subscale			X	X	
Cognitive abilities[b]	93	X		X	Heller & Perleth (2000)
Self-regulation	21		X	X	Lorenz & Wild (2007)

Note: [a]Ability self-perceptions, intrinsic values, utility and importance, goals.
[b]Two verbal (general knowledge including 18 items and 25 vocabulary items) and two non-verbal (figural classification and figural reasoning consisting of 25 items each) scales adapted from the German Cognitive Ability Test (KFT 4–12 + R) and the Wechsler Intelligence Scale for Children (WISC-III; Wechsler, 1991).

Recent Research Findings

On the basis of the broad array of individual and familial predictors of school success, CoSMoS offers the opportunity to broaden our knowledge of the etiology and development of these variables. Intelligence as the single most important predictor of school success has been studied extensively and there is ample evidence that it is substantially heritable (e.g. Deary et al., 2006), and that the genetic influence on inter-individual differences in cognitive abilities increases with age (Plomin & Spinath, 2004). At the same time, the etiology of non-cognitive predictors, such as motivational characteristics and the relationship between different predictors and school success, has been studied much less frequently. Consequently, this is the major research focus of CoSMoS.

Important predictors of school success over and beyond intelligence are children's self-perceived abilities (SPA). Contrary to theoretical assumptions (Eccles et al., 1983), studies based on TEDS data suggested that a substantial part of the inter-individual variance in SPAs is explained by genetic factors and that the main environmental influence is non-shared rather than shared (Spinath et al., 2008). This general pattern was confirmed in the German CoSMoS sample with twins at age 7–11 (Spinath et al., 2008) as well as at age 13 (Gottschling et al., 2012). Because CoSMoS gathered SPAs in all waves of the data collection, it was also possible to analyze the causes of stability and change over a period of 6 years, including the transition to secondary school. Here, genetic influences mainly accounted for stability, whereas non-shared environment accounted for change, especially just after the transition to secondary school (Gottschling, 2012). Multivariate genetic analyses also revealed that in two school domains (German and Math), SPAs correlated with academic success for genetic rather than environmental reasons (Gottschling et al., 2012), which is in line with previous research based on TEDS data (Greven et al., 2009).

With respect to prominent theories of the causal structure of SPA and school success, that is, whether former SPAs influence subsequent school success or rather vice versa (e.g., Marsh & Yeung, 1997), we are currently analyzing the origins of these cross-lagged relationships through multivariate genetic analyses. As CoSMoS encompasses additional motivational variables (e.g., intrinsic values and achievement goals) further non-cognitive predictors of school achievement can be studied in a genetically sensitive design.

Description and Major Findings of the SOEP Twin Study

Data Collection and Research Focus

The SOEP twin study was established in 2009 at Saarland University in cooperation with the German SOcio-Economic Panel study (GSOEP), initiated by the German Institute for Economic Research (DIW) in Berlin. One of the major goals of the SOEP twin project was the creation of a genetically sensitive data set of twin and non-twin relatives. The SOEP is a longitudinal and representative

https://doi.org/10.1017/thg.2012.106 Published online by Cambridge University Press

TABLE 2
Number of Pairs and Mean Age for the CoSMoS, SOEP, and ChronoS Twin Study

	CoSMoS				
	Wave 1	Wave 2	Wave 3	SOEP	ChronoS
Number of pairs	155 (MZ) 226 (DZ) 26 (not classifiable)	84 (MZ) 174 (DZ)	67 (MZ) 135 (DZ)	202 (MZ) 147 (DZ) 419 (SIB) 438 (MoCh) 102 (GpaCh)	162 (MZ) 139 (DZ)
Total	407	258	202	1,308	301
Mean age	9.1	11.4	13.1	39.6 (MZ) 41.5 (DZ) 25.5 (SIB) 27.0 (MoCh, child) 53.4 (MoCh, mother) 21.7 (GpaCh, child) 73.4 (GpaCh, grandparents)	41.0 (MZ) 41.8 (DZ)

Note: MZ = monozygotic twins; DZ = dizygotic twins; SIB = siblings; MoCh = mother–child pairs; GpaCh = grandparent–child pairs.

survey, consulting around 12,000 individuals in nearly 6,000 private German households every year. The sample incorporates every person of a household aged 17 or older, collecting data across different areas, such as personality traits, health, childcare and education participation, employment, income, living situation, life-satisfaction, and several attitudes (Wagner et al., 2007). This family structure offers a unique and rich opportunity to study different family relationships. As the number of twin pairs in the original GSOEP was too low to realize an extended twin design, we used the GSOEP mainly as the basis for the non-twin part of the data set, identifying independent groups of non-twin sibling pairs (SIB) born less than 2 years apart, mother–child dyads (MoCh), and grandparent–child dyads (GpaCh; for more details see Hahn et al., 2011). We then added monozygotic (MZ) and dizygotic (DZ) twin pairs who completed either an online or a paper–pencil version of our questionnaire, which included the same questions as used in the SOEP survey. In part, we reverted to contact information from twins who had participated in previous voluntary German twin studies (JeTSSA, BiLSAT, and TwinPaw), which have been described in detail elsewhere (BiLSAT: Spinath et al., 2002; JeTSSA: Stößel et al., 2006; TwinPaw: Spinath & Wolf, 2006). Furthermore, new contacts were made by random telephone screenings, in which people were simply asked whether they happened to be members of a twin pair. If this was the case, names and contact information were registered. A total of 940 twin pairs from different parts of Germany were contacted via telephone and 562 complete twin pairs agreed to participate in the SOEP twin study. Finally, 349 twin pairs returned a complete set of questionnaires, including a self-report physical similarity questionnaire (Oniszczenko et al., 1993) to classify the zygosity of the twins. The resulting data set for the twin and non-twin groups contained 2,616 individuals (see Table 2). With regard to education, family background, relationship and employment status, the sample was heterogeneous. In addition to biographic and descriptive information (age, sex, weight, and size) as well as objective living conditions and personal development, the data set included a wide range of different topics (see Table 3).

The combination of independent twin and non-twin groups in the SOEP twin project allowed for the exploration of additional sources of variance in a Genetically Sensitive Multi-Group Design (GSMGD). In the GSMGD, analyses rely on five groups of relatives with differing degrees of genetic and environmental relatedness, which provided several methodological advantages: (1) additive and non-additive genetic influences as well as shared and non-shared environmental influences could be estimated simultaneously; (2) twin pairs could be compared to non-twin pairs to investigate twin specific (T) environmental influences; (3) also, influences of cultural transmission could be estimated through the inclusion of inter-generational pairs (MoCh and GpaCh dyads); (4) the GSMGD increased statistical power, leading to more fine-grained and less biased estimates and a greater generalizability of the results.

Major Findings

Different research questions could be addressed in the SOEP twin project with regard to the specific extended design and the wide range of topics included in the data set. Currently, the first studies based on the SOEP twin project are being published and a number of studies are in progress. For example, a study by Hahn et al. (2011) examined genetic and environmental influences on personality dimensions from the five-factor model with regard to additive genetic influences (A) in the presence of non-additive genetic influences (D), shared (C) and non-shared (E) environmental influences, as well as cultural transmission and twin specific (T) environmental influences (i.e., environmental influences that are unique to twin pairs). The analyses revealed contributions of C and D influences for the Big Five personality traits which were not evident in classical twin analyses conducted with the same data set. Evidence for T influences was found for extraversion,

https://doi.org/10.1017/thg.2012.106 Published online by Cambridge University Press

TABLE 3

Summary of Measures for the SOEP and ChronoS Twin Study

Measures	*N* of items	SOEP	ChronoS	Source
Personality traits				
BFI-S	15	X	X	Gerlitz & Schupp (2005)
NEO-PI-R	240		X	Costa & McCrae (1992)
Satisfaction with life	1	X	X	SOEP inventory
Domain satisfaction	14	X	X	SOEP inventory
Worries	12	X	X	SOEP inventory
Future expectations	4	X	X	SOEP inventory
Willingness to take risks	1	X	X	SOEP inventory
Views on life	10	X	X	SOEP inventory
Political interests	3	X	X	SOEP inventory
Religion	1	X	X	SOEP inventory
Friends	1	X	X	SOEP inventory
Importance of different things in life	9	X	X	SOEP inventory
Education and work	15	X		SOEP inventory
Health	5	X	X	SOEP inventory
Chronotype				
LOCI	26		X	Roberts (1998)
MEQ-DE	19		X	Horne & Östberg (1976)
Sleep	20		X	Buysse et al. (1989)
Coping strategies (CISS)	48		X	Endler & Parker (1999)

Note: BFI-S = GSOEP Big Five Inventory; NEO-PI-R = NEO-Personality Inventory revised; LOCI = Lark-Owl Chronotype Indicator; MEQ-DE = Morningness–Eveningness Questionaire; CISS = Coping Inventory for Stressful Situations.

openness, agreeableness, and conscientiousness. Furthermore, the genetic and environmental influences on the relationship between personality and life satisfaction were investigated with a particular focus on twin-specific environmental influences (Hahn et al., 2012). The evaluation of life satisfaction involves a comparison process with other people which can be different for twin and non-twin family members. Using the GSMGD, twin-specific environmental influences and also shared environmental influences were found for life satisfaction. Concerning genetic influences, the analyses showed that the heritability of life satisfaction (additive and non-additive) was completely shared with the genetic influences on personality, indicating no specific genetic influences on life satisfaction independent from personality. Based on these findings, further investigations will focus on the identification of environmental influences of importance in twins versus non-twins. Further analyses in progress explore the nature and nurture of life attitudes, domain satisfaction (work, income, or health) and worries, as well as common genetic and environmental influences on these aspects and personality.

Description and Major Findings of the Chronotype Twin Study (ChronoS)

Data Collection and Research Focus

The chronotype twin project (ChronoS) started in 2010 with a special focus on genetic and environmental influences on inter-individual differences in morningness–eveningness types and the role of personality and coping strategies within this process. The chronotype encompasses a personal preference for being awake, active, and concentrated in the morning versus evening hours of the day. The ChronoS study also served as second wave for the SOEP twin project, incorporating a substantial number of participants from the previous sample and several issues of the SOEP questionnaire. A total of 172 complete data sets of twin pairs from the original SOEP sample were obtained. Additional twin pairs were recruited using contact information on persons with identical birth names, birthdays, and also birthplace provided by the registration office of Berlin, Germany. A request for 11 birth cohorts (1950, 1955, 1960, 1965, 1970, 1975, 1980, 1985, 1990, 1991, 1992) resulted in 1,804 addresses of potential twin pairs. Those twins were also contacted by mail and asked to collaborate in the ChronoS twin study. In total, complete data sets of 875 twins were obtained (see Table 2). Zygosity was diagnosed through self-reports assessing the frequency of twin confusion by different relatives, teachers, and peers across the life span as well as physical similarity (accuracies in the magnitude of 95%; for details, see Price et al., 2000).

At present, only very few studies have investigated the heritability of morningness–eveningness types (Hur, 2007; Hur et al., 1998; Koskenvuo et al., 2007). Furthermore, the underlying mechanisms on the relationship between personality, coping strategies, and chronotype are still unresolved. Depending on the measurement, some studies postulated a positive relationship between morningness and conscientiousness (Tsaousis, 2010), whereas others showed a negative correlation between extraversion and eveningness (Preckel et al., 2012). Therefore, the aim of the ChronoS twin study is to establish the chronotype with respect to different conceptualizations and its relationship to personality-related behavior from a behavior genetic point of view. Different questionnaires (Morningness–Eveningness Questionnaire, MEQ: Horne & Östberg, 1976;

https://doi.org/10.1017/thg.2012.106 Published online by Cambridge University Press

Lark-Owl Chronotype Indicator, LOCI: Roberts, 1998) were used to address different concepts of the chronotype. Preliminary analyses showed that the estimates for additive and non-additive genetic effects on the chronotype collected by the two measurements were comparable. Multivariate genetic modeling can be used to investigate the underlying structure of different measurements of a construct testing for common and specific genetic and environmental influences. Future analyses will focus on common and specific mechanism of the chronotype and the role of personality and coping strategies in this process.

References

Borkenau, P., & Ostendorf, F. (1993). *NEO-Fünf-Faktoren-Inventar (NEO-FFI)*. Göttingen, Germany: Hogrefe.

Buysse, D. J., Reynolds, C. F., Monk, T. H., Berman, S. R., & Kupfer, D. J. (1989). The Pittsburgh Sleep Quality Index (PSQI): A new instrument for psychiatric research and practice. *Psychiatry Research*, *28*, 193–213.

Costa, P. T., & McCrae, R. R. (1992). *Revised NEO Personality Inventory (NEO-PI-R) and NEO Five-Factor Inventory (NEO-FFI) professional manual*. Odessa, FL: Psychological Assessment Resources.

Deary, I. J., Spinath, F. M., & Bates, T. C. (2006). Genetics of intelligence. *European Journal of Human Genetics*, *14*, 690–700.

Eccles, J. S., Adler, T. F., Futterman, R., Goff, S. B., Kaczala, C. M., Meece, J. L., & Midgley, C. (1983). Expectancies, values, and academic behaviors. In J. T. Spence (Ed.), *Achievement and achievement motives* (pp. 75–146). San Francisco, CA: Freeman.

Elliot, A. J., & McGregor, H. A. (2001). A 2 × 2 achievement goal framework. *Journal of Personality and Social Psychology*, *80*, 501–519.

Endler, N. S., & Parker, J. D. A. (1999). *Coping Inventory for Stressful Situations (CISS): manual*. Toronto: Multi-Health Systems.

Gerlitz, J. Y., & Schupp, J. (2005). Zur Erhebung der Big-Five-basierten Persönlichkeitsmerkmale im SOEP. Dokumentation der Instrumentenentwicklung BFI-S auf Basis des SOEP-Pretests 2005. *DIW Research Notes, 4*.

Gottschling, J. (2012). *Eine Multi-Kohorten-Sequenz-Analyse des Zusammenhangs von Motivation und Schulerfolg unter Berücksichtigung allgemeiner kognitiver Fähigkeiten. Ergebnisse aus der Zwillingsstudie KoSMoS [A multi-cohort-sequence analysis of the relationship between motivation and school success taking cognitive abilities into consideration. Results of the twin study CoSMoS]*. Unpublished doctoral dissertation, Saarland University, Saarbruecken.

Gottschling, J., Spengler, M., Spinath, B., & Spinath, F. M. (2012). The prediction of school achievement from a behavior genetic perspective: Results from the German twin study on Cognitive Ability, Self-Reported Motivation, and School Achievement (CoSMoS). *Personality and Individual Differences*, *53*, 381–386.

Greven, C. U., Harlaar, N., Kovas, Y., Chamorro-Premuzic, T., & Plomin, R. (2009). More than just IQ: School achievement is predicted by self-perceived abilities: But for genetic rather than environmental reasons. *Psychological Science*, *20*, 753–762.

Grolnick, W. S., Ryan, R. M., & Deci, E. L. (1991). Inner resources for school achievement: Motivational mediators of children's perceptions of their parents. *Journal of Educational Psychology*, *83*, 508–517.

Hahn, E., Johnson, W., & Spinath, F. M. (2012). *Beyond the heritability of life satisfaction — The roles of personality and twin-specific influences*. Submitted.

Hahn, E., Spinath, F. M., Siedler, T., Wagner, G. G., Schupp, J., & Kandler, C. (2011). The complexity of personality. Advantages of a genetically sensitive multi-group design. *Behavior Genetics*, *42*, 221–233.

Heller, K. A., & Perleth, C. (2000). *Kognitiver Fähigkeitstest für 4. bis 12. Klassen, Revision (KFT4–12+R)*. Weinheim, Germany: Beltz.

Horne, J. A., & Östberg, O. (1976). A self-assessment questionnaire to determine morningness–eveningness in human circadian rhythms. *International Journal of Chronobiology*, *4*, 97–110.

Hur, Y.-M. (2007). Stability of genetic influence on morningness–eveningness: A cross-sectional examination of South Korean twins from preadolescence to young adulthood. *Journal of Sleep Research*, *16*, 17–23.

Hur, Y.-M., Bouchard, T. J., & Lykken, D. T. (1998). Genetic and environmental influence in morningness–eveningness. *Personality and Individual Differences*, *25*, 917–925.

Koskenvuo, M., Hublin, C., Partinen, M., Heikkilä, K., & Kaprio, J. (2007). Heritability of diurnal type: A nationwide study of 8,753 adult twin pairs. *Journal of Sleep Research*, *16*, 156–162.

Little, T. D., & Wanner, B. (1998, July). Validity of a big five personality inventory for children (B5P-C). Poster presented at the meeting of the International Society for the Study of Behavioral Development, Switzerland.

Lorenz, F., & Wild, E. (2007). Parental involvement in schooling—results concerning its structure and impact on students' motivation. In M. Prenzel & L. Allolio-Näcke (Eds.), *Studies on the educational quality of schools. The final report on the DFG Priority Program* (pp. 299–316). Münster, Germany: Waxmann.

Marsh, H. W., & Yeung, A. S. (1997). Causal effects of academic self-concept on academic achievement: Structural equation models of longitudinal data. *Journal of Educational Psychology*, *89*, 41–54.

Oliver, B. R., & Plomin, R. (2007). Twins' Early Development Study (TEDS): A multivariate, longitudinal genetic investigation of language, cognition and behavior problems from childhood through adolescence. *Twin Research and Human Genetics*, *10*, 96–105.

Oniszczenko, W., Angleitner, A., Strelau, J., & Angert, T. (1993). *The questionnaire of twins' physical resemblance* (Unpublished report). Warsaw, Poland: Department of Psychology, University of Warsaw.

Plomin, R., & Spinath, F. M. (2004). Intelligence: Genetics, genes, and genomics. *Journal of Personality and Social Psychology*, *86*, 112–129.

https://doi.org/10.1017/thg.2012.106 Published online by Cambridge University Press

Preckel, F., Lipnevich, A. A., Ross, A., & Roberts, R. D. (2012). *Chronotype and the Big Five: A meta-analytic and facet-analytic investigation*. Submitted.

Price, T. S., Freeman, B., Craig, I. W., Petrill, S. A., Ebersole, L., & Plomin, R. (2000). Infant zygosity can be assigned by parental report questionnaire data. *Twin Research*, *3*, 129–133.

Reitzle, M., Winkler Metzke, C., & Steinhausen, H.-C. (2001). Eltern und Kinder: Der Zürcher Kurzfragebogen zum Erziehungsverhalten. *Diagnostica*, *47*, 196–207.

Roberts, R. D. (1998). *The Lark-Owl (Chronotype) Indicator (LOCI)*. Sydney, Australia: Intelligent Testing Products.

Schwartz, S. H., & Rubel, T. (2005). Sex differences in value priorities: Cross-cultural and multi-method studies. *Journal of Personality and Social Psychology*, *89*, 1010–1028.

Spinath, F. M., & Wolf, H. (2006). CoSMoS and TwinPaW: Initial report on two new German twin studies. *Twin Research and Human Genetics*, *9*, 787–790.

Spinath, F. M., Angleitner, A., Borkenau, P., Riemann, R., & Wolf, H. (2002). German observational study of adult twins (GOSAT): A multimodal investigation of personality, temperament and cognitive ability. *Twin Research*, *5*, 372–375.

Spinath, F. M., Spinath, B., & Plomin, R. (2008). The nature and nurture of intelligence and motivation in the origins of sex differences in elementary school achievement. *European Journal of Personality*, *22*, 211–229.

Spinath, F. M., Toussaint, A., Spengler, M., & Spinath, B. (2008). Motivation als Element schulbezogener Selbstregulation: Die Rolle genetischer Einflüsse [Motivation as an element of school-related selfregulation]. *Unterrichtswissenschaft*, *36*, 3–6.

Stößel, K., Kämpfe, N., & Riemann, R. (2006). The Jena twin registry and the Jena twin study of social attitudes (JeTSSA). *Twin Research and Human Genetics*, *9*, 783–786.

Tsaousis, I. (2010). Circadian preferences and personality traits: A meta-analysis. *European Journal of Personality*, *24*, 356–373.

Wagner, G. G., Frick, J. R., & Schupp, J. (2007). The German Socio-Economic Panel study (SOEP)—Evolution, scope and enhancements. *Journal of Applied Social Science Studies*, *127*, 139–169.

Wechsler, D. (1991). *Manual for the Wechsler intelligence scale for children* (3rd ed.). San Antonio, TX: The Psychological Corporation.

https://doi.org/10.1017/thg.2012.106 Published online by Cambridge University Press