# The Creativity Premium *

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This version: July 27, 2021
First version: June 16, 2021

**Abstract**

Success in life increasingly depends on key skills that allow people to thrive in education, the labor market, and their interactions with others. In this paper, we emphasize creativity as a key skill that is essential to open-ended problem solving and resistant to automation. We use rich longitudinal data to study the relationship between people's creativity measured in childhood and their individual attributes and life outcomes. We find that childhood creativity predicts labor market and educational success: more creative individuals earn more during the course of their careers, work in higher occupational categories, and reach higher levels of educational attainment. Our analysis of attributes further suggests that creative individuals have a package of practical skills that allows them to thrive in work environments where learning from experience is important. We combine insights from our findings with evidence from psychology to propose creativity-improving interventions that could lead to substantial economic benefits.

**Keywords**: *Creativity; skills; life outcomes; children; longitudinal; labor market; wages; earnings; occupational category; educational attainment; practical skills; experience; cognitive ability; human capital.*

**JEL Classification**: *D91; J24.*

*We are grateful for helpful comments from seminar participants and in private conversations. We thank Songjun (James) Jiang, Benjamin Raymond, Christopher Smith and Junya Zhou for excellent research assistance. We also thank the Centre for Longitudinal Studies (at University College London's Social Research Institute) for the use of datasets from the National Child Development Study, and the UK Data Service for making them available.

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# 1 Introduction

In this age of computerization, automation and rapid technological change, success in life increasingly depends on a set of key cognitive and non-cognitive skills that allows people to thrive in education, in the labor market, and in their interactions with others (e.g., Heckman et al., 2006, Deming, 2017a, Castillo et al., 2019, Fe et al., 2020, Angerer et al., 2021, Cortes et al., forthcoming).[1] In this paper, we focus on creativity as a key skill in modern society.

Creativity is the ability to produce novel ideas or solutions that are useful or appropriate in a given situation (e.g., Amabile, 1997, Bradler et al., 2019). Kaufman and Sternberg (2010) emphasize that creative ideas first must be new or innovative, second must be of high quality, and third must be appropriate or relevant to the task at hand. Creativity is underpinned by discovering original combinations of existing ideas (e.g., Feinstein, 2011, Ward and Kolomyts, 2019), by reasoning by analogy from existing situations to new ones (e.g., Magee, 2005, Ward and Kolomyts, 2019), by thinking laterally to depart from usual associations (e.g., De Bono, 2015, Sternberg, 2019), by using imagination (e.g., Gaut, 2010, Gotlieb et al., 2019), and by employing judgment to evaluate new ideas (e.g., Runco and Chand, 1995, Runco and Acar, 2019). Feinstein (2006) emphasizes that creativity is more than a momentary flash of inspiration and depends on a larger process of creative development driven by creative interests.

A variety of authors highlight the importance of creativity for society. Creativity is the key to success in life and defines who we are as human beings (Glăveanu and Kaufman, 2019). Much of economic life is creative (Lucas, 1988), and creativity is a crucial input into societal success and is a main driver of the world economy (Charness and Grieco, 2019). The creative process of generating new ideas by recombining existing knowledge enables fast economic growth (Weitzman, 1998). Creativity is fundamental to entrepreneurship (Erat and Gneezy, 2016) and to innovation (Feinstein, 2013; Gross, 2020), while creative leaders help organizations to succeed and thrive (Reiter-Palmon et al., 2019). A "creative class" is increasingly important for successful and vibrant cities (Florida, 2002, 2019). Finally, learning rests on a creative process of combining new stimuli with existing knowledge (Beghetto, 2019).

Furthermore, the automation of routine tasks through computerization and new technologies amplifies the comparative advantage of the skills required to solve non-routine or open-ended problems, and creativity is one of these key skills that is (currently!) difficult to replace with computers (Autor et al., 2003; Deming, 2017b; Frey and Osborne, 2017; Jaimovich and Siu, 2020). In Autor (2015)'s words: "the interplay between machine and human comparative advantage allows computers to substitute for workers in performing routine, codifiable tasks while amplifying the comparative advantage of workers in supplying problem-solving skills, adaptability, and creativity." Kirstetter et al. (2013) go so far as to claim that we are transitioning to a new "creativity era."

[1] For example: Heckman et al. (2006) emphasize non-cognitive skills; Deming (2017a) and Cortes et al. (forthcoming) emphasize social skills; Fe et al. (2020) emphasize theory of mind (i.e., the ability to understand the mental states of others); and Castillo et al. (2019) and Angerer et al. (2021) emphasize patience.

The psychology literature has focused on the factors that predict creativity (Kaufman et al., 2019),[2] while the economics literature has focused on how to incentivize performance in tasks that require creativity. The motivation to create depends on a complex interplay of intrinsic motivation, incentives provided by extrinsic rewards, and the type of creative task (Charness and Grieco, 2019). Building on earlier work in psychology (surveyed by Hennessey, 2019), a nascent literature in economics investigates how best to motivate and incentivize creative performance. Most of this economics literature uses evidence from laboratory experiments to study creativity (Ariely et al., 2009; Dutcher, 2012; Ederer and Manso, 2013; Erat and Gneezy, 2016; Bradler et al., 2019; Charness and Grieco, 2019; Gneezy et al., 2021), while Azoulay et al. (2011), Gibbs et al. (2017) and Gross (2020) present evidence from the field.[3]

Despite the emphasis across a range of academic disciplines on the importance of creativity for society, we know little about how individuals' creative ability relates to their choices, behavior and outcomes throughout the life course. As noted by Gross (2020), creativity has received very little attention as an economic behavior. As a result, we lack a clear understanding of the mechanisms by which creativity matters for society. Understanding how creativity drives individuals' choices and outcomes will help to quantify the benefits of: (i) launching interventions that aim to enhance or train creativity in children or adults; and (ii) designing incentives, organizations and environments that encourage and spark creative thinking.

In this paper, we study the relationship between people's creativity and their individual attributes and life outcomes, including self-evaluated skills, labor market outcomes and educational attainment. To do so, we use the National Child Development Study (NCDS), a rich longitudinal birth-cohort study that has followed almost all individuals born in the United Kingdom in the first week of March 1958 throughout their life course. The NCDS includes teacher evaluations of creativity at age seven, together with measures of various individual attributes and outcomes in adulthood. In educational settings, psychologists commonly use survey-based teacher evaluations of creativity, and twenty-seven states use definitions of child giftedness that include creativity (Plucker et al., 2019).

Using a measure of creativity in childhood provides a number of benefits. First, choices later in life (e.g., which subjects to study in high school, whether to attend college, what type of job to work in) cannot affect childhood creativity, and so the associations that we study are not driven by the joint effect of life choices on creativity and outcomes. Second, alongside childhood creativity, the NCDS collected detailed information about the characteristics of the individual's parents, home and school in childhood (together with information about the individual themself), and we include these variables as controls in our regressions. Third, our measure of childhood creativity at age seven comes from the individual's school teacher, who knew the individual well and was able to compare the individual's creativity to that of others.

[2]For example, psychologists have found a robust association between creativity and the personality trait of openness to experience (Feist, 2019). Psychologists are also interested in how creativity changes over the life course, finding interesting slumps that coincide with the start of formal schooling and the transition from primary to secondary schooling (Hui et al., 2019), and in cross-cultural differences in creativity (Lubart et al., 2019).

[3]See also Eckartz et al. (2012), Ramm et al. (2013), Bradler (2015), Laske and Schröder (2017), Englmaier et al. (2018), Artes et al. (2019), Attanasi et al. (2019a,b), Dutcher and Rodet (2020), and Charness and Grieco (2021). In the context of a model with intrinsic motivation driven by learning, Gibbs (2021) notes that incentive pay can change workers' focus away from creative tasks.

Of course, teachers might make errors when they evaluate children's creativity; to address this concern, we estimate teacher evaluation errors at the child level (by comparing the teacher's evaluations of math and reading abilities to test scores) and include these estimates as a control variable in our regressions. This approach controls for teachers who systematically rate their students as better or worse than they really are relative to the population of children; similarly, the approach also controls for teachers who show positive or negative bias toward particular children.

In order to control for cognitive ability and to compare the effects of creativity to those of cognitive ability, we include a measure of childhood cognitive ability in all of our regressions. We derive this measure from tests of math, reading and "general" ability (the latter tests the understanding of connections between words or shapes) that were administered to NCDS cohort members.

In Section 3 we begin by studying the relationship between childhood creativity and a variety of individual attributes. First, we find that more creative individuals report that they are more able in artistic or practical high school subjects such as art, music, woodwork or sports. Second, we find that more creative individuals report that they have better practical skills in adulthood. For example, creativity predicts higher self-evaluated skill in construction and assembly, in selling products or services, and in looking after people who need care. Third, we find that more creative individuals are more likely to work in jobs that require experience. By contrast, we find that more cognitively able individuals report that they are more able in analytical high school subjects (such as math and science) and have better analytical skills in adulthood (e.g., skill in carrying out mathematical calculations or in understanding finance), and more cognitively able individuals are more likely to work in jobs that require formal qualifications.

These results help us to understand the nature of creative people, and the analysis sheds light on the possible mechanisms by which creativity can affect labor market and educational outcomes. Furthermore, by showing that creativity and cognitive ability relate differently to individual attributes, we provide evidence that our measures of childhood creativity and cognitive ability capture different aspects of cognition, and thus we validate the usefulness of our measure of creativity.

Together, the results from Section 3 suggest that creative individuals tend to have a package of practical skills that allows them to thrive in work environments in which learning from experience is important. Indeed, existing theories of creative thinking emphasize that the conceptual combination and analogical reasoning that underpin creativity are not based on linear analytical thinking, but instead rely on the practical application of existing knowledge based on experience. Magee (2005) emphasizes that creative problem solving depends on domain-specific "practical mastery" and expertise that is "experiential and internal in nature rather than analytical and communicable." Furthermore, Magee (2005) underscores the importance of experience for the reasoning by analogy that underpins creativity: "creative efficiency" is the ability to "turn experiences into learning and new ideas" and "an analogical transfer occurs when information and experiences from one known situation are retrieved and utilized in the search for the solution to an entirely different situation." Similarly, Charness and Grieco (2019) remark that experience is essential to the "experimental" creative style, whereby creative ideas arise from new combinations of existing items, while Huang et al. (2020)'s work on engineering design notes "the importance of practical skills and expertise to creative performance."

In Section 4 we then study the relationship between childhood creativity and life outcomes. First, we find that more creative individuals tend to perform better in the labor market: more creative individuals are more likely to be in work, and when they work more creative individuals also earn more during the course of their careers. For example, among individuals in work, we find that a one-standard-deviation increase in childhood creativity is associated with labor market earnings that around two percent higher ($p < 0.001$). Furthermore, this same increase in creativity is associated with an increase of nearly one percentage point in the probability of being in work. These effects are economically significant, but they understate the importance of creativity to society because consumers and firms will capture some of the benefits that flow from creativity, while creative ideas act as public goods and form the foundation for further innovation over time (and so creative ideas are likely to be underprovided by markets, relative to the social optimum).[4]

Second, to help understand how creativity can influence labor market success, we study the relationship between childhood creativity and the type of occupation that individuals work in. We find that more creative individuals tend to work in better quality jobs. In particular, more creative individuals are more likely to work in the higher category of managerial and technical occupations, while they are less likely to work in the lower category of skilled non-manual occupations. More cognitively able individuals also tend to work in higher occupational categories, but according to a pattern distinct from that predicted by creativity: for example, unlike creativity, cognitive ability predicts a higher probability of working in professional occupations and a substantially lower probability of working in skilled manual occupations.

Our finding that the positive effects of creativity on occupational type are concentrated on the managerial and technical category links to our earlier results showing that more creative individuals report having better practical skills, while also providing support for a view in psychology that creativity is particularly important for managers and leaders. For example, Reiter-Palmon et al. (2019) argue that "one of the most important skills for managers is that of creative thinking" because good managers or leaders support the creative process and act as a clearing house for ideas.

Finally, we find that more creative individuals tend to reach higher levels of educational attainment at the high school and college levels, which helps to shed further light on the mechanisms by which creativity can affect life outcomes and labor market behavior and success. Our finding that childhood creativity predicts educational attainment later in life provides evidence in support of a view in psychology that learning and creativity are interdependent because understanding new concepts and ideas engages a creative process that combines new stimuli with existing knowledge (Beghetto, 2019). Indeed, our results are consonant with those of psychologists who have found a positive association between creativity and academic achievement (Beghetto, 2019; Kaufman et al., 2019).

[4] From a theoretical perspective, it is not obvious that creativity must always be beneficial to individuals or society. First, creative ideas are often risky and unconventional, and so can be met with skepticism and resistance (Mellander and Florida, 2021). Second, creativity can be used for good and for bad purposes (Cropley and Cropley, 2019). Third, creative work provides intrinsic rewards, which could drive up supply and so reduce extrinsic rewards (Liu and Grusky, 2013).

A stream of research builds on Florida (2002)'s concept of the "creative class" to study the relationship between the size of this creative class (based on occupations) and outcomes such as firm growth and regional wages (e.g., Florida et al., 2008, Mellander and Florida, 2011, Sleuwaegen and Ramboer, 2020; see Mellander and Florida, 2021, for a summary). Florida (2002) divides the workforce into three classes: the creative class, the service class, and the working class, with the creative class making up over one-third of the workforce in the United States (see also Mellander and Florida, 2021). Florida (2019) defines the creative class as those who "work in high skill jobs in science, technology, engineering, business, finance, management, law, healthcare, education, and arts, culture, entertainment, and media." This notion of the creative class captures much of work in higher skill professional and technical occupations, and so does not clearly distinguish creativity from broader human capital and other skills (Glaeser, 2005; Markusen, 2006; Krätke, 2010). Some authors have attempted to refine occupations more carefully according to the skills that they require (e.g., McGranahan and Wojan, 2007, and Liu and Grusky, 2013; relatedly, Allen et al., 2020, find that graduates of Dutch professional/vocational colleges who self-report working in occupations that require higher creativity also report higher wages). Even so, this approach based on occupations cannot capture the relationship between individuals' creativity and their life outcomes. By measuring the relationship between being more creative and earnings at the individual level, we capture both the effects of creativity through *choice of occupation* and the effects of individuals' creativity on wages *within occupation.* Furthermore, because we measure creativity in childhood, our measure of creativity cannot be affected by later occupational choice.

In this paper we provide evidence that creativity matters for important outcomes such as career earnings, employment rates and educational attainment. Our findings suggest that interventions that succeed in improving creativity could have substantial positive economic impacts. In the conclusion we combine insights from our findings with evidence from psychology to suggest fruitful ways in which we could train people to be more creative and motivate them to engage in creative thinking. To briefly highlight some of the main insights from the conclusion: (i) learning should be more practical, experiential and judgment-based, with less focus on traditional classroom academics; (ii) creativity training should build the confidence and independent-minded thinking needed to pursue creative ideas in the face of resistance and skepticism; and (iii) interventions to improve creativity should cultivate cognitive activities such as redefining problems, challenging assumptions, combining concepts, criticizing and evaluating new ideas constructively, and tolerating ambiguity while developing ideas.

The paper proceeds as follows: Section 2 introduces the data and empirical methodology; Section 3 studies the relationship between childhood creativity and individual attributes; Section 4 studies the relationship between childhood creativity and life outcomes; Section 5 concludes; and the Web Appendix provides further details.

# 2 Data and empirical methodology

## 2.1 Description of the data

The National Child Development Study (NCDS) is a British birth-cohort study that follows 18,558 cohort members born in the first full week of March 1958. The NCDS cohort members include 17,415 individuals from the Perinatal Mortality Survey (PMS), who comprise almost all individuals born in England, Scotland and Wales in the relevant week. The NCDS further includes 1,143 individuals born during the same week but who were not in the PMS (these individuals are mostly immigrants).

The NCDS data include social and obstetric information at birth (from the PMS, completed by a midwife). The NCDS further collected information on cohort members at ages 7, 11, 16, 23, 33, 42, 46, 50, and 55 (data were collected from teachers, parents, doctors and the cohort members themselves).[5] The NCDS also collected information on performance in national exams from schools and colleges.

## 2.2 Analysis sample

We exclude NCDS cohort members who were not part of the PMS (because we want to control for social and obstetric information at birth collected by the PMS; see Section 2.1) or for whom we do not have the information to calculate our measure of creativity, cognitive ability or teacher evaluation error (see Sections 2.4 to 2.6). After these exclusions, we have 12,211 individuals in our analysis sample.

## 2.3 Introduction to the empirical methodology

In Section 3 we study the relationship between creativity measured in childhood and individual attributes such as ability in various high school subjects and skills in adulthood (e.g., practical and analytical). In Section 4 we then study the relationship between childhood creativity and labor market and educational outcomes. In the introduction (eighth paragraph) we describe the benefits of studying these relationships using a measure of creativity from childhood.

In all cases, we run OLS regressions of the attribute or outcome of interest on childhood creativity and cognitive ability. Including cognitive ability allows us to compare the effects of creativity to those of cognitive ability. Furthermore, by showing that creativity and cognitive ability relate differently to individual attributes, we validate the usefulness of our measure of creativity.

Using the rich data from the NCDS, our regressions include numerous controls for characteristics of the individuals' parents, home and school in childhood. We also include controls for childhood characteristics of the individuals (e.g., derived from obstetric information at birth and medical questionnaires). Web Appendix I.1 describes these controls.

As with all longitudinal birth-cohort studies, not all questions were completed for all individuals. As is standard, in order to make our results representative of all the individuals in the analysis sample, we follow the inverse probability weighting method, which ensures compara-

[5] The age 62 data collection is currently in the field.

bility between effects estimated at different points in the life cycle (Wooldridge, 2002, 2007). Web Appendix II describes the inverse probability weighting procedure.

### 2.4 Measurement of creativity

At age 7, teachers evaluated the creativity of the NCDS cohort members in their class on a five-point scale (this question was not repeated at other ages and was not asked of parents; Figure A.1 in Web Appendix IV provides the five-point scale). Section 2.6 describes how our analysis addresses the concern that teachers might make errors when evaluating creativity.

The teacher questionnaire emphasized that teachers should evaluate creativity in relation to all children of the same age, and not just children in the teacher's class or school. The questionnaire further instructed teachers that in a representative cross-section of children, about 5% should fall in the first (top) category, 25% in the second category, 40% in the third (middle) category, 25% in the fourth category, and 5% in the fifth (bottom) category. Thus, we convert evaluations to percentile scores using the mid-points of the ranges. That is, the first category (top 5%) converts to a percentile score of 97.5, the second category (top 5%-30%) to a score of 82.5, the third category (middle 40%) to a score of 50, the fourth category (bottom 5%-30%) to a score of 17.5, and the fifth category (bottom 5%) to a score of 2.5.

We standardize the percentile scores of the individuals in the analysis sample to obtain a measure of childhood creativity with a mean of zero and variance of one that we include in our regressions.

### 2.5 Measurement of cognitive ability

Our measure of cognitive ability is based on five tests administered to NCDS cohort members at ages 7 and 11. Shepherd (2012) provides a detailed description of the tests (and how they are scored): at age 7, the NCDS measured math ability (10 questions) and reading ability (30 questions); at age 11, the NCDS again measured math ability (40 questions) and reading ability (35 questions); and at age 11, the NCDS further measured "general ability" (80 questions) by testing the understanding of connections between words or shapes.

To facilitate comparisons between the effects of creativity and cognitive ability, we use principal factor analysis on the test scores of the individuals in the analysis sample to derive a single measure of cognitive ability from the five tests described above. Only one factor has an eigenvalue above one; following the Kaiser (1960) criterion we retain only this single cognitive ability factor. For each individual in the analysis sample, we use the cognitive ability factor loadings to translate the scores on the five tests into a single cognitive ability score. We then standardize this variable to obtain a measure of childhood cognitive ability with a mean of zero and variance of one that we include in our regressions.

In Web Appendix III.1 we show that our results on creativity are robust when, instead of using this measure of cognitive ability, we include all five underlying test scores in our regressions.

The Pearson correlation between our measures of creativity and cognitive ability is 0.54, while the partial correlation, holding all controls fixed, is 0.41.

## 2.6 Teacher evaluation errors

Our analysis addresses the concern that teachers might make errors when they evaluate children's creativity. Conveniently, alongside teacher evaluations of creativity, we observe equivalent teacher evaluations of each child's math and reading abilities at age 7. By comparing these teacher evaluations to the math and reading scores from the tests that were administered to NCDS cohort members at the same age (see Section 2.5), we can estimate teacher evaluation errors at the child level. We then include our estimate of the child-level teacher evaluation error as a control in our regressions. This approach controls for teachers who systematically rate their students as better or worse than they really are relative to the population of children; similarly, the approach also controls for teachers who show positive or negative bias toward particular children.[6]

Web Appendix I.2 describes how we construct the teacher evaluation error control variable. In Web Appendix III.2 we show that our results on creativity and cognitive ability are robust when we exclude the teacher evaluation error control.

[6]Including this teacher evaluation error control helps to address potential attenuation bias due to measurement error. Including this control also helps to reduce any bias due to omitted variables (because teacher evaluation errors might be correlated with unobserved characteristics of the child or their environment).

# 3 Creativity and individual attributes

In this section we study the relationship between childhood creativity and a variety of individual attributes. The analysis serves three purposes. First, and most importantly, the results help us to understand the nature of creative people. Second, the analysis sheds light on the possible mechanisms by which creativity can affect labor market and educational outcomes. Third, by showing that creativity and cognitive ability relate differently to individual attributes, we provide evidence that our measures of childhood creativity and cognitive ability capture different aspects of cognition, and thus we validate the usefulness of our measure of creativity.

We begin by briefly summarizing our main findings in this section. First, we find that more creative individuals report that they are more able in artistic or practical high school subjects (Section 3.1) and have better practical skills in adulthood (Section 3.2), and more creative individuals are more likely to work in jobs that require experience (Section 3.3). Together, these results suggest that creative individuals tend to have a package of practical skills that allows them to thrive in work environments in which learning from experience is important. By contrast, we find that more cognitively able individuals report that they are more able in analytical high school subjects and have better analytical skills, and more cognitively able individuals are more likely to work in jobs that require formal qualifications. Together, these results suggest that cognitively able individuals tend to have a package of analytical skills that are well-suited to work environments in which formal qualifications are important.

## 3.1 Ability in various high school subjects

Table 1 reports the strength of relationships between childhood creativity and self-evaluated ability in various high school subjects. We find that creativity and cognitive ability relate differently to these ability self-evaluations. To summarize the main findings: (i) for artistic or practical subjects, creativity predicts positive self-evaluation, but in contrast cognitive ability tends to predict negative self-evaluation; and (ii) for analytical subjects (math and science), only cognitive ability predicts positive self-evaluation.

Panel A of Table 1 shows that more creative individuals are more likely to report that they are above average ability in art, music, practical subjects (e.g., woodwork or metalwork) and sports, while at the same time more cognitively able subjects are less likely to report being above average in these same subjects (except for music where we find no effect of cognitive ability). For example, a one-standard-deviation increase in childhood creativity is associated with a five-percentage-point increase in the probability of reporting being above average ability in art, while a one-standard-deviation increase in childhood cognitive ability is associated with a four-percentage-point decrease in this probability. To help interpret the size of these effects, we also include the mean of the dependent variable (e.g., 22% report being above average ability in art).

For high school math and science, Panel A of Table 1 shows no statistically significant relationship between childhood creativity and self-evaluated ability, while childhood cognitive ability strongly predicts positive self-evaluation. Finally, for English Panel A shows that both creativity and cognitive ability predict positive self-evaluation.

**Panel A: Above average ability**

| | Math | English | Science | Art | Music | Practical | Sports |
|---|---|---|---|---|---|---|---|
| Creativity | -0.007 | 0.023*** | 0.002 | 0.054*** | 0.017** | 0.026*** | 0.021*** |
| | (0.005) | (0.006) | (0.005) | (0.007) | (0.007) | (0.006) | (0.006) |
| Cognitive ability | 0.139*** | 0.081*** | 0.078*** | -0.038*** | 0.001 | -0.040*** | -0.027*** |
| | (0.006) | (0.007) | (0.006) | (0.008) | (0.008) | (0.008) | (0.007) |
| Number of individuals | 8,809 | 9,011 | 7,483 | 6,520 | 4,508 | 7,458 | 8,757 |
| Mean dep. var. | 0.16 | 0.24 | 0.16 | 0.22 | 0.15 | 0.27 | 0.27 |

**Panel B: Average or above average ability**

| | Math | English | Science | Art | Music | Practical | Sports |
|---|---|---|---|---|---|---|---|
| Creativity | -0.016*** | 0.004 | 0.008 | 0.055*** | 0.005 | 0.010** | 0.012** |
| | (0.006) | (0.004) | (0.007) | (0.007) | (0.009) | (0.005) | (0.005) |
| Cognitive ability | 0.114*** | 0.032*** | 0.018** | -0.073*** | -0.011 | -0.043*** | -0.020*** |
| | (0.007) | (0.005) | (0.008) | (0.009) | (0.011) | (0.006) | (0.006) |
| Number of individuals | 8,809 | 9,011 | 7,483 | 6,520 | 4,508 | 7,458 | 8,757 |
| Mean dep. var. | 0.73 | 0.89 | 0.69 | 0.70 | 0.57 | 0.88 | 0.84 |

Notes: As described in detail in Section 2, we run OLS regressions of the dependent variable on standardized measures of childhood creativity and cognitive ability and a rich set of controls. At age 16, individuals who had studied the high school subject in question were asked "to say roughly how good you think you are at it compared with other people of your age" (below average; average; above average). Woodwork, metalwork and domestic science were given as examples of practical subjects. Heteroskedasticity-consistent standard errors are in parentheses. *, ** and *** denote significance at the 10%, 5% and 1% levels (two-sided tests).

Table 1: High school subject ability (self-evaluated).

Panel B of Table 1 repeats the analysis, but using a weaker measure of positive self-evaluation, namely reporting being average or above average ability. The results are broadly similar, although the effect sizes for creativity tend to be lower (in the case of English and music, the coefficients on creativity become statistically insignificant). For math, creativity now predicts negative self-evaluation.

### 3.2 Skills in adulthood

Table 2 reports the strength of relationships between childhood creativity and self-evaluated skills in adulthood. We find that creativity and cognitive ability relate differently to self-evaluations of skills. To briefly summarize the findings: (i) for practical skills, creativity predicts better self-evaluation, while by contrast cognitive ability predicts worse self-evaluation; (ii) for analytical skills, cognitive ability now predicts better self-evaluation, while we find no effect of creativity; and (iii) for mixed and guidance-related skills, both creativity and cognitive ability predict better self-evaluation (but more strongly for cognitive ability).

Panel A of Table 2 considers primarily practical skills, namely: construction and assembly; using tools; selling products or services; and looking after others. Panel A shows that more creative individuals report that they have better practical skills (all four coefficients are positive, with three statistically significant at the 1% level), while more cognitively able individuals report that they have worse practical skills (all four coefficients are negative, with two significant at the 1% level). In each of the four cases, either the coefficient on creativity is positive and statistically significant at the 1% level or the coefficient on cognitive ability is negative and significant at the same level (or both). To help interpret the size of these effects, note that we have standardized each of the skill self-evaluations (which were reported on a four-point scale). Thus, for example, the first column of Panel A shows that a one-standard-deviation increase in childhood creativity is associated with an increase of 0.05 of a standard deviation in self-evaluated skill in construction and assembly when an adult.

Panel B of Table 2 considers primarily analytical skills, namely: carrying out mathematical calculations; understanding finance; and using a computer to solve problems. In Panel B we find no evidence of any relationship between childhood creativity and self-evaluated analytical skills when an adult, while childhood cognitive ability strongly predicts better self-evaluation in these analytical skills.

Panel C of Table 2 considers mixed skills that have substantial practical and analytical components, namely: writing clearly; speaking clearly; reading plans or diagrams; and running an organization. Panel D of Table 2 considers skills that involve guiding others, namely: advising; teaching; and supervising. For all of these mixed and guidance-related skills, we find that both childhood creativity and cognitive ability predict better self-evaluation in adulthood (with stronger effects of cognitive ability).

**Panel A: Primarily practical skills**

| | Construction & assembly | Using tools properly | Selling products or services | Looking after people who need care |
|---|---|---|---|---|
| Creativity | 0.054*** | 0.037*** | 0.046*** | 0.019 |
| | (0.013) | (0.013) | (0.014) | (0.013) |
| Cognitive ability | -0.018 | -0.076*** | -0.018 | -0.061*** |
| | (0.016) | (0.016) | (0.017) | (0.016) |
| Number of individuals | 8,111 | 8,061 | 8,051 | 8,131 |

**Panel B: Primarily analytical skills**

| | Mathematical calculations | Understanding finance | Using a computer to solve problems |
|---|---|---|---|
| Creativity | -0.006 | 0.003 | 0.001 |
| | (0.013) | (0.013) | (0.013) |
| Cognitive ability | 0.408*** | 0.273*** | 0.303*** |
| | (0.015) | (0.017) | (0.016) |
| Number of individuals | 8,098 | 8,103 | 8,126 |

**Panel C: Mixed skills**

| | Writing clearly | Speaking clearly | Reading plans or diagrams | Running an organisation |
|---|---|---|---|---|
| Creativity | 0.069*** | 0.041*** | 0.049*** | 0.029** |
| | (0.013) | (0.013) | (0.013) | (0.013) |
| Cognitive ability | 0.214*** | 0.051*** | 0.174*** | 0.131*** |
| | (0.016) | (0.017) | (0.016) | (0.017) |
| Number of individuals | 8,185 | 8,165 | 8,115 | 8,072 |

**Panel D: Guiding others**

| | Advising | Teaching | Supervising |
|---|---|---|---|
| Creativity | 0.038*** | 0.047*** | 0.030** |
| | (0.013) | (0.013) | (0.013) |
| Cognitive ability | 0.064*** | 0.135*** | 0.140*** |
| | (0.017) | (0.017) | (0.017) |
| Number of individuals | 8,123 | 8,099 | 8,071 |

Notes: As described in detail in Section 2, we run OLS regressions of the dependent variable on standardized measures of childhood creativity and cognitive ability and a rich set of controls. At age 33, individuals were asked "how good are you at the skills listed below?" (good; fair; poor; don't have skill). We standardize each skill score to give a mean of zero and variance of one (after scoring the skill on a scale of 1 to 4). The questionnaire included 15 skills about which individuals had not been asked at earlier ages. We placed each skill into one of four categories (except for typing, a physical skill that does not fit well into these categories). We abbreviated some of the skill descriptions (e.g., the first skill is "constructing, assembling or building things well"). Heteroskedasticity-consistent standard errors are in parentheses. *, ** and *** denote significance at the 10%, 5% and 1% levels (two-sided tests).

Table 2: Skills in adulthood (self-evaluated).

### 3.3 Job requirements

Table 3 studies the relationship between childhood creativity and job requirements in early adulthood. Focusing on effects with $p < 0.05$, we find that more creative individuals are more likely to work in a job that requires experience and less likely to work in a job that requires training, while more cognitively able individuals are more likely to work in a job that requires formal qualifications. These results provide suggestive evidence that creative individuals thrive in environments that reward on-the-job learning rather than training or formal qualifications.

In conjunction with our earlier results that more creative individuals report better practical skills and higher ability in practical high school subjects, the results in Table 3 accord with a world where learning from experience is important in work environments that demand creativity and good practical skills, and where as a result more creative individuals self-select (or are more likely to be hired) into jobs that require experience. Indeed, as we discuss in detail in the introduction, theories of creative thinking emphasize that the conceptual combination and analogical reasoning that underpin creativity are not based on linear analytical thinking, but instead rely on the practical application of existing knowledge based on experience.

Similarly, in conjunction with our earlier results that more cognitively able individuals report better analytical skills and higher ability in analytical high school subjects, the results in Table 3 accord with a world where formal qualifications are important in work environments that demand cognitive ability and good analytical skills, and where as a result more cognitively able individuals self-select (or are more likely to be hired) into jobs that require formal qualifications.

| | Formal qualification | Experience | Training |
|---|---|---|---|
| Creativity | 0.006 | $0.011^{**}$ | $-0.013^{**}$ |
| | (0.006) | (0.004) | (0.006) |
| Cognitive ability | $0.134^{***}$ | 0.000 | -0.006 |
| | (0.008) | (0.006) | (0.007) |
| Number of individuals | 6,635 | 6,635 | 6,635 |
| Mean dep. var. | 0.30 | 0.10 | 0.19 |

Notes: As described in detail in Section 2, we run OLS regressions of the dependent variable on standardized measures of childhood creativity and cognitive ability and a rich set of controls. At age 23, individuals were asked whether their job required "any particular skills, training or qualifications," and up to three responses per individual were coded by the NCDS (the question was not asked at other ages). The formal qualification variable is an indicator for the individual reporting that her job required a formal qualification. The experience variable is an indicator for the individual reporting that her job required "general knowledge of the field / previous experience." The training variable is an indicator for the individual reporting that her job required an "apprenticeship (time served)," "on the job training" or "other training." Heteroskedasticity-consistent standard errors are in parentheses. $^{*}$, $^{**}$ and $^{***}$ denote significance at the 10%, 5% and 1% levels (two-sided tests).

Table 3: Job requirements in early adulthood.

# 4 Life outcomes

In this section we study the relationship between childhood creativity and life outcomes. We begin by briefly summarizing the main findings in this section. First, in Section 4.1 we find that more creative individuals tend to achieve better labor market outcomes: more creative individuals are more likely to be in work, and when they work more creative individuals also earn more. To help understand how creativity can influence labor market success, in Section 4.2 we then study the relationship between childhood creativity and the type of occupation that individuals work in. We find that more creative individuals tend to work in better quality jobs: more creative individuals are more likely to work in the higher category of managerial and technical occupations, while they are less likely to work in the lower category of skilled non-manual occupations. More cognitively able individuals also tend to work in higher occupational categories, but according to a pattern distinct from that predicted by creativity: for example, unlike creativity, cognitive ability predicts a higher probability of working in professional occupations and a substantially lower probability of working in skilled manual occupations. Finally, in Section 4.3 we find that more creative individuals tend to reach higher levels of educational attainment at the high school and college levels, which helps to shed further light on the mechanisms by which creativity can affect life outcomes and labor market behavior and success.

Our results in Section 3 suggested that more creative individuals tend to have a better package of practical skills, while more cognitively able individuals tend to have a better package of analytical skills. The better practical skills of more creative people could, in part, help to explain why more creative individuals tend to achieve greater labor market success. In this regard, we find it striking that more creative individuals tend to hold better quality jobs even though they are not more likely to enter professional occupations, and we suggest that these professional occupations depend heavily on analytical skills. Indeed, as we note above, we find that more cognitively able individuals report having better analytical skills and are more likely to work in these professional occupations, while they are also less likely to work in skilled manual occupations.

## 4.1 Labor market outcomes

Table 4 studies the relationship between childhood creativity and labor market outcomes in adulthood. In summary, we find that more creative individuals tend to perform better in the labor market: more creative individuals are more likely to be in work, and when they work more creative individuals also earn more during the course of their careers.

Panel A of Table 4 uses information on earnings and employment status that was collected by the NCDS six times during individuals' careers (from the individuals' early twenties up to their mid-fifties). The first two columns of Panel A show that more creative individuals tend to earn more when they work. In particular, among individuals in work, a one-standard-deviation increase in childhood creativity is associated with labor market earnings that are around two percent higher, with the effects of creativity on earnings statistically significant at the 1% level (in fact, $p < 0.001$ for both hourly and weekly earnings). The third column of Panel A shows that more creative individuals tend to work longer hours. In particular, among individuals in work, a one-standard-deviation increase in childhood creativity is associated with work hours that are nearly one percent higher. Finally, the fourth column of Panel A shows that more creative individuals are also more likely to be in work: a one-standard-deviation increase in childhood creativity is associated with an increase of nearly one percentage point in the probability of working.

In Table A.13 in Web Appendix IV we regress the same outcomes on binary measures of creativity and cognitive ability and their interaction. When considering work hours or the likelihood of being in work, we find a negative interaction of creativity and cognitive ability. This negative interaction in the case of work hours amplifies the effect of creativity on weekly earnings for individuals whose cognitive ability is below the mean. However, when considering hourly earnings we find no evidence of an interaction between creativity and cognitive ability. Furthermore, the results in Table A.13 imply that individuals whose creativity is above the mean earn about six to seven percent more per hour.

**Panel A: All individuals**

| | Individuals in work | | | |
|---|---|---|---|---|
| | Log hourly earnings | Log weekly earnings | Log weekly hours | In work |
| Creativity | 0.016*** | 0.022*** | 0.006** | 0.006** |
| | (0.004) | (0.006) | (0.003) | (0.003) |
| Cognitive ability | 0.111*** | 0.125*** | 0.015*** | 0.035*** |
| | (0.005) | (0.007) | (0.004) | (0.004) |
| Individual-year obs. | 35,342 | 35,342 | 35,342 | 48,363 |
| Mean dep. var. | - | - | - | 0.81 |

**Panel B: Excluding self-employed**

| | Individuals in work | | |
|---|---|---|---|
| | Log hourly earnings | Log weekly earnings | Log weekly hours |
| Creativity | 0.017*** | 0.022*** | 0.005 |
| | (0.004) | (0.005) | (0.003) |
| Cognitive ability | 0.107*** | 0.128*** | 0.021*** |
| | (0.005) | (0.007) | (0.004) |
| Individual-year obs. | 31,878 | 31,878 | 31,878 |

Notes: As described in detail in Section 2, we run OLS regressions of the dependent variable on standardized measures of childhood creativity and cognitive ability and a rich set of controls. The NCDS collected information on work and net earnings at ages 23, 33, 42, 46, 50, and 55; our individual-year observations encompass these six waves of data, and here our controls additionally include an indicator for each wave. For every wave, we trim the top 1% and bottom 1% of observations for individuals in work using hourly earnings. In Panel A, $48,363 \times 0.81 > 35,342$ because in the first three columns we do not include individual-year observations where the individual worked but did not report their earnings. In Panel B, we exclude individual-year observations where the individual was self-employed. Heteroskedasticity-consistent standard errors (clustered at the individual level) are in parentheses. *, ** and *** denote significance at the 10%, 5% and 1% levels (two-sided tests).

Table 4: Earnings, hours, and employment.

Panel B of Table 4 shows that our results in Panel A are not driven by an interaction of creativity and self-employment. In Panel B we exclude self-employment and find associations between creativity and earnings and hours that are similar to those in Panel A. Note that when we exclude self-employment in Panel B, we no longer include the fourth column because the pool of individuals out of work includes some individuals who would be self-employed if they did work.

In Panels A and B of Table 4, we find that the relationships between childhood creativity and labor market outcomes are in the same direction, but smaller in magnitude, compared to those for cognitive ability. This comparison provides a valuable reality check: given that cognitive ability is of fundamental importance to labor market success (e.g., Heckman et al., 2006), we argue that it would be implausible to find that other aspects of cognition relate as strongly to labor market outcomes.

## 4.2 Type of occupation

How can creativity influence labor market behavior and success? To help answer this question, Table 5 studies the relationship between childhood creativity and the type of occupation that individuals work in. The NCDS classified individuals in work into one of six broad occupational categories; these categories represent a "graded hierarchy of occupations" that was used extensively in the UK to allocate individuals to social class (Rose, 1995).

We begin by summarizing the main results from Table 5. We find that both childhood creativity and cognitive ability tend to predict higher occupational categories, but with quite distinct patterns. More creative individuals are more likely to work in the higher category of managerial and technical occupations, while they are less likely to work in the lower category of skilled non-manual occupations. Focusing on the intermediate skilled occupations, we find that more cognitively able individuals are more likely to work in non-manual occupations and less likely to work in manual occupations, but we find no such pattern for creativity. Finally, cognitive ability predicts working in professional occupations, while creativity does not.

Panel A of Table 5 shows that more creative individuals are more likely to work in the higher category of managerial and technical occupations, while they are less likely to work in the lower category of skilled non-manual occupations. These two effects are statistically significant at the 1% level (in fact, $p < 0.001$ in both cases). In particular, among individuals in work, a one-standard-deviation increase in childhood creativity is associated with: (i) a two-percentage-point increase in the probability of working in the higher category of managerial and technical occupations; and (ii) a nearly two-percentage-point decrease in the probability of working in the lower category of skilled non-manual occupations. To help interpret these effect sizes, Panel A reports the mean of the dependent variable (38% of individuals work in managerial and technical occupations, while 21% work in skilled non-manual occupations). We also find a small negative relationship between creativity and the probability of working in unskilled occupations ($p = 0.055$).

**Panel A: All individuals**

| | Professional | Managerial & Technical | Skilled non-manual | Skilled manual | Partly skilled | Unskilled |
|---|---|---|---|---|---|---|
| Creativity | 0.002 | $0.022^{***}$ | $-0.015^{***}$ | -0.005 | -0.001 | $-0.003^{*}$ |
| | (0.002) | (0.005) | (0.004) | (0.004) | (0.003) | (0.002) |
| Cognitive ability | $0.037^{***}$ | $0.098^{***}$ | $0.014^{***}$ | $-0.077^{***}$ | $-0.052^{***}$ | $-0.020^{***}$ |
| | (0.003) | (0.006) | (0.005) | (0.005) | (0.004) | (0.002) |
| Individual-year obs. | 31,703 | 31,703 | 31,703 | 31,703 | 31,703 | 31,703 |
| Mean dep. var. | 0.05 | 0.38 | 0.21 | 0.20 | 0.13 | 0.03 |

**Panel B: Excluding self-employed**

| | Professional | Managerial & Technical | Skilled non-manual | Skilled manual | Partly skilled | Unskilled |
|---|---|---|---|---|---|---|
| Creativity | 0.001 | $0.023^{***}$ | $-0.014^{***}$ | -0.004 | -0.002 | $-0.004^{***}$ |
| | (0.002) | (0.006) | (0.005) | (0.004) | (0.004) | (0.002) |
| Cognitive ability | $0.031^{***}$ | $0.108^{***}$ | $0.012^{**}$ | $-0.074^{***}$ | $-0.056^{***}$ | $-0.021^{***}$ |
| | (0.003) | (0.007) | (0.006) | (0.005) | (0.004) | (0.002) |
| Individual-year obs. | 26,895 | 26,895 | 26,895 | 26,895 | 26,895 | 26,895 |
| Mean dep. var. | 0.05 | 0.38 | 0.23 | 0.18 | 0.13 | 0.03 |

Notes: As described in detail in Section 2, we run OLS regressions of the dependent variable on standardized measures of childhood creativity and cognitive ability and a rich set of controls. At ages 33, 42, 46, 50, and 55, the NCDS allocated each individual in work into one of the six broad occupational categories reported in the table; our individual-year observations encompass these five waves of data, and here our controls additionally include an indicator for each wave. To classify individuals into these broad categories, the NCDS made use of three-digit occupational codes from the UK's 1990 Standard Occupational Classification (or its 2000 update); we exclude age 23 because the NCDS used an older non-comparable occupational classification system (and the broad categories used by the NCDS were also different). In Panel B, we exclude individual-year observations where the individual was self-employed. Heteroskedasticity-consistent standard errors (clustered at the individual level) are in parentheses. $^{*}$, $^{**}$ and $^{***}$ denote significance at the 10%, 5% and 1% levels (two-sided tests).

Table 5: Occupational categories.

Turning to the results for cognitive ability in Panel A of Table 5, we find interesting differences compared to those for creativity. Focusing on the two highest occupational categories in the first two columns of Panel A, we find that more cognitively able individuals are more likely to work both in professional occupations (the highest category) and in managerial and technical occupations (the second highest category), while creativity only predicts working in managerial and technical occupations. Focusing next on the intermediate skilled occupational categories in the third and fourth columns of Panel A, creativity and cognitive ability both predict an overall reduction in the likelihood of working in these occupations. However: (i) creativity predicts a decrease in the probability of working in the skilled non-manual category, while cognitive ability predicts an increase in this probability; and (ii) cognitive ability predicts a substantial reduction in the probability of working in the skilled manual category, while the corresponding effect of creativity is small and not statistically significant ($p > 0.2$). Finally, focusing on the two lowest occupational categories in the last two columns of Panel A, we find a strong negative relationship between cognitive ability and working in these occupations, while we find little effect of creativity.

Panel B of Table 5 shows that our results in Panel A are not driven by an interaction of creativity or cognitive ability with self-employment. In Panel B we exclude self-employment and find relationships between creativity or cognitive ability and occupational categories that are similar to those in Panel A.

### 4.3 Educational attainment

Finally, Table 6 considers the relationship between childhood creativity and educational attainment, which helps to shed further light on the mechanisms by which creativity can affect life outcomes and labor market behavior and success. In brief, we find that more creative individuals tend to reach higher levels of educational attainment: more creative individuals are more likely to achieve educational qualifications at ages 16 and 18, and they are also more likely to achieve a university qualification.

The first column of Table 6 shows that creativity predicts educational attainment at age 16. In particular, a one-standard-deviation increase in childhood creativity is associated with a three-percentage-point increase in the probability of achieving an O-level qualification at age 16, with the effect statistically significant at the 1% level (in fact, $p < 0.001$). To understand why only 52% of individuals in our sample achieved such a qualification, we note that academically weaker students did not take O-level examinations (the table notes provide further details).

The second column of Table 6 shows that creativity also predicts educational attainment at age 18. In particular, a one-standard-deviation increase in childhood creativity is associated with a one-percentage-point increase in the probability of achieving an A-level qualification at age 18, with the effect statistically significant at the 1% level. To help interpret this effect size, Table 6 reports that only 16% of individuals in our sample achieved an A-level qualification: for the NCDS cohort, schooling was compulsory only to age 16 (see Bolton, 2012, for historic data on school and university enrollment in the UK).

The third column of Table 6 shows that creativity predicts college attainment. In particular, a one-standard-deviation increase in childhood creativity is associated with a one-percentage-point increase in the probability of achieving a university qualification by age 23 ($p = 0.014$). To help interpret this effect size, Table 6 reports that only 12% of individuals in our sample achieved a university qualification (again, see Bolton, 2012, for historic data on school and university enrollment in the UK).

Mirroring our findings in Table 4 for labor market outcomes, in all three cases the relationship between childhood creativity and educational attainment is in the same direction, but smaller in magnitude, compared to that for cognitive ability. Again, this comparison provides a reality check: given the fundamental importance of cognitive ability for academic success (e.g., see the review by Malanchini et al., 2020), it would be implausible to find that other aspects of cognition relate as strongly to educational attainment.

| | O-level (age 16) | A-level (age 18) | University qualification |
|---|---|---|---|
| Creativity | 0.033*** | 0.012*** | 0.009** |
| | (0.005) | (0.004) | (0.004) |
| Cognitive ability | 0.250*** | 0.149*** | 0.113*** |
| | (0.006) | (0.005) | (0.005) |
| Number of individuals | 10,505 | 10,505 | 9,519 |
| Mean dep. var. | 0.52 | 0.16 | 0.12 |

Notes: As described in detail in Section 2, we run OLS regressions of the dependent variable on standardized measures of childhood creativity and cognitive ability and a rich set of controls. Based on examinations data collected by the NCDS from schools and colleges, the first dependent variable is an indicator for whether each individual received at least one O-level qualification, Certificate of Secondary Education (CSE) at grade 1, or Scottish equivalent (O-levels were generally taken at age 16; NCDS cohort members took O-levels in 1974 when O-level qualifications were pass/fail; academically weaker children took CSE examinations and a CSE at grade 1 was considered equivalent to an O-level pass). Similarly, the second dependent variable is an indicator for whether each individual received at least one A-level qualification (an A-level at grades A-E or Scottish equivalent; A-levels are generally taken at age 18). The third dependent variable is an indicator for whether each individual at age 23 reported having a university qualification ("university or CNAA"). Heteroskedasticity-consistent standard errors are in parentheses. *, ** and *** denote significance at the 10%, 5% and 1% levels (two-sided tests).

Table 6: Educational attainment.

## 5 Conclusion

In this paper we have used rich longitudinal data to study the relationship between creativity and individual attributes and life outcomes. As we note in the introduction, a better understanding of how creativity drives behavior and outcomes allows quantification of the benefits of interventions and policies that aim to train creativity or create environments and incentive structures that spark creative thinking.

We provide evidence that creativity matters for important outcomes such as career earnings, employment rates and educational attainment. The natural question then is how best to go about training people to be more creative and motivating them to engage in creative thinking. Our results suggest that interventions which succeed along these dimensions could have substantial positive economic impacts.

Psychologists suggest that childhood creativity can be developed by encouraging curiosity, exploration and independent decision-making (Hui et al., 2019). Linking this to our finding that more creative individuals report having better practical skills, creativity in childhood could be enhanced by a smaller emphasis on formal academic learning and a greater emphasis on learning through experience, hands-on play, experimentation, and educational tasks that require independent judgement with no right-or-wrong answers.[7] Similarly, to improve creative potential,

[7] Indeed, psychologists have found that creativity slumps at the start of formal schooling and at the transition from primary to secondary schooling (Hui et al., 2019), while too much formal education can have the effect of suppressing creativity (Beghetto, 2019).

adult education could emphasize practical and experiential learning more strongly, with more learning in the field and less learning in the classroom. This recommendation connects to our findings which suggest that more creative individuals thrive in environments that reward on-the-job learning from experience over formal training and qualifications. The recommendation also links to Feinstein (2015)'s model of creative development in which individuals who enter a creative field are first taught a core common curriculum and then explore individual paths of creative development to produce a creative output.

The confidence-assertiveness component of extraversion predicts creativity (Feist, 2019), and creative ideas are often met with resistance and skepticism because they are risky and unconventional (Mellander and Florida, 2021). Furthermore, creative people tend to be more autonomous and willing to question tradition and authority (Feist, 2019). This all suggests that training children and adults to be more confident and independent-minded could improve their creative potential by making them more likely to pursue creative ideas in the face of actual or potential opposition.

The psychology literature suggests a number of other potentially fruitful routes to improving creativity in the economy. Sternberg (2019) endorses a number of techniques that can help to improve successful creative thinking, including: redefining problems, challenging assumptions, using constructive criticism to evaluate new ideas, and tolerating ambiguity while developing and refining ideas. Similarly, effective creativity training emphasizes cognitive-processing activities such as: problem identification, conceptual combination, and idea evaluation (Reiter-Palmon et al., 2019). Finally, within organizations, environments that promote creativity present people with meaningful work while encouraging the exchange of thoughts and ideas in positive peer relationships (Reiter-Palmon et al., 2019).

Furthermore, as we describe in the introduction, a new literature in economics studies how best to incentivize creativity (see the survey by Attanasi et al., 2020). The motivation to create depends on a complex interplay of intrinsic and extrinsic incentives, and we encourage economists to continue to use laboratory, field and observational evidence to understand more about how best to motivate creative performance and about how creativity benefits the economy and society more generally.

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# Web Appendix

(Intended for Online Publication)

# Web Appendix I

# Description of controls

## Web Appendix I.1

## Controls for childhood characteristics

We describe here the controls referred to in the third paragraph of Section 2.3. When the value of a control is missing for some individuals in the analysis sample, we include an indicator for the value being missing. For each control listed below that is not an indicator variable, we winsorize at 2.5% (top and bottom). All controls for social class are based on occupation.

The NCDS does not include direct measures of parental income or wealth, but the controls listed below include various proxies for parental income and wealth derived from parental questionnaires (including social class based on occupation, education, housing characteristics, household financial difficulties, and household receipt of free school meals).

- Controls collected at birth from the PMS questionnaire (completed by the midwife during an interview with the mother shortly after the cohort member's birth):
  - Mother's age
  - Mother in education beyond the minimum school leaving age
  - Mother's region of residence
  - Mother's working behavior during the pregnancy
  - Mother's social class
  - Mother's father's social class
  - Mother's smoking behavior during the pregnancy
  - Mother's parity (number of previous live births or stillbirths)
  - Mother's husband's age
  - Mother's husband's social class
  - Gestational duration of the pregnancy
  - Cohort member's sex
  - Cohort member's birthweight

- Controls collected at age 7 from a parental questionnaire (completed by a health visitor during an interview with the mother):
  - Number of children aged under 21 in the household
  - Parents' preference about cohort member's school leaving age
  - Mother's activities with cohort member: frequency mother reads to cohort member; frequency mother goes on outings with cohort member
  - Father's activities with cohort member: frequency father reads to cohort member; frequency father goes on outings with cohort member
  - Father's role in managing cohort member (relative to mother)
  - Father's social class
  - Father's education: education beyond the minimum school leaving age; age when finished full-time education
  - Mother's working behavior: before cohort member started school; since cohort member started school
  - Housing: tenure; number of rooms
  - Household financial difficulties
  - Breast feeding duration for cohort member
- Controls collected at age 11 from a parental questionnaire (completed by a health visitor during an interview with the mother):
  - Number of children aged under 21 in the household
  - Parents' preference about cohort member's school leaving age
  - Mother's activities with cohort member: frequency mother goes on outings with cohort member
  - Father's activities with cohort member: frequency father goes on outings with cohort member
  - Father's role in managing cohort member (relative to mother)
  - Father's social class
  - Mother's social class
  - Mother's working behavior: since the cohort member was age 7; in the last year
  - Housing: tenure; number of rooms
  - Household financial difficulties
  - Household receives free school meals (at least one child)

- Controls collected at age 7 from a medical questionnaire (completed by a doctor during an examination of the cohort member):
  - Assessments of deficits: speech; hearing; vision
- Controls collected at age 11 from a medical questionnaire (completed by a doctor during an examination of the cohort member):
  - Assessments of deficits: speech; hearing; vision
- Controls collected at age 7 from a school questionnaire (completed partly by the headteacher and partly by the cohort member's class teacher):
  - Characteristics of the cohort member: attendance rate; help for special educational needs; native English speaker
  - Characteristics of the cohort member's school: school type (state or private); number of pupils in the school; presence of a parent-teacher association
  - Characteristics of the cohort member's school class: number of pupils in the cohort member's class; class grouping based on ability; fraction of fathers of the class pupils in various social class groups; proportion of parents of the class pupils who have met the class teacher (or the headteacher) during the current school year
- Controls collected at age 11 from a school questionnaire (completed partly by the headteacher and partly by the cohort member's class teacher):
  - Characteristics of the cohort member: attendance rate; help for special educational needs; native English speaker
  - Characteristics of the cohort member's school: school type (state or private); number of pupils in the school
  - Characteristics of the cohort member's school class: number of pupils in the cohort member's class; class grouping based on ability

## Web Appendix I.2

## Teacher evaluation error control

Section 2.6 explained that we: (i) estimate teacher evaluation errors at the child level by comparing teacher evaluations of math and reading ability at age 7 to the math and reading scores from the tests that were administered to NCDS cohort members at the same age; and (ii) include our estimate of the child-level teacher evaluation error as a control in our regressions. Here, we describe how we construct this control variable for each individual in the analysis sample.

(a) Teacher evaluations of math and reading ability at age 7 were elicited in the same way and using the same questionnaire as teacher evaluations of creativity at the same age. Thus, we convert teacher evaluations of math and reading ability at age 7 to percentile scores in the same way that we converted teacher evaluations of creativity at age 7 to percentile scores (see the second paragraph of Section 2.4).

(b) To make the math test scores comparable to the teacher evaluations of math ability, we: (i) compare each individual's math test score at age 7 to the test scores of the other individuals in the analysis sample; (ii) categorize each individual's math test score using the same five categories that were used for teacher evaluations (see the second paragraph of Section 2.4); and (iii) convert these categories to percentile scores in the same way that we convert teacher evaluations to percentile scores (again, see the second paragraph of Section 2.4). We follow the same procedure for the reading test scores.

(c) For math, for each individual we calculate the difference between the teacher evaluation percentile score and the test percentile score. We do the same for reading, and then average the two differences to obtain our estimate of the child-level teacher evaluation error.

# Web Appendix II

## Inverse probability weighting

The fourth paragraph of Section 2.3 introduces the inverse probability weighting method. Here we describe the details of the procedure.

When we study an outcome or attribute using one wave of the NCDS:

(a) We construct an indicator variable that is equal to one if the question(s) that we use to construct the outcome or attribute was (were) completed for the individual in the analysis sample, and is equal to zero otherwise.[8]

(b) We estimate a logistic regression of this indicator on the controls from the PMS questionnaire (see Web Appendix I.1), which measure the baseline characteristics of the individuals.

(c) Using the parameter estimates from this logistic regression, we calculate individual-level question completion probabilities, i.e., the probability that the requisite question(s) was (were) completed given the individual's baseline characteristics.

(d) Finally, we re-weight each individual in the estimation sample (which consists of the individuals in the analysis sample who completed the requisite question(s)) by the inverse of the question completion probability that we calculated in the previous step.

When we study an outcome or attribute over multiple waves of the NCDS (e.g., when we study wages using data from different ages), we apply inverse probability weighting to each wave.

[8] An individual might not have answered a particular question due to non-response to the relevant survey, non-response to that particular question, or because the question was not asked given a previous response (e.g., wages were not asked of individuals who reported not being in work).

# Web Appendix III

# Robustness

## Web Appendix III.1

## Robustness to measure of cognitive ability

**Panel A: Above average ability**

| | Math | English | Science | Art | Music | Practical | Sports |
|---|---|---|---|---|---|---|---|
| Creativity | -0.006 | $0.027^{***}$ | 0.005 | $0.062^{***}$ | $0.016^{**}$ | $0.025^{***}$ | $0.016^{***}$ |
| | (0.005) | (0.006) | (0.005) | (0.007) | (0.007) | (0.007) | (0.006) |
| Number of individuals | 8,809 | 9,011 | 7,483 | 6,520 | 4,508 | 7,458 | 8,757 |
| Mean dep. var. | 0.16 | 0.24 | 0.16 | 0.22 | 0.15 | 0.27 | 0.27 |

**Panel B: Average or above average ability**

| | Math | English | Science | Art | Music | Practical | Sports |
|---|---|---|---|---|---|---|---|
| Creativity | $-0.016^{***}$ | 0.002 | 0.011 | $0.061^{***}$ | 0.007 | $0.008^{*}$ | $0.010^{*}$ |
| | (0.006) | (0.004) | (0.007) | (0.007) | (0.010) | (0.005) | (0.005) |
| Number of individuals | 8,809 | 9,011 | 7,483 | 6,520 | 4,508 | 7,458 | 8,757 |
| Mean dep. var. | 0.73 | 0.89 | 0.69 | 0.70 | 0.57 | 0.88 | 0.84 |

Notes: See the notes to Table 1. As described in Section 2.5, instead of using our measure of cognitive ability that we derived from the five underlying test scores, here we include all five test scores in our regressions.

Table A.1: High school subject ability (self-evaluated).

**Panel A: Primarily practical skills**

| | Construction & assembly | Using tools properly | Selling products or services | Looking after people who need care |
|---|---|---|---|---|
| Creativity | 0.059*** | 0.046*** | 0.040*** | 0.016 |
| | (0.013) | (0.013) | (0.014) | (0.013) |
| Number of individuals | 8,111 | 8,061 | 8,051 | 8,131 |

**Panel B: Primarily analytical skills**

| | Mathematical calculations | Understanding finance | Using a computer to solve problems |
|---|---|---|---|
| Creativity | -0.013 | 0.000 | 0.010 |
| | (0.013) | (0.014) | (0.014) |
| Number of individuals | 8,098 | 8,103 | 8,126 |

**Panel C: Mixed skills**

| | Writing clearly | Speaking clearly | Reading plans or diagrams | Running an organisation |
|---|---|---|---|---|
| Creativity | 0.060*** | 0.041*** | 0.062*** | 0.024* |
| | (0.013) | (0.014) | (0.013) | (0.014) |
| Number of individuals | 8,185 | 8,165 | 8,115 | 8,072 |

**Panel D: Guiding others**

| | Advising | Teaching | Supervising |
|---|---|---|---|
| Creativity | 0.036*** | 0.047*** | 0.033** |
| | (0.014) | (0.014) | (0.014) |
| Number of individuals | 8,123 | 8,099 | 8,071 |

Notes: See the notes to Table 2. As described in Section 2.5, instead of using our measure of cognitive ability that we derived from the five underlying test scores, here we include all five test scores in our regressions.

Table A.2: Skills in adulthood (self-evaluated).

| | Formal qualification | Experience | Training |
|---|---|---|---|
| Creativity | 0.010 | 0.010** | -0.013** |
| | (0.007) | (0.005) | (0.006) |
| Number of individuals | 6,635 | 6,635 | 6,635 |
| Mean dep. var. | 0.30 | 0.10 | 0.19 |

Notes: See the notes to Table 3. As described in Section 2.5, instead of using our measure of cognitive ability that we derived from the five underlying test scores, here we include all five test scores in our regressions.

Table A.3: Job requirements in early adulthood.

**Panel A: All individuals**

| | Individuals in work | | | |
|---|---|---|---|---|
| | Log hourly earnings | Log weekly earnings | Log weekly hours | In work |
| Creativity | 0.015*** | 0.021*** | 0.007** | 0.005* |
| | (0.004) | (0.006) | (0.003) | (0.003) |
| Individual-year obs. | 35,342 | 35,342 | 35,342 | 48,363 |
| Mean dep. var. | - | - | - | 0.81 |

**Panel B: Excluding self-employed**

| | Individuals in work | | |
|---|---|---|---|
| | Log hourly earnings | Log weekly earnings | Log weekly hours |
| Creativity | 0.016*** | 0.021*** | 0.005 |
| | (0.004) | (0.006) | (0.003) |
| Individual-year obs. | 31,878 | 31,878 | 31,878 |

Notes: See the notes to Table 4. As described in Section 2.5, instead of using our measure of cognitive ability that we derived from the five underlying test scores, here we include all five test scores in our regressions.

Table A.4: Earnings, hours, and employment.

**Panel A: All individuals**

| | Professional | Managerial & Technical | Skilled non-manual | Skilled manual | Partly skilled | Unskilled |
|---|---|---|---|---|---|---|
| Creativity | 0.003 | 0.023*** | -0.015*** | -0.007* | -0.002 | -0.003 |
| | (0.002) | (0.005) | (0.004) | (0.004) | (0.003) | (0.002) |
| Individual-year obs. | 31,703 | 31,703 | 31,703 | 31,703 | 31,703 | 31,703 |
| Mean dep. var. | 0.05 | 0.38 | 0.21 | 0.20 | 0.13 | 0.03 |

**Panel B: Excluding self-employed**

| | Professional | Managerial & Technical | Skilled non-manual | Skilled manual | Partly skilled | Unskilled |
|---|---|---|---|---|---|---|
| Creativity | 0.001 | 0.024*** | -0.015*** | -0.004 | -0.002 | -0.004** |
| | (0.002) | (0.006) | (0.005) | (0.004) | (0.004) | (0.002) |
| Individual-year obs. | 26,895 | 26,895 | 26,895 | 26,895 | 26,895 | 26,895 |
| Mean dep. var. | 0.05 | 0.38 | 0.23 | 0.18 | 0.13 | 0.03 |

Notes: See the notes to Table 5. As described in Section 2.5, instead of using our measure of cognitive ability that we derived from the five underlying test scores, here we include all five test scores in our regressions.

Table A.5: Occupational categories.

| | O-level (age 16) | A-level (age 18) | University qualification |
|---|---|---|---|
| Creativity | 0.041*** | 0.019*** | 0.013*** |
| | (0.005) | (0.004) | (0.004) |
| Number of individuals | 10,505 | 10,505 | 9,519 |
| Mean dep. var. | 0.52 | 0.16 | 0.12 |

Notes: See the notes to Table 6. As described in Section 2.5, instead of using our measure of cognitive ability that we derived from the five underlying test scores, here we include all five test scores in our regressions.

Table A.6: Educational attainment.

## Web Appendix III.2

## Robustness to excluding teacher evaluation error control

| | Math | English | Science | Art | Music | Practical | Sports |
|---|---|---|---|---|---|---|---|
| **Panel A: Above average ability** | | | | | | | |
| Creativity | -0.005 | 0.026*** | 0.005 | 0.050*** | 0.015** | 0.027*** | 0.022*** |
| | (0.004) | (0.005) | (0.005) | (0.006) | (0.007) | (0.006) | (0.006) |
| Cognitive ability | 0.136*** | 0.077*** | 0.073*** | -0.032*** | 0.004 | -0.042*** | -0.029*** |
| | (0.006) | (0.006) | (0.006) | (0.008) | (0.008) | (0.008) | (0.007) |
| Number of individuals | 8,809 | 9,011 | 7,483 | 6,520 | 4,508 | 7,458 | 8,757 |
| Mean dep. var. | 0.16 | 0.24 | 0.16 | 0.22 | 0.15 | 0.27 | 0.27 |
| **Panel B: Average or above average ability** | | | | | | | |
| | Math | English | Science | Art | Music | Practical | Sports |
| Creativity | -0.013** | 0.005 | 0.009 | 0.052*** | 0.005 | 0.010** | 0.011** |
| | (0.006) | (0.004) | (0.007) | (0.007) | (0.009) | (0.005) | (0.005) |
| Cognitive ability | 0.108*** | 0.031*** | 0.016** | -0.068*** | -0.011 | -0.044*** | -0.019*** |
| | (0.007) | (0.005) | (0.008) | (0.008) | (0.011) | (0.006) | (0.006) |
| Number of individuals | 8,809 | 9,011 | 7,483 | 6,520 | 4,508 | 7,458 | 8,757 |
| Mean dep. var. | 0.73 | 0.89 | 0.69 | 0.70 | 0.57 | 0.88 | 0.84 |

Notes: See the notes to Table 1. As described in Section 2.6, here we exclude the teacher evaluation error control from our regressions.

Table A.7: High school subject ability (self-evaluated).

**Panel A: Primarily practical skills**

| | Construction & assembly | Using tools properly | Selling products or services | Looking after people who need care |
|---|---|---|---|---|
| Creativity | 0.047*** | 0.034*** | 0.037*** | 0.019 |
| | (0.012) | (0.013) | (0.014) | (0.013) |
| Cognitive ability | -0.007 | -0.072*** | -0.004 | -0.059*** |
| | (0.015) | (0.016) | (0.017) | (0.016) |
| Number of individuals | 8,111 | 8,061 | 8,051 | 8,131 |

**Panel B: Primarily analytical skills**

| | Mathematical calculations | Understanding finance | Using a computer to solve problems |
|---|---|---|---|
| Creativity | -0.005 | 0.006 | 0.003 |
| | (0.012) | (0.013) | (0.013) |
| Cognitive ability | 0.406*** | 0.268*** | 0.299*** |
| | (0.015) | (0.016) | (0.015) |
| Number of individuals | 8,098 | 8,103 | 8,126 |

**Panel C: Mixed skills**

| | Writing clearly | Speaking clearly | Reading plans or diagrams | Running an organisation |
|---|---|---|---|---|
| Creativity | 0.072*** | 0.041*** | 0.046*** | 0.028** |
| | (0.013) | (0.013) | (0.012) | (0.013) |
| Cognitive ability | 0.210*** | 0.052*** | 0.177*** | 0.133*** |
| | (0.016) | (0.016) | (0.015) | (0.016) |
| Number of individuals | 8,185 | 8,165 | 8,115 | 8,072 |

**Panel D: Guiding others**

| | Advising | Teaching | Supervising |
|---|---|---|---|
| Creativity | 0.036*** | 0.047*** | 0.032** |
| | (0.013) | (0.013) | (0.013) |
| Cognitive ability | 0.067*** | 0.134*** | 0.137*** |
| | (0.016) | (0.016) | (0.016) |
| Number of individuals | 8,123 | 8,099 | 8,071 |

Notes: See the notes to Table 2. As described in Section 2.6, here we exclude the teacher evaluation error control from our regressions.

Table A.8: Skills in adulthood (self-evaluated).

| | Formal qualification | Experience | Training |
|---|---|---|---|
| Creativity | 0.008 | 0.011** | -0.013** |
| | (0.006) | (0.004) | (0.006) |
| Cognitive ability | 0.131*** | 0.000 | -0.006 |
| | (0.008) | (0.005) | (0.007) |
| Number of individuals | 6,635 | 6,635 | 6,635 |
| Mean dep. var. | 0.30 | 0.10 | 0.19 |

Notes: See the notes to Table 3. As described in Section 2.6, here we exclude the teacher evaluation error control from our regressions.

Table A.9: Job requirements in early adulthood.

**Panel A: All individuals**

| | Individuals in work | | | |
|---|---|---|---|---|
| | Log hourly earnings | Log weekly earnings | Log weekly hours | In work |
| Creativity | 0.017*** | 0.025*** | 0.007** | 0.007** |
| | (0.004) | (0.005) | (0.003) | (0.003) |
| Cognitive ability | 0.108*** | 0.121*** | 0.013*** | 0.033*** |
| | (0.005) | (0.007) | (0.004) | (0.004) |
| Individual-year obs. | 35,342 | 35,342 | 35,342 | 48,363 |
| Mean dep. var. | - | - | - | 0.81 |

**Panel B: Excluding self-employed**

| | Individuals in work | | |
|---|---|---|---|
| | Log hourly earnings | Log weekly earnings | Log weekly hours |
| Creativity | 0.018*** | 0.025*** | 0.006* |
| | (0.004) | (0.005) | (0.003) |
| Cognitive ability | 0.104*** | 0.123*** | 0.019*** |
| | (0.005) | (0.007) | (0.004) |
| Individual-year obs. | 31,878 | 31,878 | 31,878 |

Notes: See the notes to Table 4. As described in Section 2.6, here we exclude the teacher evaluation error control from our regressions.

Table A.10: Earnings, hours, and employment.

**Panel A: All individuals**

| | Professional | Managerial & Technical | Skilled non-manual | Skilled manual | Partly skilled | Unskilled |
|---|---|---|---|---|---|---|
| Creativity | 0.003 | 0.023*** | -0.013*** | -0.006* | -0.003 | -0.004** |
| | (0.002) | (0.005) | (0.004) | (0.004) | (0.003) | (0.002) |
| Cognitive ability | 0.035*** | 0.097*** | 0.011** | -0.075*** | -0.050*** | -0.019*** |
| | (0.003) | (0.006) | (0.005) | (0.005) | (0.004) | (0.002) |
| Individual-year obs. | 31,703 | 31,703 | 31,703 | 31,703 | 31,703 | 31,703 |
| Mean dep. var. | 0.05 | 0.38 | 0.21 | 0.20 | 0.13 | 0.03 |

**Panel B: Excluding self-employed**

| | Professional | Managerial & Technical | Skilled non-manual | Skilled manual | Partly skilled | Unskilled |
|---|---|---|---|---|---|---|
| Creativity | 0.002 | 0.024*** | -0.012*** | -0.005 | -0.003 | -0.005*** |
| | (0.002) | (0.005) | (0.005) | (0.004) | (0.003) | (0.002) |
| Cognitive ability | 0.029*** | 0.107*** | 0.009 | -0.072*** | -0.053*** | -0.020*** |
| | (0.003) | (0.007) | (0.006) | (0.005) | (0.004) | (0.002) |
| Individual-year obs. | 26,895 | 26,895 | 26,895 | 26,895 | 26,895 | 26,895 |
| Mean dep. var. | 0.05 | 0.38 | 0.23 | 0.18 | 0.13 | 0.03 |

Notes: See the notes Table 5. As described in Section 2.6, here we exclude the teacher evaluation error control from our regressions.

Table A.11: Occupational categories.

| | O-level (age 16) | A-level (age 18) | University qualification |
|---|---|---|---|
| Creativity | 0.038*** | 0.015*** | 0.010*** |
| | (0.005) | (0.004) | (0.004) |
| Cognitive ability | 0.243*** | 0.145*** | 0.111*** |
| | (0.005) | (0.005) | (0.005) |
| Number of individuals | 10,505 | 10,505 | 9,519 |
| Mean dep. var. | 0.52 | 0.16 | 0.12 |

Notes: See the notes Table 6. As described in Section 2.6, here we exclude the teacher evaluation error control from our regressions.

Table A.12: Educational attainment.

# Web Appendix IV

# Additional figures and tables

| | | |
|---|---|---|
| **Creativity** | Shows marked originality or creativity in most areas | 1 |
| *(e.g. in free writing, telling a story, hand-work, painting, drawing, dramatic work)* | Usually produces good, original work | 2 |
| | Shows some imagination or originality in most areas | 3 |
| | Little originality or creativity in all areas | 4 |
| | Never shows a trace of originality or creativity in any of his work | 5 |

Notes: The screenshot reflects the low quality of the scanned document available from the NCDS.

Figure A.1: Screenshot of five-point creativity scale.

| | Individuals in work | | | |
|---|---|---|---|---|
| | Log hourly earnings | Log weekly earnings | Log weekly hours | In work |
| High creativity | $0.065^{***}$ | $0.094^{***}$ | $0.029^{***}$ | $0.047^{***}$ |
| | (0.010) | (0.014) | (0.009) | (0.008) |
| High cognitive ability | $0.135^{***}$ | $0.173^{***}$ | $0.038^{***}$ | $0.069^{***}$ |
| | (0.016) | (0.019) | (0.012) | (0.011) |
| High creat. × High cog. ab. | -0.005 | $-0.037^{*}$ | $-0.032^{**}$ | $-0.045^{***}$ |
| | (0.018) | (0.022) | (0.013) | (0.012) |
| Individual-year obs. | 35,342 | 35,342 | 35,342 | 48,363 |
| Mean dep. var. | - | - | - | 0.81 |

Notes: See the notes to Table 4. We run the same regressions as in Panel A of Table 4, except that we replace our measure of creativity (cognitive ability) with an indicator for whether the individual's creativity (cognitive ability) was above the mean for the individuals in the analysis sample (no individual was at the mean), and we further include the interaction of these two indicators.

Table A.13: Earnings, hours, and employment (binary measures).