J. Intell. **2014**, *2*, 68-81; doi:10.3390/jintelligence2030068

OPEN ACCESS

Journal of

Intelligence

ISSN 2079-3200

www.mdpi.com/journal/jintelligence

Article

Predicting Intellectual Ability and Scholastic Outcomes with a Single Item: From Early Childhood to Adulthood

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Received: 9 May 2014; in revised form: 15 July 2014 / Accepted: 21 July 2014 / Published: 31 July 2014

Abstract: Previous research shows that perceived intelligence judgments significantly correlate with measured intelligence scores. The present study investigated the developmental trajectory of the association between perceived intelligence and measured intelligence. Using the Block and Block longitudinal dataset, we examined the relationship between a single rating of "high intellectual ability" made in early childhood by targets' preschool teachers with future intellectual ability and scholastic outcome measures, including IQ scores, grade-point average, SAT scores, and educational attainment. Even when controlling for variables including attractiveness, parental education levels, the General Factor of Personality, and socioeconomic status, correlations between early childhood intelligence perceptions and later intellectual measures were significant, large, and robust. Results are discussed in terms of potential mechanisms and cues in early childhood that may reveal future intellectual abilities.

Keywords: perceived intelligence; CCQ; person perception; longitudinal; scholastic outcomes

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1. Introduction

Intelligence is a valued social trait and individuals associate high intelligence with a number of positive social outcomes, including status, attractiveness, and kindness [1–3]. How individuals perceive intelligence in others has the potential to influence the success or failure of many social outcomes, including everyday conversations, job interviews, and dating interactions, to name just a few. And research consistently demonstrates perceivers are able to detect strangers' levels of intelligence at better-than-chance levels across a variety of social interactions and judgment conditions [4–7]. For example, accurate intelligence impressions were achieved with brief exposure (<1 min videos) to target individuals [8]. With less than 5 s exposure to video clips of strangers in a social interaction, participants were significantly better-than-chance at judging strangers' IQ scores [9].

The ecological perspective on social perception may provide one explanation for the relationship between perceived intelligence ratings and measured intelligence. According to Zebrowitz and Collins , the ecological perspective on social perception posits that individuals evolved the capacity to process cues to personality traits and emotional states [10]. A person's constellation of physical and behavioral cues to personality is available during a social interaction and accurate social perception is achieved when perceivers correctly detect social cues that validly indicate personality traits. In essence, the social interaction "affords" the perceiver the possibility of noticing clues to another's trait or mood state. In the case of intelligence, a social interaction provides the perceiver with a number of indicators that reveal a person's intellectual abilities. It is also clear that nonverbal behavioral cues are important components in accurate social perception [11]. In terms of intelligence judgments, nonverbal cues such as responsiveness to conversation partner, eye gaze, and self-assured expressions significantly correlated with both measured intelligence and ratings of perceived intelligence [8]. Perceivers apparently need nonverbal cues to accurately detect intelligence, as suggested by results whereby those who made intelligence judgments solely from transcripts of social interactions were inaccurate at perceiving intelligence but intelligence estimates rose to better-than-chance levels with exposure to nonverbal cues [6].

From a developmental perspective, previous research explored the relationship between judgments of intelligence and measured intelligence at various ages based on a longitudinal dataset [12]. Perceivers judged photographs of target individuals at various ages and those intelligence judgments were correlated with targets' IQ scores obtained at each age level. Perceivers were better-than-chance at detecting measured intelligence levels from target photographs in childhood, early adolescence, and middle adulthood, though most of these relationships fell to nonsignificance when target attractiveness was controlled. However, the findings suggest that judgments of an individual's intelligence remain somewhat stable, and potentially accurately predict measured intelligence throughout childhood and adulthood.

Thus far, the aforementioned research was all conducted in a zero-acquaintanceship situation, that is, the perceivers and targets were strangers [13]. Research suggests that acquaintanceship can affect accuracy rates, such that friends and family have higher accuracy rates than judgments between strangers (e.g., [14,15]). However, this acquaintanceship-accuracy relationship appears to be qualified by the type of trait being judged. Accuracy seems impaired between strangers when the judged trait is low in observability (e.g., creativity) whereas accuracy rates for acquainted or stranger judgments do not vary much, if the trait is high in observability (e.g., extraversion) [16]. Given that strangers can detect intelligence from very brief exposure to targets, the aforementioned intelligence judgment research suggests that intelligence appears to be one such observable trait.

While much past research investigated concurrent accuracy whereby perceived intelligence ratings were correlated with measured intelligence scores at one age level, we were interested in whether early childhood impressions of intelligence could predict the scholastic achievements and intellectual abilities at future ages. That is, do judgments of perceived intelligence made in childhood significantly correlate with individuals' future intelligence levels? Using the Block and Block dataset, we were able to investigate this question by examining preschool teachers' ratings of children's intelligence with future intellectual and scholastic outcomes [17]. We hypothesized that ratings of targets' perceived intelligence in early childhood would significantly predict later intellectual ability and scholastic outcomes up to adulthood, including measured IQ, SAT scores, grade-point average, and years of education completed.

2. Method

2.1. Participants

The data and documentation files were obtained electronically from the Murray Research Archive [17]. The Block and Block longitudinal study was designed to examine personality holistically and developmentally [18]. To this end, the 30-year longitudinal study used a multitrait-multimethod approach by administering a large battery of measures across multiple points in time. Participants were recruited from two preschools in Berkeley, California. Data collection began when the participants were between the ages of three and four with multiple waves of testing up to age 32. For the present study, data from ages three and four, 11, 18, and 32 were analyzed. The sample at ages three and four consisted of 78 males and 79 females. Of the 157 participants: 98 were White, 48 were Black, 7 were Asian-American, 3 were listed as "other," and ethnicity was not available for one participant. Attrition at subsequent waves of data collection caused the demographic composition of the sample to vary from that of the base year.

2.2. Q-sort Methodology and the California Child Q-Set (CCQ) Item "High Intellectual Capacity"

The Q-sort methodology involves having raters arrange a set of items, called a Q-set, based on the degree to which the items describe what is being rated. There are many elements to the Q-sort method and these can be adjusted to suit the purpose of the research and the particular constraints faced by the researchers. Typically, items in a Q-set are personality dimensions and a rater, or set of raters, are asked to judge a target individual (or individuals) on these personality dimensions [18].

One standard Q-sort measure is the California Child Q-Set (CCQ) [19]. The CCQ involves a stack of 100 cards listing personality dimensions such as "warm and responsive", and "cries easily." A rater places the cards in a series of piles from most to least characteristic of the target. The Q-sort methodology and CCQ have been extensively validated and employed in many research studies [20–24]. One CCQ item is "high intellectual capacity." For the present analyses, we examined ratings obtained from participants at age three or four. Participants were rated on this item by preschool teachers and the CCQ methods for ages three and four were described in data files as follows:

> At ages 3 and 4, each child was described by three nursery school teachers who had worked with the children a minimum of 5 months before completing the descriptions. Teachers also received training and met with the project director who explained the rationale, provided written instructions to the CCQ, and answered questions about item meanings. Teachers then independently did a Q-sort for a child who was not in the study (usually from a previous year) but was known to all of the teachers. The item descriptions were discussed, and usually a second child was described to check understandings. At age 4, each child was again described via the CCQ procedure but by an entirely different set of three nursery school teachers equivalently trained [17].

It should be noted that not all of the children were rated at both ages three and four, some were only rated at one age. Eighty-seven participants were rated at both ages, 29 only at age three, and 41 only at age four. To maximize the sample size we included participants with ratings for only age three, only age four, or three and four averaging the ratings at both ages.

2.3. Intellectual Ability and Scholastic Outcomes

The intellectual ability measures and scholastic outcome data collected at ages four, 11, 18, and 32, which were included in the present analyses, are described below. At age four, the Wechsler Preschool and Primary Scale of Intelligence (WPPSI) was administered by examiners to 111 participants (M = 117.27, SD = 12.32). At age 11, the Wechsler Intelligence Scale for Children (WISC) was administered by examiners to 105 participants; the total scores ranged from 80 to 145 (M = 117.99, SD = 13.04). At age 18, the Wechsler Adult Intelligence Scale (WAIS) was administered by examiners to 102 participants; the total scores ranged from 76 to 140 (M = 113.51, SD = 13.85).

A subset of 61 participants took the Scholastic Aptitude Test (SAT) while in high school. The SAT Math scores ranged from 250–780 (M = 545.03, SD = 110.79) and the SAT Verbal scores ranged from 290–860 (M = 531.34, SD = 116.24). High-school grade-point average (GPA) was reported for 98 participants and GPAs ranged from 0.72 to 4.00 (M = 2.79, SD = 0.82).

At age 32, participants reported the number of years of education completed. Years of education were quantified using a four-point scale with the following values: 1 = completed high school; 2 = earned a technical or two-year degree; 3 = earned a Bachelor's degree; 4 = earned a post-graduate degree. Data were available for 80 participants (M = 2.99, SD = 0.97).

2.4. Controls and Covariates

In order to control for confounding influences and alternative explanations, analyses separating the sample or statistically controlling for variables were employed. These potential confounds are listed below along with the rationale for controlling for them and a brief description of their measurement.

2.5. Sex and Ethnicity

Because of differences in groups' objectively measured ability and perceived aptitude, group membership could be a potential confound [25]. Therefore, the groups were split based on sex and ethnicity (Black and White) and analyses were rerun for each group separately.

The sample size for the Black participants is small and reduced even further on some cognitive outcome measures such as SAT scores. While reasons for this are unknown, perhaps Black participants (at that time) were less likely to anticipate pursuing post-secondary education and, therefore, did not take the placement test.

2.6. Physical Attractiveness

Studies indicate a positive correlation between attractiveness and intelligence at several ages including childhood, adolescence, and adulthood [12,25]. There is also evidence that teachers, parents, and peers expect higher academic performance from physically attractive individuals [26–30]. Hence, the Q-sort raters could be influenced by a child's attractiveness in their rating of the child's intellectual capacity which could cause a spurious association between the target variables. The CCQ includes the item "physically attractive, good-looking." The score on this item derived from the same raters of the child's intellectual capacity was included in analyses as a covariate.

2.7. The General Factor of Personality (GFP)

Theoretical and empirical evidence suggests that a GFP may underlie a constellation of personality traits, in a fashion similar to *g* and individual cognitive abilities [31]. Dunkel (2013) found a strong relationship between the GFP [32], which may reflect social-effectiveness [31], and general intelligence using the Block and Block data file [17]. Hence, the Q-sort raters could be influenced by a child's disposition in their rating of the child's intellectual capacity which could cause a spurious association between the target variables. The GFP, as described by Dunkel, was computed for the ages three and four and was included in analyses as a covariate [32].

2.8. Parental Education

Parental education has a sizable association with a child's intelligence [33,34]. Hence, the Q-sort raters could be influenced by the child's parent's education in their rating of the child's intellectual capacity which could cause a spurious association between the target variables. At age 7, information concerning the educational background of both the participant's mother and father was collected. Both parents simply reported the number of years of education they had completed (father M = 16.94, SD = 2.93; mother M = 15.67, SD = 2.20). Both father's and mother's level of education were included in analyses as covariates.

2.9. Socioeconomic Status (SES)

SES is another variable that is associated with intellectual ability and scholastic outcomes [35,36], and could potentially color the judgments of the Q-sort raters. Included in the Block and Block data file is the Warner's Index of SES as measured when participants were four years of age [37]. This score was used as a covariate.

3. Results

3.1. Bivariate Correlations between "High Intellectual Capacity" Rating, Intellectual Ability, and Scholastic Outcomes

The results of the correlation analyses between the rating of "high intellectual capacity" at ages three and four and the indices of intellectual ability and scholastic outcomes at ages 11 and 18 are shown in the second column of Table 1. All correlations were significant, with rated intellectual capacity accounting for between 12% (SAT Math) and 47% (WISC at age 11) of the variance in the criteria variables.

Table 1. Bivariate correlations between "high intellectual capacity" ratings judged at ages 3–4 and indices of intellectual ability and scholastic outcomes.

Intellectual and Scholastic Indices	Full Sample	Males Only	Females Only	White Only	Black Only
WPPSI age 4	0.56 $^{***}_{(111)}$	0.55 $^{***}_{(53)}$	0.60 $^{***}_{(58)}$	0.52 $^{***}_{(74)}$	$0.29_{(29)}$
WISC age 11	0.69 $^{***}_{(104)}$	0.76 $^{***}_{(53)}$	0.59 $^{***}_{(51)}$	0.53 $^{***}_{(69)}$	0.72 $^{***}_{(28)}$
WAIS age 18	0.67 $^{***}_{(102)}$	0.71 $^{***}_{(50)}$	0.62 $^{***}_{(52)}$	0.56 $^{***}_{(70)}$	0.60 $^{**}_{(25)}$
SAT_{Math}	0.36 $^{**}_{(60)}$	0.41 $^{*}_{(26)}$	$0.21_{(34)}$	0.36 $^{*}_{(45)}$	$n < 10$
SAT_{Verbal}	0.54 $^{***}_{(60)}$	0.64 $^{***}_{(26)}$	40 $^{*}_{(34)}$	0.51 $^{***}_{(45)}$	$n < 10$
High-School GPA	0.48 $^{***}_{(97)}$	0.62 $^{***}_{(49)}$	$0.24_{(48)}$	0.35 $^{**}_{(65)}$	$0.36_{(26)}$
Years of Education age 32	0.46 $^{***}_{(79)}$	0.64 $^{***}_{(35)}$	0.34 $^{*}_{(44)}$	0.44 $^{***}_{(62)}$	$0.53_{(13)}$

Note. Degrees of freedom are in parentheses. GFP = General Factor of Personality; GPA = Grade Point Average; SAT = Scholastic Aptitude Test; SES = Socioeconomic status; WAIS = Wechsler Adult Intelligence Scale IQ score; WISC = Wechsler Intelligence Scale for Children IQ score; WPPSI = Wechsler Preschool and Primary Scale of Intelligence IQ score. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Next the correlational analyses were repeated within sex and ethnic groups. Splitting the sample by sex and computing correlations within each group essentially resulted in the replication of general patterns from the full sample. However, some correlations fell to nonsignificance for females (SAT Math scores and GPA). Subsequently, two separate hierarchal regressions were used to test for the possibility that sex and/or ethnicity moderated the relationship between the item rating and the cognitive outcomes. In Step 1 dummy coded sex or ethnicity and the value of "high intellectual capacity" were entered. For all criteria the effect of the rated intellectual capacity was significant. In Step 2, the interaction term of the two variables was added (the product of the rating with sex or with ethnicity). For high school GPA, the interaction term of sex and the value of "high intellectual capacity" explained a significant amount of additional variance, $\Delta R^2 = 0.04$, $F\ (1, 93) = 5.18$, $p < 0.05$. No other interaction was significant. Some correlations were also not significant for the Black ethnic group (WPPSI, GPA, years of education). However, the sample size was quite small in the Black ethnic group resulting in low power and in the case of the SAT scores the sample size for the Black group was even too small to warrant testing ($n < 10$).

3.2. Regression Analyses Predicting Intellectual Ability and Scholastic Outcomes from "High Intellectual Capacity" Rating, while Controlling for Potential Confounds

A series of regression analyses tested the prediction of intellectual/scholastic outcomes from the "high intellectual capacity" rating at age 3–4, while controlling for physical attractiveness, the GFP, SES, and parental years of education For each model, the intellectual/scholastic outcome was the dependent variable with Step 1 containing the control variables and the "high intellectual capacity" rating entered in Step 2. These results are shown in Table 2. All models were significant and the "high intellectual capacity" rating contributed a significant amount of additional variance in each model, except for years of education at age 32, which did, however, approach significance ($p < 0.07$).

Table 2. Regression analyses predicting intellectual ability and scholastic outcomes from "high intellectual capacity" rating as judged at ages 3–4 (controlling for physical attractiveness, GFP, SES, and parental education).

Dependent Variable	N	Step 1—Control Variables					Total R^2	Step 2—"High Intellectual Capacity"
		Attractiveness	GFP	SES	$\text{Education}_{\text{Mother}}$	$\text{Education}_{\text{Father}}$		ΔR^2
WPPSI age 4	96	−0.01	0.28 **	0.10	0.36 *	−0.01	0.31 ***	0.04 *
WISC age 11	87	−0.11	0.36 ***	0.19	0.28 *	−0.12	0.44 ***	0.06 **
WAIS age 18	85	−0.01	0.22 *	0.15	0.38 **	0.03	0.41 ***	0.07 **
SAT_{Math}	55	0.01	0.08	0.15	0.41 *	0.00	0.18 *	0.07 *
$\text{SAT}_{\text{Verbal}}$	55	0.11	0.10	0.25	0.34 *	0.05	0.28 **	0.13 **
High-School GPA	82	−0.06	0.12	0.01	0.24	0.13	0.14 *	0.11 **
Years of Education age 32	69	−0.03	0.33 ***	0.08	0.25	0.09	0.28 **	0.04

Note. Each row represents a separate regression analysis with control variables entered at Step 1 and "high intellectual capacity" rating entered at Step 2. Attractiveness = physical attractiveness rated at age 3–4; GFP = General Factor of Personality; "High Intellectual Capacity" = rated at 3–4; GPA = Grade Point Average; SAT = Scholastic Aptitude Test; SES = socioeconomic status; WAIS = Wechsler Adult Intelligence Scale IQ score; WISC = Wechsler Intelligence Scale for Children IQ score; WPPSI = Wechsler Preschool and Primary Scale of Intelligence IQ score. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

3.3. Relationship between "High Intellectual Capacity" Rating and Measured Intelligence in Predicting Future Intellectual Ability and Scholastic Outcomes

To examine the unique contribution of objectively measured intelligence (*i.e.*, WPPSI score) and the subjective rating of intelligence (*i.e.*, rating of "high intellectual capacity") in predicting future intellectual ability and scholastic outcomes, a series of regressions were performed in which the WPPSI total and the "high intellectual capacity" were used to predict the future intellectual and scholastic measures. The results of these analyses are shown in Table 3. The total variance explained for each dependent variable was significant. The regression weights for the WPPSI were significant in each case, with the exception of SAT Verbal scores and years of education. The regression weights for the "high intellectual capacity" rating were significant in each case, with the exception of the SAT Math (but the result neared significance, $p = 0.06$).

Table 3. Regression analyses predicting future intellectual ability and scholastic outcomes from age 4 IQ and "high intellectual capacity" rating as judged at ages 3–4.

Dependent Variable	*N*	WPPSI Age 4	"High Intellectual Capacity"	R^2
WISC age 11	83	β = 0.52 ***	β = 0.33 ***	0.59 ***
WAIS age 18	81	β = 0.43 ***	β = 0.38 ***	0.52 ***
SAT_{Math}	49	β = 0.41 **	β = 0.26	0.32 ***
SAT_{Verbal}	49	β = 0.18	β = 0.50 ***	0.35 ***
High-School GPA	77	β = 0.29 *	β = 0.33 **	0.30 ***
Years of Education age 32	66	β = 0.09	β = 0.50 ***	0.31 ***

Note. Each row represents a separate regression analysis. WPSSI = Wechsler Preschool and Primary Scale of Intelligence IQ score; "High Intellectual Capacity" = rated at age 3–4; WISC = Wechsler Intelligence Scale for Children IQ score; WAIS = Wechsler Adult Intelligence Scale IQ score; SAT = Scholastic Aptitude Test; GPA = Grade Point Average. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

These analyses were repeated in two additional series with the simple replacement of the age at which IQ was measured. Table 4 exhibits the results of regression analyses in which the "high intellectual capacity" rating at ages 3–4 and IQ measured at age 11 (*i.e.*, WISC) were used to predict the cognitive ability and scholastic outcome indices. The WISC was a significant predictor of all the dependent measures, save years of education. The rating of "high intellectual ability" at ages 3–4 was a significant predictor of all dependent measures with the exception of score on the SAT math section. As seen in Table 5, when these analyses were repeated using IQ measured at age 18 (*i.e.*, WAIS), while the WAIS was a significant predictor of all of the dependent variables, the "high intellectual capacity" rating only was a significant predictor of SAT Verbal scores.

Table 4. Regression analyses predicting future intellectual ability and scholastic outcomes from age 11 IQ and "high intellectual capacity" rating as judged at ages 3–4.

Dependent Variable	*N*	WISC Age 11	"High Intellectual Capacity"	R^2
WAIS age 18	99	β = 0.72 ***	β = 0.17 *	0.71 ***
SAT_{Math}	59	β = 0.68 ***	β = 0.10	0.53 ***
SAT_{Verbal}	59	β = 0.37 **	β = 0.39 **	0.40 ***
High-School GPA	94	β = 0.31 *	β = 0.28 *	0.30 ***
Years of Education age 32	77	β = 0.26	β = 0.31 *	0.26 ***

Note. Each row represents a separate regression analysis. WISC = Wechsler Intelligence Scale for Children IQ score; "High Intellectual Capacity" = rated at age 3–4; WAIS = Wechsler Adult Intelligence Scale IQ score; SAT = Scholastic Aptitude Test; GPA = Grade Point Average. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Table 5. Regression analyses predicting future intellectual ability and scholastic outcomes from age 18 IQ and "high intellectual capacity" rating as judged at ages 3–4.

Dependent Variable	*N*	WAIS Age 18	"High Intellectual Capacity"	R^2
SAT_{Math}	59	β = 0.43 ***	β = 0.21	0.33 ***
SAT_{Verbal}	59	β = 0.44 ***	β = 0.34 **	0.44 ***
High-School GPA	94	β = 0.53 ***	β = 0.11	0.37 ***
Years of Education age 32	78	β = 0.43 ***	β = 0.21	0.33 ***

Note. Each row represents a separate regression analysis. WAIS = Wechsler Adult Intelligence Scale IQ score; "High Intellectual Capacity" = rated at age 3–4; SAT = Scholastic Aptitude Test; GPA = Grade Point Average. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

4. Discussion

It was hypothesized that ratings of "high intellectual capacity" in early childhood would predict future intellectual and scholastic outcomes. The Block and Block data offered a unique opportunity for the assessment of this hypothesis [17]. Each participant was rated by several preschool teachers on the CCQ item "high intellectual capacity" and intellectual ability and scholastic outcomes were assessed for each participant repeatedly up to mid-adulthood, and the comprehensiveness of the data file allowed for the statistical control of possible confounding variables.

The results clearly support the hypothesis. Rating of children's "high intellectual capacity" at ages three and four was positively associated with IQ scores at ages 11 and 18, SAT scores, high-school GPA, and years of education at age 32. Although hampered by a small sample size, to the extent that the associations could be tested within ethnic groups (Black and White), the direction of results suggested replication of the full sample patterns. Splitting the sample by sex essentially replicated the overall results as well. However, the correlations between "high intellectual capacity" ratings with high-school GPA and years of education at age 32 were notably stronger for males as compared to females. Indeed, hierarchical regression revealed that sex moderated the relationship between item rating and high school GPA. Bearing in mind the era and social norms at the time of the participants' upbringing (who were born in the mid-1960s), perhaps female participants were less educationally motivated, and this accounts for the smaller female GPA results. However, given the relatively small sample size within the male and female samples and the potential for cohort effects, future research and replication is needed before interpreting the sex effects between the "high intellectual capacity" rating and GPA results. Additional separate analyses controlling for physical attractiveness, GFP, parental education, and SES showed that rated "high intellectual capacity" at age 3–4 contributed a significant amount of additional variance to each intellectual or scholastic outcome (except years of education at age 32). Thus, the association between rated "high intellectual capacity" and each intellectual or scholastic outcome was not a function of these possible confounds. Of course, the associations between the CCQ item "high intellectual capacity" and the cognitive outcomes, while controlling for the possible confounds, could be in part a function of the measurement unreliability of the confounds. Lastly, because intellectual ability was objectively assessed via an intelligence test administered at age four, the unique and shared variance for the intelligence test and the subjective rating "high intellectual capacity" in predicting future intellectual ability and scholastic outcomes could be assessed. In each case (excepting SAT Math scores), the subjective rating of "high intellectual capacity" explained significant additional variance in future intellectual ability and scholastic outcomes beyond that explained by objectively assessed intellectual ability alone. In the case of the SAT Verbal scores and years of education at age 32 subjectively rated "high intellectual capacity" explained a significant amount of unique variance while the objective measure of intellectual ability did not. These findings are especially intriguing because the raters are detecting indicators of intellectual ability beyond objective measures of intelligence and are buttressed by the findings that the ratings continued to account for variance beyond that of objectively measured intelligence in later childhood (age 11), SAT Math score still being an exception. While, based on the results of the significance tests (SAT Verbal score excepted), the ability of the ratings seemed to "lose steam" in comparison to objectively measured intelligence in late adolescence/young adulthood (age 18), the trends in the beta weights remained stable and detecting significance may have been hampered by smaller sample size.

The findings suggest that along with objective measures, it may be useful to take subjective assessments of intellect into account when attempting to predict future intellectual ability and outcomes.

Possible Mechanisms

What are possible explanations as to how early childhood ratings of perceived intelligence predict later intellectual and scholastic outcomes? Several possible mechanisms may be involved. To begin with, the ratings of "high intellectual capacity" were made by preschool teachers (raters) who were acquainted with the participants for at least five months. A self-fulfilling prophecy interpretation would suggest that the preschool teachers' impressions of the children's intelligence led to an actual improvement in intelligence. As Rosenthal and Jacobson's seminal research demonstrated, teachers' expectations about student performance can impact students' intellectual achievements [38]. So perhaps the preschool teachers' impressions of the children's intelligence and subsequent expectations about the children's academic performance led to the children performing to those expectations. However, given the strength of the associations that last throughout childhood and into adulthood, preschool teachers' impressions of children's intelligence would have to exert continued powerful effects. In a review of the self-fulfilling prophecy literature, Jussim and Harber note that teacher expectation effects, when found, tend to be small and dissipate across time. In their thorough review, the authors conclude: "The hypothesis that teacher expectations have large and dramatic effects on IQ has been disconfirmed" (p. 137) [39]. Thus, it is unlikely that the strong associations between "high intellectual capacity" ratings in preschool and later intellectual outcomes in the present research are explained solely by self-fulfilling prophecy and/or teacher expectation effects. Furthermore, Jussim and Harber note that the relationship between teacher expectations and student achievement is not the result of causal effects (*i.e.*, higher student achievement is due to teacher expectations), but rather because teachers are accurate in their perceptions of students' performance and achievement [39].

Previous research suggests that acquaintanceship can improve the accurate detection of personality traits [15] and the present findings confirm such results. The present work also extends previous research by demonstrating that acquaintanceship ratings of intelligence at one time point can predict future intelligence-related outcomes. The acquaintanceship effect and amount of information the preschool teacher raters were able to draw upon may in part explain the relationship between the impressions of intellectual capacity and future intellectual and scholastic outcomes. Preschool teachers are likely to observe children in a variety of settings and interactions, including those with peers and parents. Previous research shows valid cues to intelligence, such as eye gaze and responsiveness, are revealed during social interactions [6]. Other indicators of intelligence including verbal proficiency, working memory, and problem-solving abilities also would be apparent to teachers. As the ecological perspective of social perception would suggest [10], the children displayed such behavior cues to intelligence during social interactions. Perhaps these cues were detected by the preschool teachers, informed their impressions of "high intellectual capacity," and led to the accurate detection of intelligence. Especially interesting is that these informal impressions accounted for unique variance in the outcomes measures beyond that of the formal assessment of these abilities.

5. Limitations and Conclusions

While the general pattern of results revealed strong associations, it is worth acknowledging potential limitations of our study. Because of their experience as preschool teachers, the raters may have developed astute abilities in making judgments about children. Whether these results would hold true for zero-acquaintanceship situations, where raters are entirely unacquainted with target participants is unknown and could be a potential future direction of study. Also, it is likely that the majority of the raters were female, and females are more accurate judges than males of personality characteristics and nonverbal cues, including intelligence [8,40]. It is possible that the results would not be quite as strong if raters were males. Additionally, the participant demographics were somewhat homogenous, as they were recruited locally in Berkeley, CA. There was not geographic diversity and Asians and Hispanics, sizeable ethnic groups in California, were underrepresented.

The use of ipsative measures, including the Q-sort, in which one score or value is dependent upon other scores or values, has received criticism [41]. Although these criticisms have been addressed [42] and the Q-sort method is being used in new and innovative ways in psychology [24,43,44], clarification is needed. The rating of "high intellectual capacity" is not an independent, but a relative value; it reflects the degree to which the target's character or personality is defined by having a "high intellectual capacity" in relation to other items in the Q-set. However, this does not change the fundamental nature of the findings, that the rating of "high intellectual capacity" in early childhood is a robust predictor of future outcomes. Indeed, because the Q-set items are interdependent it makes it more likely that controlling for rated attractiveness and personality would significantly attenuate the association between the rating and the outcome variables, but this did not occur. This relativity may be an important characteristic of the Q-sort methodology allowing individuals whose intellectual capacity is especially prominent to be identified.

Our results add to a growing literature that is changing our understanding about the accuracy of interpersonal perception [45]. Interpersonal perception appears to be more accurate than previously acknowledged. Future research could further examine the characteristics involved in the accuracy of interpersonal perception from the characteristics of the rater, the individual being rated, and the ability or aspect of personality being assessed. Given the importance of intelligence in modern life [46] understanding the interpersonal perception of intelligence seems especially important.

Acknowledgments

This project was made possible by the Henry A. Murray Research Archive which is housed by the Institute for Quantitative Social Science at Harvard University. The data employed in this study derive from a 30-year longitudinal study begun with 128 three-year-old girls and boys, planned and conducted by Jack and Jeanne H. Block, involving a sequence of nine independent assessments based on personality and cognitive Life, Observational, Test, and Self-report (LOTS) measures.

The authors would like to thank Brynne G. Downum for her contribution in organizing the references.

Author Contributions

Curtis S. Dunkel originated the idea for the study and was the primary conductor of analyses. Nora A. Murphy conducted the literature review and confirmed results of analyses. Nora M. Murphy was the primary author of the Introduction section and Curtis S. Dunkel was the primary author of the Method section. Both authors contributed equally to the Results and Discussion sections of the article.

Conflicts of Interest

The authors declare no conflict of interest.

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