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Why children differ in motivation to learn: Insights from over 13,000 twins from 6 countries

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ABSTRACT

Little is known about why people differ in their levels of academic motivation. This study explored the etiology of individual differences in enjoyment and self-perceived ability for several school subjects in nearly 13,000 twins aged 9–16 from 6 countries. The results showed a striking consistency across ages, school subjects, and cultures. Contrary to common belief, enjoyment of learning and children's perceptions of their competence were no less heritable than cognitive ability. Genetic factors explained approximately 40% of the variance and all of the observed twins' similarity in academic motivation. Shared environmental factors, such as home or classroom, did not contribute to the twin's similarity in academic motivation. Environmental influences stemmed entirely from individual specific experiences.

1. Introduction

Academic motivation refers to a wide range of traits, such as individuals' educationally relevant beliefs, perceptions, values, interests, enjoyment, and attitudes (Ryan & Deci, 2000; Urdan & Midgley, 2003; Wigfield & Eccles, 2000) that are associated to school achievement (Elliot & Dweck, 2005). The etiology of individual differences in these traits remains poorly understood.

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In this paper, we focused on two important motivational constructs: enjoyment of learning (e.g., interest, liking), usually referred to intrinsic motivation; and self-perceived ability, also known as academic self-concept (e.g., children's perception of how good they are at school subjects).

Several recent studies found self-perceived ability to be substantially heritable (Spinath, Spinath, & Plomin, 2008), even when controlling for general cognitive ability (Greven, Harlaar, Kovas, Chamorro-Premuzic, & Plomin, 2009; Luo, Kovas, Haworth, & Plomin, 2011). In terms of environmental contributions, up to 60% of the variance in enjoyment and self-perceived ability is explained by non-shared experiences (Spinath et al., 2008).

Despite the absence of significant shared environmental effects shown by recent large twin studies, several educational studies found a link between aspects of academic motivation and family/classroom-wide factors, such as classroom climate, peer influence, and mothers' motivational practices in child's education (Church, Elliot, & Gable, 2001; Gottfried, Fleming, & Gottfried, 1994; Marsh, Martin, & Cheng, 2008; Ryan, 2000). One possible explanation for this inconsistency is that environmental influences may be correlated with genetic effects (Plomin, DeFries, Knopik, & Neiderhiser, 2012). For example, parental involvement in child's education may have a causal effect on motivation or/and reflect partly genetically driven parental levels of education, ability, and motivation. Some observed classroom effects might also stem from intake selection (e.g., ability streaming). Most research into the relevant home environmental influences examines only one child per family, which makes it difficult to establish whether the environmental effects operate in a family-wide or child-specific manner. It is possible that even objectively shared experiences, such as availability of educational resources at home, act as child-specific experiences through gene-environment correlation, a mechanism through which children in the same home modify their shared environment into individual experiences.

The role of teachers in shaping children's academic motivation has been extensively studied (Chirkov & Ryan, 2001; Church et al., 2001; Reeve & Jang, 2006; Urdan & Midgley, 2003). Research suggested that teachers can promote the development of intrinsic motivation (e.g., enjoyment, liking) by encouraging students' autonomy, providing feedback and optimal challenges, and adopting a caring attitude towards students (Chirkov & Ryan, 2001; Ryan & Deci, 2000). However, teacher effects cannot be easily disentangled from other potential effects of classroom resources, number of children in the class, and teacher unfacilitated classroom-peer interactions (Olson, Keenan, Byrne, & Samuelsson, 2014). Such teacher/classroom effects vary across development, with potentially stronger or persistent effects at the early stages of the formal education when children are facing systematic instruction and academic feedback for the first time (Church et al., 2001; Kovas, Haworth, Dale, & Plomin, 2007; Reeve & Jang, 2006; Urdan & Midgley 2003).

If teachers/classrooms have a strong average effect on children's liking a particular school subject, we should expect twins in different classes to be on average less similar in their enjoyment of the subject than those in same classes. Findings on academic achievement are mixed: several studies have found small teacher/classroom influences (Byrne et al., 2010; Nye, Konstantopoulos, & Hedges, 2004), whereas other studies did not find any (Kovas et al., 2007), with a recent review suggesting that classroom performance differences should not be viewed as indicators of teacher quality (Olson et al., 2014). It could be that teachers and classrooms have a non-shared, child-specific influence, possibly interacting with children's genetic and unique environmental background - leading to unique perceptions and reactions in different children.

The goal of this study was to investigate the relative contribution of genetic and environmental factors to individual differences in enjoyment and self-perceived ability as a function of cultural and educational settings. Twins between 9 and 16 years of age from six different countries were evaluated on their enjoyment of learning and the perception of their competence in several academic disciplines. We also compared twin similarity in same versus different classrooms to evaluate teacher/classroom effects. Finally, we tested whether the first formal teacher/classroom affects later class-wide level of enjoyment and self-perceived ability (Church et al., 2001; Kovas et al., 2007; Reeve & Jang, 2006; Urdan & Midgley, 2003).

2. Method

2.1. Participants

Data of nearly 13,000 identical twins (monozygotic, MZ) and non-identical (dizygotic, DZ) same-sex twins came from six different ongoing twin studies conducted in United Kingdom (Twins Early Development Study – TEDS; Haworth, Davis, & Plomin, 2012), Canada (Quebec Newborn Twin Study – QNTS; Boivin et al., 2013), Japan (Keio Twin Project; Ando et al., 2013), Germany (Twin study on Cognitive ability, Self-reported Motivation and School performance – CoSMoS; Spinath & Wolf, 2006), United States (Western Reserve Reading Project – WRRP; Petrill, Deater-Deckard, Thompson, DeThorne, & Schatschneider, 2006); and Russia (Russian School Twin Registry – RSTR; Kovas et al., 2012). Detailed information on each sample is presented in the Appendix A.1.

2.2. Materials

Across all samples, children reported their level of enjoyment and self-perceived ability of different school subjects by completing questionnaires. Self-reported evaluations of enjoyment and self-perceived ability were collected from the UK twins at ages 9, 12 (Luo et al., 2011; Spinath, Spinath, Harlaar, & Plomin, 2006) and 16 (OECD, 2000, 2003, 2006); Canadian twins at ages 10 and 12 (Guay, Marsh, & Boivin, 2003); Japanese twins at ages 10, 11, 12, 13 and 16 (Pintrich & de Groot, 1990); German twins at ages 9, 11 and 13 (Spinath et al., 2008); US twins at age 12 (Harlaar, Deater-Deckard, Thompson, DeThorne, & Petrill, 2011); and Russian twins at age 16 (OECD, 2000, 2003, 2006). Table 1 summarizes the measures and the overall sample size for each twin study. The table indicates maximum number of children in each sample.

Although the measures used across the samples were not identical, they were designed to tap into the same motivational constructs. Convergence of results under these circumstances warrants greater confidence in their generalizability and replicability beyond specific methodological features. Details of each measure are presented in the Appendix A.2.

2.3. Procedure

Analyses were conducted on variables corrected for age and sex within each sample. Where data on opposite-sex DZ twins were available (UK, Canada, Japan, and Germany), we ran the analyses twice, including and excluding opposite sex DZ twins - with very similar results.

The information on whether twins and their co-twins were taught in the same or different classes was also available in the UK sample at ages 7 and 9. We tested whether being in different classes for 8 or more months reduces similarity in the level of