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Socioeconomic status modifies interest-knowledge associations among adolescents

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ABSTRACT

Researchers have recently taken a renewed interest in examining the patterns by which noncognitive traits and cognitive traits relate to one another. Few researchers, however, have examined the possibility that such patterns might differ according to environmental context. Using data from a nationally representative sample of approximately 375,000 students from 1300 high schools in the United States, we examined the relations between socioeconomic status (SES), interests, and knowledge in eleven academic, vocational/professional, and recreational domains. We found little support for the hypothesis that SES-related differences in levels of interest mediate SES-related differences in levels of knowledge. In contrast, we found robust and consistent support for the hypothesis that SES moderates interest-knowledge associations. For 10 out of 11 of the knowledge domains examined, the interest-knowledge association was stronger for individuals living in higher SES contexts. Moderation persisted after controlling for an index of general intelligence. These findings are consistent with the hypothesis that low SES inhibits individuals from selectively investing their time and attention in learning experiences that are consistent with their interests.

1. Introduction

According to investment perspectives, individual differences in knowledge acquisition result from differences in the amount of time and effort directed towards learning, the ability to process to-be-learned information, and interest in the subject matter. Cattell (1987) originated the investment perspective in hypothesizing that "this year's crystallized ability level is a function of last year's fluid ability level – and last year's interest in school work and abstract problems generally" (p. 139). While Cattell focused on the role of ability, rather than interest, as the primary determinant of knowledge acquisition, Ackerman (1996) developed the investment hypothesis to include a host of personality and interest factors that, he argued, each play a role in the acquisition of specialized knowledge in myriad domains. Ackerman proposed that "investment of cognitive (ability), affective (personality), and conative (motivational) resources is what drives the acquisition and maintenance of domain-specific knowledge over the lifespan" (Ackerman, 2000, p. 70). Further building on this framework, Chamorro-Premuzic and Furnham (2004; also see Marsh & Craven, 2006, and Tucker-Drob & Harden, in press) commented that the interest-knowledge relation may be reciprocal in the sense that interest leads to knowledge acquisition, which in turn leads to higher self-perceived ability, and hence, greater interest. In sum, contemporary investment perspectives have built on Cattell's original ability-based theory to place a stronger emphasis on personality and interests as determinants of knowledge acquisition, and on the role of individual differences in acquired knowledge reinforcing individual differences in interests.

Evidence consistent with contemporary investment perspectives have derived from both cross-sectional and longitudinal studies. For instance, a meta-analysis by Schiefele, Krapp, and Winteler (1992) estimated the cross-sectional correlation between interest and academic achievement as .31 (.40 after correcting for unreliability), although this relation differed somewhat by content domain. Applications of cross-lagged models to longitudinal data have indicated that reciprocal causation may underlie these relations. In a number of publications, Marsh and colleagues have reported both that levels of achievement precede and predict changes in interest, and that levels of interest precede and predict changes in achievement (Köller, Baumert, & Schnabel, 2001; Marsh & Craven, 2006; Marsh, Trautwein, Lüdtke, Köller, & Baumert, 2005). Others have reported similar patterns of reciprocal relations between self-perceived ability and achievement (Chamorro-Premuzic, Harlaar, Greven, & Plomin, 2010; Greven, Harlaar, Kovas, Chamorro-Premuzic, & Plomin, 2009).

With evidence supportive of investment perspectives now well in place, one outstanding question concerns whether the efficiency of the investment process differs for individuals living in different social and economic contexts. Some of the earliest theorizing on this topic comes from Sandra Scarr (Scarr, 1992; Scarr-Salapatek,

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1971), who argued that the process by which "people sort themselves into environments according to their interests, talents, and personality... depends on people having a varied environment from which to choose and construct experiences," which she noted is unlikely to be the case for "children reared in very disadvantaged circumstances" (Scarr, 1992, p. 9). In other words, children being raised in wealthy contexts are more likely to have sufficient opportunities to direct their time and attention towards learning experiences that are consistent with their dispositions than are children being raised in impoverished contexts. Indeed, indices of socioeconomic status (SES), such as family income and parental educational attainment, evidence strong and consistent relations with achievement and knowledge throughout the school years and into adulthood (Sirin, 2005). However, as Huston and Bentley (2010) have noted, "almost all of the literature investigating poverty effects is based on a unidirectional model" that treats children as passive recipients of educational and experiential inputs of varying levels of quality (p. 414; see, e.g. Kazdin, Kraemer, Kessler, Kupfer, & Offord, 1997; McLoyd, 1998). Moreover, the extent to which previous work has considered the interface between SES, interests, and knowledge has been to treat interests as *mediators* of SES-knowledge relations. For example, Eccles (1994) has proposed that experiential forces result in social differences in individual interests, expectations, and values that guide both task choice and task investment, which in turn influence achievement. We are aware of no studies, however, that have systematically examined the *moderation* hypothesis that interest-knowledge relations vary with socioeconomic opportunity. If low SES is indeed associated with restriction of the opportunities to actively select and attend to both curricular and extracurricular experiential inputs that are congruent with children's individual interests, then one would expect a moderation effect in the direction of lower interest-knowledge relations among children being raised in lower SES contexts.

The purpose of the current study was to test the above prediction using data collected from a nationally representative sample of high school students. We examined interest-knowledge relations in eleven scholastic, professional, and recreational content areas. Based on our hypothesis that low SES is associated with fewer opportunities for children to actively seek learning experiences that are congruent with their interests, we predicted that (1) there would be moderate-sized socioeconomic differences in adolescents' levels of knowledge across scholastic, professional, and recreational content domains, (2) these differences would not be well accounted for by socioeconomic differences in adolescents' interest levels in the content domains, and (3) domain-specific interests would be positively related to domain-specific levels of knowledge, but to a larger extent for adolescents being raised in higher SES homes. Finally, because our predictions specifically pertained to the within-domain intersection between interests and knowledge, we also conducted a series of sensitivity analyses in which an index of general intelligence was controlled for. If our findings indeed apply to specific content domains, the same pattern of results should persist even after controlling for general intelligence.

2. Method

2.1. Participants

We used data from Project Talent collected in 1960 from 377,015 students (49.9% male) from approximately 1300 high schools (both public and private) randomly sampled from across the United States (93% of the high schools originally invited to participate). Project Talent was designed to determine the "best methods for the identification, development, and utilization of human talents" (Flanagan et al., 1962, p.1). Directed by Dr. John Flanagan working at the University of Pittsburgh, and a number of associates and coordinators at the federal and state levels, this massive research endeavor sought to shed light on the education process and the links between interests, abilities, and achievement. The average age of the sample was 15.8 years (SD = 1.82). There were a large proportion of individuals who did not report their race. The most accurate indices of the diversity of the sample derive from school reports of ethnic/racial composition made on a discrete 1 to 9 point scale ranging from 0–10% (choice 1) to 90–100% (choice 9). Mean reports were 2.12, 1.21, 1.06, and 1.57 for proportion Black, Asian, Native American, and Hispanic

Table 1
Descriptive statistics of study variables.

Variable	N	Minimum	Maximum	Mean	SD	Reliability
Socioeconomic status	358,030	58	131	97.73	10.20	.65
Accounting, business, and sales interest	362,146	0	120	48.67	21.63	.91
Art interest	362,161	0	40	18.48	9.75	.79
Biological sciences interest	362,397	0	40	17.41	10.07	.85
Farming interest	362,276	0	40	16.91	10.19	.81
Hunting & fishing interest	357,641	0	40	20.75	12.63	.75
Literature interest	362,403	0	40	18.26	8.99	.89
Mechanical-technical interest	362,392	0	40	14.04	9.37	.91
Music interest	362,410	0	40	15.93	11.24	.81
Physical sciences interest	362,402	0	40	16.33	9.32	.91
Social studies/Public service interest	359,921	0	40	14.71	11.81	.95
Sports interest	362,150	0	40	22.77	10.09	.83
Accounting, business, and sales knowledge	363,058	0	10	4.40	2.00	>.52
Art knowledge	363,058	0	12	5.99	2.63	>.62
Biological sciences knowledge	371,103	0	11	5.73	2.42	>.55
Farming knowledge	371,103	0	12	7.21	2.61	>.49
Hunting & fishing knowledge	363,058	0	10	2.94	1.96	>.38
Literature knowledge	371,103	0	24	11.94	4.66	>.71
Mechanical-technical knowledge	371,103	0	19	9.56	3.99	>.68
Music knowledge	371,103	0	13	6.00	3.00	>.61
Physical sciences knowledge	371,103	0	18	8.03	4.10	>.69
Social studies/Public service knowledge	371,103	0	24	13.82	5.50	>.73
Sports knowledge	371,103	0	14	6.54	3.07	>.57
General intelligence (Abstract reasoning test)	366,825	0	15	8.66	3.121	>.52

Note: Reliability coefficients for knowledge variables are R^2 values from predicting the variable with other similar variables from the dataset due to lack of access to the item level variables. They can therefore be considered lower bound estimates of the variables' reliabilities.

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Table 2
Correlations among SES, interest, general intelligence, and knowledge, according to content domain.

Domain	SES-Interest	SES-Knowledge	Interest-Knowledge	Intelligence-Interest	Intelligence-Knowledge
Accounting, business, & sales	−.050	.322	.043	.014	.392
Art	.108	.393	.217	.133	.445
Biological sciences	.149	.293	.242	.109	.406
Farming	−.035	.216	.200	.033	.363
Hunting & fishing	.013*	.069	.378	.061	.129
Literature	.110	.423	.241	.076	.471
Mechanical-technical	−.074	.227	.418	.015	.337
Music	.046	.436	.222	.031	.433
Physical sciences	.111	.333	.412	.187	.469
Social studies/Public service	.074	.393	.146	.016	.498
Sports	.055	.324	.356	.070	.362

Note: Correlations marked * are not significant. All other correlations are significant at $p < .001$.

respectively. Previous reports have concluded that the Project Talent sample was nationally representative of high school students in 1960 (Flanagan et al., 1964).

2.2. Measures

Descriptive statistics and reliabilities for each scale are presented in Table 1.

Socioeconomic status was computed as a unit-weight composite from participants' responses to nine questions concerning parental education, monetary resources, and material resources. These included father's education, mother's education, father's occupational prestige, estimated value of family's home, estimated family income, and the availability of a number of different articles in the home (e.g. electric dish washer, television, typewriter). The composite was computed by the original Project Talent researchers. Participant responses to the items were standardized based on a sample of high school seniors ($n = 2946$). The score of each item was summed and divided by the estimated standard deviation of the sum, and a linear transformation was applied to produce standard scores with a mean of 100 and a standard deviation of 10.

Participants' content – specific interests were measured using a battery of 205 items. Items asked participants to rate their interests in various activities and occupations on a five-point Likert scale ranging from "I would like this very much" to "I would dislike this very much." Examples of occupations included artist, designer, psychologist, laboratory technician, and sports umpire. Examples of activities included manage a large store, play an instrument, invest money, study muscles and nerves, and help the poor.

Participants' knowledge was measured with a 395-item scale with multiple content-specific subscales. Each knowledge item was multiple choice. Example questions include, "Artist's oil paints are thinned with A. turpentine, B. shellac, C. water, D. alcohol, E. kerosene;" "The liquid portion of blood is called the A. coagulant, B. plasma, C. enzyme, D. hemoglobin, E. Rh factor;" "The principal of a loan is the A. amount borrowed, B. amount repaid, C. interest paid, D. interest rate, E. period of time;" and "In baseball, fouls count as strikes unless there are A. two strikes, B. no men on base, C. three men on base, D. three balls, E. two outs."

Composite domain-specific interest and knowledge variables were computed by the original Project Talent researchers using rational scale construction methods in consultation with several leading experts in education and psychometrics (Flanagan et al., 1962). We utilized their composites with two exceptions aimed at producing matching interest and knowledge variables: (1) We combined the accounting, business, and sales interest domains; and (2) we combined the hunting and fishing knowledge domains. Supporting their concurrent and predictive validities, Project talent interest and knowledge measures have been found to show within person-across domain concordance (Reeve & Hakel, 2000), and to predict later occupational attainment (Austin & Hanisch, 1990).

General intelligence was measured with the Abstract Reasoning test, which is nearly identical in format to the Raven's Progressive Matrices test (Raven, 1962). Each of the 15 items on the test provides a matrix of abstract figures, with at least one cell of the matrix missing. For each item, the participant must choose from among five choices the figure that best fits in the missing cell to complete the pattern in the matrix. Previous work with data from Project Talent (e.g. Reeve, Meyer, & Bonaccio, 2006), has indicated that the Abstract Reasoning test loads directly on the *g* factor, and does not load on any domain-specific group factors, thus indicating that it is an appropriate index of general intelligence. In general, matrix reasoning tasks have been identified as among the best

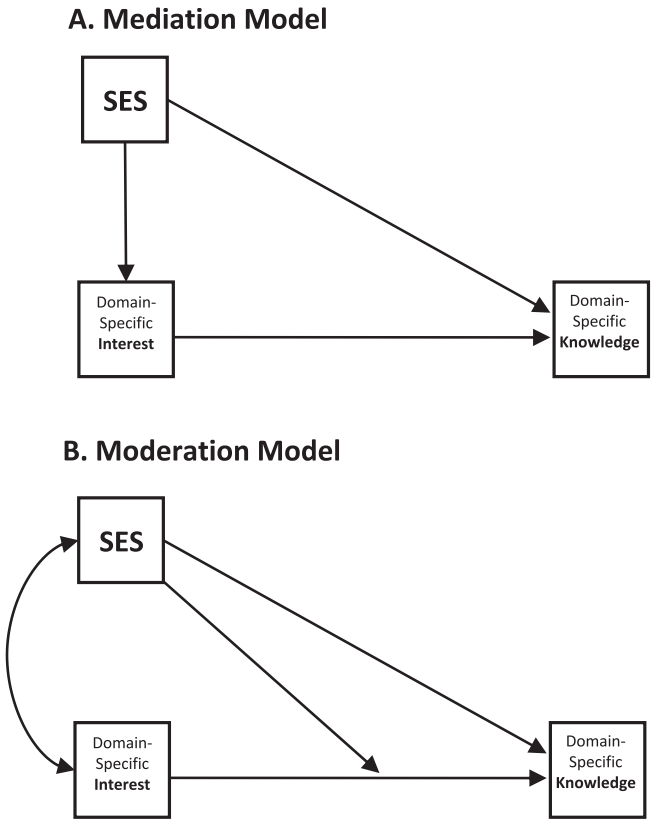

Fig. 1. (A) A mediation model that can be used to examine whether SES-related differences in domain-specific knowledge can be statistically accounted for by way of domain-specific interest. (B) A moderation model that can be used to examine whether the relation between domain-specific interest and domain-specific knowledge differs at different levels of SES.

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Table 3
Results of SES→Interest→Knowledge mediation analyses.

Domain	SES-Interest	Interest-Knowledge	SES-Knowledge (Indirect effect)	SES-Knowledge (Direct effect)
Accounting, business, & sales	−.050(−.062)	.059(.049)	−.003(−.003)	.325(.217)
Art	.108(.071)	.177(.144)	.019(.010)	.373(.263)
Biological sciences	.149(.126)	.203(.183)	.030(.023)	.263(.154)
Farming	−.035(−.052)	.208(.193)	−.007(−.010)	.223(.115)
Hunting & fishing	.013*(−.009*)	.377(.372)	.005*(−.003*)	.064(.033)
Literature	.110(.095)	.197(.183)	.022(.017)	.401(.280)
Mechanical-technical	−.074(−.090)	.437(.426)	−.032(−.038)	.259(.166)
Music	.046(.040)	.202(.197)	.009(.008)	.427(.319)
Physical sciences	.111(.054)	.380(.327)	.042(.018)	.291(.180)
Social studies/Public service	.073(.077)	.118(.121)	.009(.009)	.384(.244)
Sports	.055(.036)	.339(.325)	.019(.012)	.305(.216)

Note: All coefficients are unstandardized. However, all variables were standardized prior to analyses. Coefficients marked * are not significant. All other coefficients are significant at $p < .001$. Coefficients given in parentheses are from analyses controlling for intelligence.

indices of general intelligence available (Snow, Kyllonen, & Marshalek, 1984; Tucker-Drob & Salthouse, 2009).

For additional technical and psychometric properties of the scales, see Tiedeman (1972).

2.3. Procedure

Following extensive evaluation of the test forms, regional coordinators arranged testing dates and distributed the materials. School guidance counselors and teachers supervised administration of surveys and tests at their respective schools. The completed forms were then returned to Project Talent headquarters for coding and scoring (Flanagan et al., 1962).

2.4. Data analysis

We estimated correlations and fit regression-based path models in *M*plus using the complex survey option to correct standard errors for nesting of participants within schools. All variables were z-transformed prior to analysis. The very large sample size available allowed us to consider any p value above .001 to be non-significant.

3. Results

Our results are organized around three major questions: (1) What are the simple relations between SES, domain-specific interests, and domain-specific knowledge? (2) Can socioeconomic differences in interests account for socioeconomic differences in knowledge? (3) Do interest-knowledge relations differ systematically with SES? We report results of analyses both with and without intelligence controlled.

3.1. Zero-order relations

Pearson product-moment correlation coefficients for SES, interests, knowledge, and intelligence are reported in Table 2. For all domains, positive SES-knowledge relations existed. Participants with higher SES tended to have higher levels of knowledge. Apart from hunting and fishing ($r = .069$), SES-knowledge correlations were moderate, ranging between .216 and .436. The average SES-knowledge correlation was .312 across domains. Similarly, consistent positive relations were found between interest and knowledge. Apart from accounting, business, and sales ($r = .043$), interest-knowledge correlations were moderate, ranging from .146 to .418. The average interest-knowledge correlation was .261 across domains, indicating that participants who reported having stronger interest in a domain tended to have more knowledge in that domain. Weak correlations were found between SES and interests, and these correlations varied in direction across variables, ranging from −.074 to .149. In other words, there was no strong tendency for socioeconomic background of the participants to be related to their interest in a domain. However, there was some evidence for a pattern of fairly small positive relations between SES and interests in academic domains. That is, for art, biological sciences, literature, and physical sciences, SES-interest correlations ranged from .108 to .149. Intelligence-interest relations were all very small, but uniformly positive, ranging from .014 to .187 (average = .068). Intelligence-Knowledge correlations were moderate, ranging from .129 to .498 (average = .391). Finally, although not displayed in Table 2, it is of note that the SES-Intelligence correlation was .337.

3.2. Mediation analysis

To answer our second question, we fit mediation models to determine the direct and indirect effects of SES on participants' knowledge scores. It is possible that SES may affect the level of knowledge a person obtains indirectly through levels of interest. However, based on low zero-order correlations between SES and interest, we did not expect that interests would substantially mediate SES-knowledge relations. The basic mediation model is illustrated as a path diagram in the top portion of Fig. 1, and results of mediation analyses are presented in Table 3. It can be seen that all of the indirect effects were very small, and all of the direct effects were comparable in size to the zero order SES-Knowledge correlation reported in Table 2. Moreover, for three domains (accounting, business, and sales; farming; mechanical-technical) a suppression effect was observed. The largest mediated effect was found for physical sciences (.042). Even for this domain, how-

Table 4
Results of regression of information on SES, Interest, and the Interaction of SES × Interest, according to content domain.

Information test	SES	Interest	SES × Interest
Accounting, business, & sales	.325(.217)	.059(.049)	.025(.014)
Art	.372(.262)	.174(.142)	.052(.044)
Biological sciences	.260(.152)	.201(.181)	.041(.030)
Farming	.222(.115)	.207(.193)	−.017(−.019)
Hunting & fishing	.064(.033)	.378(.373)	.040(.040)
Literature	.392(.275)	.194(.181)	.094(.076)
Mechanical-technical	.259(.167)	.441(.430)	.062(.057)
Music	.420(.315)	.197(.193)	.088(.072)
Physical sciences	.288(.178)	.374(.323)	.081(.070)
Social studies/Public service	.380(.241)	.116(.120)	.058(.043)
Sports	.305(.216)	.340(.326)	.036(.035)

Note: All coefficients are unstandardized. However, all variables (but not product terms) were standardized prior to analyses. All coefficients are significant at $p < .001$. Coefficients given in parentheses are from analyses controlling for intelligence.

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ever, the direct effect of SES was much larger (.291). In sum, socioeconomic differences in knowledge could not be well-accounted for by socioeconomic differences in interests. A very similar pattern of results was obtained when general intelligence was controlled for (see Table 3).

3.3. Moderation analysis

To answer our final question, we fit regression based moderation models to determine if interest-knowledge relations differ systematically with SES. The basic moderation model is illustrated in the bottom panel of Fig. 1, and results of moderation analyses are presented in Table 4. The interaction terms for all of the domains are positive except for the farming domain. This indicates that higher SES is associated with stronger magnitude relations between interests and knowledge. The interaction effect of the farming domain was both the closest to zero and negative which indicates that SES plays little role in farming interest-knowledge associations. To illustrate these findings, Fig. 2 plots the moderation model-implied relation between interest and knowledge in each of the 11 content domains for high SES (2 SD above the mean), mean SES, and low SES (2 SD below the mean) individuals. Two effects can be clearly seen in these graphs. First, higher SES children have higher average levels of domain-specific

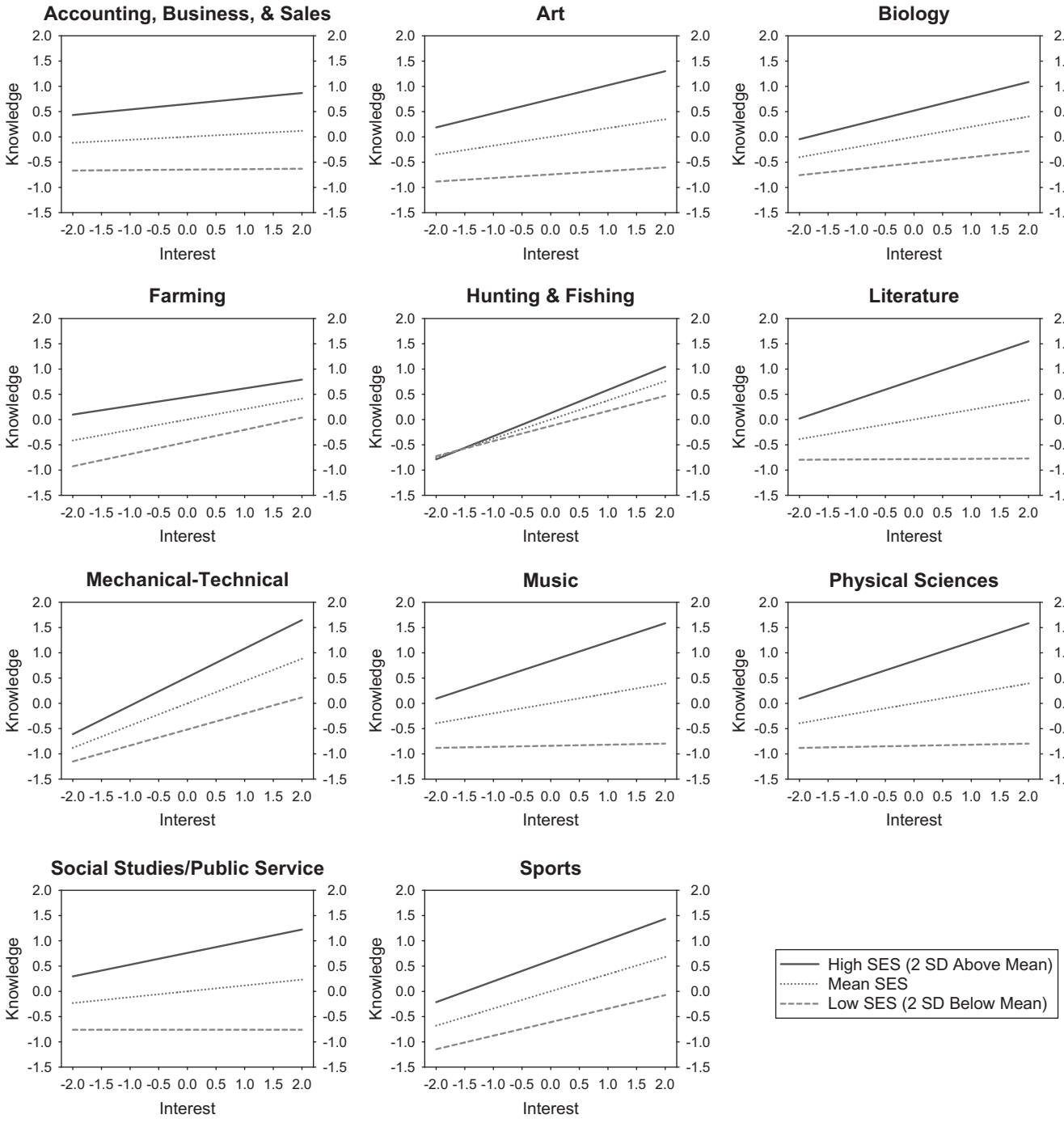

Fig. 2. Plots of interest-knowledge associations for low SES (2 SD below the mean) mean SES, and high SES (2 SD above the mean) children.

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knowledge, as indicated by the large SES differences in the intercepts for all domains but hunting and fishing. Second, for each domain except farming, the slope of the line relating interest to knowledge is higher for higher SES groups; in other words, knowledge is more strongly related to interests at higher levels of SES. This finding is consistent with our hypothesis that SES facilitates the active selection of learning experiences that result in domain-specific knowledge acquisition.

Table 4 additionally presents results from the same set of moderation analyses, this time with intelligence controlled. The pattern of results was largely unchanged. The average magnitude of the interaction parameter (not including the parameter for farming) was .058 when intelligence was not controlled, and .048 when intelligence was controlled (a 17% reduction).

4. Discussion

Investment perspectives emphasize that the acquisition of knowledge is largely an active process by which children selectively attend to and expose themselves to experiences and environments that are consistent with their interests and motivations. Meanwhile, there is considerable theoretical and empirical work in a range of social, behavioral, and economic disciplines that emphasizes the strong causal effect that social and economic contexts play in cognitive development and learning (Duncan, 2012; Ostrove & Cole, 2003). Integrating these two perspectives, we hypothesized that person-driven processes of selective attention and exposure to learning experiences are facilitated by socioeconomic privilege and hindered by socioeconomic disadvantage. We hypothesized that adolescents living in differing socioeconomic contexts do not differ considerably in their levels of interest in academic, vocational/professional, and recreational domains, but rather, differ in opportunities to learn about the topics that interest them. Three major findings were reported in this article, all of which were consistent with these predictions.

First, there were moderate relations between interests and knowledge within content domains. Second, although there were considerable socioeconomic disparities in performance on all but one (hunting & fishing) of the eleven knowledge measures, there were not considerable socioeconomic differences in adolescents' interests in the different content domains. Interests, therefore, did not mediate meaningful proportions of variance in the SES-knowledge relation. Third, the associations between domain-specific interests and domain-specific knowledge were positively moderated by SES for all domains examined, with the exception of farming. In other words, higher SES was associated with stronger relations between interests and knowledge.

4.1. Limitations and future directions

The current results are consistent with our hypothesis that the active process of knowledge acquisition is facilitated by environmental opportunity. However, our results are derived from cross-sectional data, and it will therefore be important for future longitudinal research to specifically test for SES moderation of cross-lagged interest→knowledge and knowledge→interest pathways.

An additional issue concerns the possibility that children growing up in lower SES homes may possess less knowledge about *how* to go about finding the learning experiences that are consistent with their interests. In some respects, this possibility confounds the to-be explained outcome (domain-specific knowledge) with the explanatory mechanisms (lack of how-to knowledge). Under our current thinking, lack of *how-to* knowledge can be considered a form of inopportunity.

Future research will also need to take into account whether learning motivation plays a role in social class differences in knowledge. While the current findings demonstrate that SES is not appreciably related to interests, it is possible that SES is related to motivation. Children living in higher SES contexts might be more motivated to learn material that relates to their interests. Another prospect for future research will be to examine when in development these interactions first emerge. Project Talent was based on a narrow range of ages, and the data were therefore inappropriate for examining age differences in the magnitude of the interaction. However, because socioeconomic differences in cognitive development and academic achievement begin very early in childhood (Heckman, 2006; Tucker-Drob, Rhemtulla, Harden, Turkheimer, & Fask, 2011), one might expect that SES differences in interest-knowledge associations would emerge very early as well.

The current study was based on data that were collected in 1960. One may therefore wonder about the extent to which the current findings pertain to ongoing dynamics occurring in contemporary society. Over the past 50 years in the United States, impoverished individuals have become increasingly confined to geographically isolated communities and urban areas (Massey, 1996; Wilson, 1987). To the extent that opportunities to pursue educational and recreational experiences consistent with individual interests depends on the resources and of *communities*, as we might indeed expect, then the changes that have occurred since the initiation of Project Talent might be expected to result in even more pronounced interaction effects than those observed here.

5. Conclusions

In summary, we examined the three-way relation between SES, domain-specific interests, and domain-specific knowledge in 11 domains. We found that low SES was not associated with considerably less interest in academic, vocational/professional, and recreational content domains, but rather, with attenuation of the relation between domain-specific interests, and corresponding domain-specific knowledge. These findings suggest that the restriction of opportunity to pursue interests impedes realization of high competencies and knowledge bases among low SES children. Future longitudinal research is warranted to examine how these processes unfold over development.

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