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Recognition and longevity: an examination of award timing and lifespan in Nobel laureates

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Abstract

Using data for 387 Nobel Prize winners in physics, chemistry, or physiology/medicine from 1901 to 2000, this study focuses on the relation between the timing of prestigious awards and human longevity. In particular, it uses a linear regression model to examine how a winner's longevity is affected by (1) the age at which the prestigious award is won, (2) the total number of prestigious awards collected, and (3) the delay between the Nobel Prize work and recognition. To alleviate estimation issues stemming from survival selection, we conduct our analyses using subsamples of surviving individuals and controlling for age-specific life expectancy. Our results suggest that receiving the Nobel Prize at a younger age is related to a longer expected lifespan (e.g., obtaining the Nobel Prize 10 years earlier is associated with an additional 1 year of lifespan compared to the average population life expectancy). The results also point to a strong negative association between the age of receiving major scientific awards and relative life expectancy, which further indicates the benefit of early recognition. Yet, we did not find evidence suggesting that the *number* of prestigious awards received at an earlier age correlated with longevity. Nor are we able to observe that the duration between Nobel Prize work and the award reception (waiting time for the Nobel Prize recognition) is associated with changes in longevity.

Keywords Nobel prize · Longevity · Lifespan · Awards · Recognition

> I beg to acknowledge the receipt of your communication informing me that the Académie des Sciences Morales et Politiques has elected me a correspondent in the section of philosophy, in the place of Mr. Tappan, deceased. Along my thanks for the intended honour, will you please convey to the members of the Academy the following reasons which oblige me to decline it…I have come to the conclusion that such honorary titles, while they seem to be encouragements to intellectual achievement,

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> do, in reality, by their indirect influences, act as discouragements. If, supposing due discrimination were possible, men of much promise received from a learned body such marks of distinction as would bespeak attention from the world at large, I can well imagine that such men would be greatly helped, and would oftentimes be saved from sinking in their struggles with adverse circumstances in the midst of a society prepossessed in favour of known men. But there ordinarily comes no such aid until the difficulties have been surmounted—supposing, that is, that they have not proved fatal.

Herbert Spencer, in David Duncan, The Life and Letters of Herbert Spencer, pp. 233–234.

> I was talking to Professor Owen yesterday, and said that I imagined I had to thank him in great measure for the honour of the F.R.S. "No" he said, "you have nothing to thank but the goodness of your own work." For about ten minutes I felt rather proud of that speech, and shall keep it by me whenever I feel inclined to think myself a fool, and that I have a most mistaken notion of my own capacities. The only use of honours is as an antidote to such fits of the "blue devils."

Thomas Henry Huxley, Letters and Diary 1851, May 4, [To Miss Heathorn]

Introduction

Ralph Steinman, the Canadian scientist who won the 2011 Nobel Prize for medicine, died of pancreatic cancer 3 days before the official announcement of his Nobel Prize. Unaware of his recent death, the Nobel Committee in Stockholm attempted to reach Steinman by phone to relay to him the good news that he had won the Nobel Prize that year.[1] It was in doing so that the committee learned that it had awarded that year's Nobel Prize in physiology/medicine posthumously (Orange, 2011). This occurrence marked the first time in the Nobel Prize's then 110-year history that a recipient had died before the official announcement. It was also remarkable that the Nobel Prize had unknowingly been awarded posthumously, an outcome prevented by a rule adopted by the Nobel Committee in the 1970s (Orange, 2011).

Certain details surrounding Steinman's death are even more intriguing than the behind-the-scenes scrambling caused in Stockholm by Steinman's selection. Until the day of his demise, Steinman had survived his pancreatic cancer diagnosis for four years, "thanks largely to a form of immunotherapy *he* had designed using *his* discovery of dendritic cells" (Orange, 2011).[2] The possibility of winning the Nobel Prize in Physiology or Medicine was one of Steinman's motivations for beating his disease. According to his daughter, Alexis Steinman, he told her in the week leading up to the big announcement, "I know I have got to hold out for that... [t]hey don't give it to you if you have passed away... "I['ve] got to hold out for that."[3]

Steinman's struggle to beat pancreatic cancer so he could receive the Nobel Prize in Physiology or Medicine, besides being a profile in courage, raises interesting questions about the conferral of prestigious awards and human longevity. For example, how is a winner's longevity impacted

[1] At the time, Steinman was serving on the faculty at Rockefeller University.

[2] See Mixon and Upadhyaya (2014) for a brief discussion about medical advancements that have extended the lives of Nobel laureates throughout history.

[3] See Orange (2011).

by (i) the age at which he or she wins a prestigious award like the Nobel Prize and (ii) the total number of prestigious awards collected? Our study thus aims to shed light on these questions by examining whether the *timing* of Nobel Prize and conferral of other major awards affects laureate longevity. To do so, we apply multiple Ordinary Least Squares (OLS) regression analysis to longevity and demographic data for the 387 deceased individuals who had won the Nobel Prize in physics, chemistry, or physiology/medicine between 1901 and 2000. We use a subsample analytical approach and control for sex- and age-specific life expectancy from the same birth cohort to mitigate estimation bias due to survivor selection issue, we demonstrate that significant recognition in terms of receiving the Nobel Prize and such major scientific awards is associated with an increase in life expectancy. Other results suggest that the total number of major awards obtained at a younger age and the duration between the Nobel Prize-winning work conducted by the Laureate and the award conferral do not affect Laureate's longevity. Before discussing these results, however, we review the prior literature on the economics of awards. We then report the findings of our initial data analyses, followed by a more in-depth discussion of the empirical results overall. We conclude the paper with a few relevant remarks.

Timing of achievement and longevity: framing the hypotheses

Our primary research question is whether the timing of award conferral affects longevity. We explore whether achieving the academic pinnacle, i.e., the Nobel Prize,[4] especially at an early age, creates such pressure to produce comparative or even superior work that it could lead to early death or if it can increase longevity by mitigating work-related stress and/or promoting a healthier lifestyle. Achieving the career pinnacle earlier may tend to shorten one's life due to stress, strains, burdens, and responsibilities in achieving such an outstanding early success which then can accelerate the later physical decline (McCann, 2001, 2004). We also extend the primary empirical analysis to address the secondary question: whether being awarded other major awards early (vs. late) in the career also affects longevity. As a corollary, this allows one to ponder whether being passed over for the prize year after year, even when the prize is later awarded, may create a different type of stress that could shorten the life of a Nobel Prize-worthy academic. This latter aspect is underscored by economist Gary Becker's (2004) account of his own experience in the 1980s:

> [My name] was so often mentioned as a leading candidate. A betting pool organized by some American economists had me listed as their favourite (i.e., the lowest odds person) for three or 4 years running before I got the prize. And so individuals and reporters had begun asking me with some regularity: "When will you get the prize?" or, once the prize was announced each year, "Why didn't you get it this year?" Of course this bothered me.[5] (p. 268)

Merton (1973) also alludes to scholars or other professionals who resented late recognition, including Thorstein Veblen and Justice Holmes, or who were embittered by the lack of formal endorsement (e.g., D'Arcy Wentworth Thompson).

[4] Mixon (2018) finds that career milestones, such as tenure, do not stem scholars' attempts to produce "home run" research.

[5] For a discussion of Nobelists' thoughts before and after the Nobel Prize, see Torgler's (2018) metalogue *Scientific Work after the Nobel Prize.*

The relevance of receiving such acknowledgement is colourfully described by Nobel economist Paul Samuelson (2004): “Scientists are as avaricious and competitive as Smithian businessmen. The coin they seek is not apples, nuts, and yachts; nor is it the coin itself, or power as that term is ordinarily used. Scholars seek fame” (p. 60). In consequence, as one Nobel biochemist related to Zuckerman (1996), the disappointment of not receiving the ultimate accolade can even overshadow other important achievements:

> [Baker, a pseudonym] was just over seventy when I went to his laboratory. A whole group went to his home, and Mrs. Baker showed us all of his medals, and there was something she said that made me realize that she was disappointed. It was undoubtedly a reflection of her husband’s own feelings of disappointment that he had not been recognized by a Nobel award. Driving home with my wife, we got to talking about this and I said, “I am never going to worry or have a goal in mind of any prize, even a Nobel award. I refuse to die disappointed if I don’t get it.” You put your happiness into the hands of some committee, which can be capricious. You’ve got to work for the fun of it. Men of equal accomplishment don’t get it and then they have to rationalize for the rest of their lives. But don’t get me wrong, I’m not sorry I got it. (pp. 209–210)

Even those who win the prize may suffer stressful post-prize anxiety over upholding their Nobel-worthy reputations, “a very unhealthy” and potentially destructive attitude in the opinion of Nobel physicist and mathematician Frank Wilczek (as cited in Hargittai et al. 2014, p. 118). As another Nobel physicist puts it,

> [a]fter you’ve done something good and received such high recognition for it, it’s hard to publish anything without feeling it’s below the stature you’ve gained. It becomes very hard to do anything that you might call pedestrian, and a good many people just quit. At the present time, it’s difficult for me to keep going because of all of this extraneous honour. (As cited in Zuckerman, 1996, p. 229)

Receiving the Nobel Prize relatively early in a career can be especially harmful, as Nobel physicist Isidor Isaac Rabi explains:

> I think it can be a very useful thing to have, but it subjects the individual to enormous pressures… It puts the winner on a sort of pedestal, because of the great public attention and prestige and also the prestige among one’s colleagues. So that unless you are very competitive you aren’t likely to function with the same vigour afterward. (As cited in Bernstein 1975, p. 54).

On the other hand, the quest to survive and finally be recognized may be the catalyst for healthier behaviour or happiness. For example, chemist Richard Ernst, in his 1991 Nobel banquet speech, admitted to being “one of the very fortunate scientists who have achieved what many claims to be the ultimate form of recognition or even the ultimate form of happiness in this exuberant, splendid, almost unearthly setting.”[6] This high level of professional acknowledgement may not only reduce doubt and lack of self-confidence but even diminish feelings of alienation (Merton, 1973, p. 438).

[6] https://www.nobelprize.org/prizes/chemistry/1991/ernst/speech/.

Prior literature: a brief review

Our investigation into the relation between the timing of awards conferral and longevity draws upon two foundational bodies of academic literature: the economics of status and prestige, and a newer stream of research on the economics of awards and recognition. Individual motivation, whether to achieve higher-order social status or prestigious work-related accomplishments, is a key facet in both research streams.

Economics of status and prestige

As Rablen and Oswald (2008) point out, a well-established body of medical sciences research links higher socio-economic status to better health and longer life (see, e.g., Reid et al., 1974; Marmot et al., 1978, 1984; Marmot & Shipley, 1996; Boyce & Oswald, 2012; Daly et al., 2015),[7] engendering a new stream of theoretical and experimental research on the economic consequences of status-seeking behaviour (in particular, Ball et al., 2001; Becker et al., 2005; Clark & Oswald, 1998; Fershtman et al., 1996; Frank, 1985; Oswald & Powdthavee, 2007; Rablen, 2008). As an extension of this foundational work, Kumru and Vesterlund (2010) seek to explain why many fundraising campaigns begin by seeking support from the wealthier, more recognized, and respected individuals in a community. They assert that individuals prefer to associate with other individuals who are situated at higher positions in a social hierarchy. They support this assertion with experimentally derived comparative statics showing that donations are larger when high-status donors give before low-status donors, compared to when wealthier and more recognized donors are solicited last. They ascribe this finding to low-status individuals tending to be followers who mimic donations by high-status leaders, an outcome that works to encourage high-status leaders to participate (Kumru & Versterlund, 2010).[8]

In a study of panel data from 26 remote rural villages in China, Brown et al. (2011) show that socially observable household spending is sensitive to similar spending by other villagers, indicating that social spending may be positional in nature (i.e., motivated by status concerns). They also demonstrate that, consistent with rank-based status-seeking behaviour, spending by poor villagers on funerals and gifts increases as competition for status intensifies, while spending on wedding ceremonies by the groom's parents increases with local competition (Brown et al., 2011). A formal study by Charness et al. (2014) on the importance of status-seeking behaviour in sabotage and cheating related to performance ranking indicates that relative ranking feedback during the experiment leads to disreputable behaviour because individuals are willing to risk sabotaging the efforts of others to improve their own ranking. Lastly, more recent research by Palma et al. (2017) on prestige-seeking behaviour and individual food choices shows that when individuals are partitioned into classes based on evidence of prestige-seeking behaviour, their food consumption is driven by prestige. More specifically, while higher-class individuals seek to differentiate themselves from lower-class individuals (invidious comparison), lower-class

[7] See Adler et al. (1993), Adler and Ostrove (1999) and Adams et al. (2003) for studies of this relation across industrialized countries.

[8] In a contemporaneous extension of this literature, Woersdorfer (2010) points out that interdependencies in consumer behaviour stem from either status-seeking consumption or compliance with social norms. Such norms emerge as learning processes based on changing associations between a specific consumption act and widely shared consumer needs, as exemplified by the 19th century emergence of the cleanliness norm.

individuals buy prestigious goods so as to be perceived as members of a higher class (pecuniary emulation).

Economics of awards and recognition

The second, and relatively new, stream of research that informs this study is the economics of workplace awards and recognition (Merton, 1973; Frey, 2006; Borjas & Doran, 2015; Frey & Gallus, 2016, 2017). Much of this research focuses on awards as direct incentives when workers exert explicit effort to win them and as indirect incentives when awards create role models, highlight social values, or are associated with individual prestige (Frey & Gallus, 2014; Frey & Neckermann, 2009).[9] Not only do field experiments on workplace awards and recognition reveal their effectiveness in motivating employees (Kosfeld & Neckermann, 2011),[10] but other work shows that when finely tuned, they can motivate greater employee cooperation and teamwork (Neckermann & Frey, 2013).

Prior research also delves into the power of early-career performance and recognition to generate additional individual awards later in the academic career.[11] For example, Chan and Torgler (2012) find that almost 15 percent of individuals selected for Fellowship of the Econometric Society (FES) before 1970 would ultimately win the Nobel Prize in economics, a relation they suggest implies an increase in motivation generated by FES recognition.[12] Ye et al. (2013) similarly demonstrate that winning the Nobel Prize in physiology/medicine is often preceded by receipt of other awards, such as the Gairdner Award, Lasker Award, Wolf Prize, or Louisa Gross Horwitz Prize. These authors find that almost 70 percent of Nobel laureates between 1983 and 2012 had obtained the Gairdner Award prior to winning the Nobel Prize. Chan et al. (2018) provide evidence that having previously been awarded the John Bates Clark Medal in economics leads to a 1.7 to 3.3 percentage point increase in the probability of subsequently winning the Nobel Prize in economics. Lastly, Frey and Gullo (2020) found citation performance differences among Nobel Prize winners in economics based on their course of life. Those who died prematurely suffered from a marked reduction of attention while death had no effect on citation for those who died of old age.

Combining the two research streams

Rablen and Oswald (2008) combine both the above research streams in their comparative study of longevity outcomes for 1901–1950 Nobel Prize winners versus nominees in chemistry and physics, which constitutes a natural experiment in which one sub-set of

[9] A secondary incentive in the case of workplace awards is that the remuneration they provide is often taxed differently from traditional work-related compensation (Frey and Neckermann 2009).

[10] According to Kosfeld and Neckermann (2011), even symbolic awards lead to an increase in workplace performance, a finding supported in more recent studies by Levitt and Neckermann (2014), Neckermann et al. (2014) and Kosfeld et al. (2016).

[11] Seminal work in this area includes Cole and Cole (1967); Garfield and Malin (1968); Inhaber and Przednowek (1976) and Ashton and Oppenheim (1978).

[12] Similar motivation is exhibited by winners of the John Bates Clark Medal, arguably the second-most prestigious award in economics. For example, Chan et al., (2014a, b) show that by 5 years after the award, the typical JBCM winner has produced 13 percent more published research than he or she would have been predicted to produce without this recognition.

individuals receives a status boost while the other does not. Using 19th-century birth data for a sample of 528 such scholars, they show that the Prize winners enjoyed longer lifespans than those merely nominated (compared against nominees who were born in similar times and places), with an estimated longevity gap of one to 2 years. They find no evidence, however, of an association between this gap and the monetary award that accompanies the Nobel Prize (Rablen & Oswald, 2008).[13] Beyond that, McCann (2001) looked at individuals in leadership positions—such as presidents, prime ministers, monarchs, popes, or others with high-level creative accomplishments such as Nobelists or Oscar winners—to explore what he calls the precocity-longevity hypothesis. His hypothesis states that "those who reach career peaks earlier tend to have shorter lives" (p. 1429) due to "the stresses that accompany a rapid drive to achievement peaks" (p. 1430). According to McCann (2001), a person who is ambitious, aggressively achievement oriented, and subject to an exaggerated sense of time urgency (impatient and restless) is more prone to live a shorter life (p. 1431). His descriptive exploration, relying on Pearson or partial correlations, indicates that those who reach their career peak earlier tend indeed to have shorter lives. The precocity-longevity hypothesis has also been examined in various sports setting with mixed evidence. For example, using Major League Baseball players, Abel and Kruger (2007) found support for the hypothesis while Wattie et al. (2016) and Lemez et al. (2014) did not find an association between earlier achievement and earlier death when exploring North American professional basketball players and Canadian national hockey league players, respectively. In research beyond sports using a large sample of elected US congressmen, McCann (2015) concludes that the correlation between career peak age (first serving in the Congress) and age of death is conflated when failing to account for expected death age. A re-examination of his previous investigation (see McCann, 2003) under this approach in McCann (2015) also refutes his earlier findings in support for the precocity-longevity hypothesis.

In light of the causal evidence from Rablen and Oswald (2008) regarding the positive effect of receiving the Nobel Prize on longevity, in this study, we further examine longevity when the major award receptions take place at different life stages in scientists' careers. We also contribute to the literature by using a more robust method in testing the precocity-longevity hypothesis.

Material and methods

Sample

The sample of this study comprises 460 Nobel Prize winners in physics, chemistry, or physiology/medicine between 1901 and 2000. The dataset includes the number of major scientific awards received (and year of conferral) by each Nobel Prize winner, collated annually during the 45 years before and the 48 years after prize receipt, up until 2000.[14] Demographic information of the laureates was collected from publicly available sources such as NobelPrize.org, biographies, and Wikipedia; this includes gender, year and place of birth, death and highest educational attainment, nationality, and cause of death (i.e.,

[13] As Rablen and Oswald (2008) point out, the finding that the monetary reward offers no longevity-related benefits is consistent with Layard (1980).

[14] For details on classification of major awards and data collection procedure, see Chan et al., (2014a, b).

natural, suicide, or otherwise). For the ages at which Nobel Laureates produced their Nobel Prize-winning work, we follow the definition by Jones and Weinberg (2011).[15] We obtained the share of Nobel Prize amount from the Nobel Foundation, measured in real value in 2018 Swedish Krona (SEK).

The cut-off date for death data collection was September 20, 2021, with 73 living Nobel Laureates and 393 deceased, all but six from natural causes.[16] Life span is calculated as the year of death minus the birth year. The oldest living Laureate at the time of writing is Leon M. Lederman (born 1922, awarded the Nobel Prize in Physics in 1988), and the earliest cohort with living Laureates is 1957 (Physics Prize; Yang Chen-Ning (born 1922) and Tsung-Dao Lee (born 1926)). We exclude Nobel Prize winners with non-natural deaths ($n=6$; i.e., Eduard Buchner, Paul John Flory, Pierre Curie, Henry Way Kendall, Sir Frederick Grant Banting, and Rodney Robert Porter) and count only the first Nobel Prize for dual prize winners (i.e., John Bardeen, Marie Curie, and Frederick Sanger).

Methodological limitations

Although the considerations in section 'Timing of achievement and longevity: framing the hypotheses' offer testable hypotheses, the actual testing requires caution. First, because of the Nobel committee's 1970's restriction against posthumous recognition, we exclude the meritorious portfolios of deceased contenders (i.e., those who did not live long enough to win the prize).[17] In theory, this selection effect is larger on more recent cohorts of Nobel Laureates with the increase in the age at which candidates could receive the Nobel Prize (Baffes & Vamvakidis, 2011; Polemis & Stengos, 2022). Likewise, a sample of Nobel Laureates awarded the Nobel Prize at an older age would be inherently subject to selection bias (in this case, a "survival" bias). A second consideration is inherent survivability, the fact that the survivability characteristics of older Nobel laureates might be superior to those of (some) earlier prize winners, raising the issue of reverse causality. Similarly, healthier Nobel Prize candidates are likely to engage in more scientific research and discovery than their less healthy counterparts, increasing their chances of prize conferral and engendering a "healthy survivor" bias.[18] As regards the average age for producing Nobel Prize-worthy research, our multidisciplinary data suggest it to be around 38.5 years (SD = 8.04 years), although Nobel physicists typically meet the research standard at an average of 2.9 to 3.1 years earlier. Moreover, given the extended coverage of Nobel Laureates born between 1835 and 1950—over a century difference between the oldest and the youngest winners—we need to account for the general improvement in life expectancy due to technological advancement relating to factors such as medical treatments and improved living standard. Additionally, the increasing Nobel Prize conferral age over time (Baffes & Vamvakidis,

[15] Jones and Weinberg (2011) define the Nobel Prize winning work based on the single most important contribution using scientific literature as well as individual biographies. In a more recent study, Bjørk (2019) found that there is no statistically significant difference in the distributions between the age (based on Jones and Weinberg's (2011) definition) and the age of Prize-winning research as determined using only the official information from the Nobel Foundation.

[16] We adopt the definition of death of non-biological causes from Rablen and Oswald (2008).

[17] Dag Hammarskjöld and Erik Axel Karlfeldt were the only two recipients who had been awarded the Nobel Prize posthumously (Peace Prize in 1961 and Prize in Literature in 1931, respectively).

[18] Mixon and Upadhyaya (2014) discuss some of these ideas.

2011; Polemis & Stengos, 2022) is likely to contribute to the same confounding problem, as late achievers are more likely to be from more recent years.

To mitigate the estimation bias on the effect of early Nobel Prize achievement due to these issues, we examine the data using two approaches. First, following McCann (2003), we analyse the relationship between the timing of achievement and lifespan by constructing sub-samples from the whole sample—where each subsample contained achievers from an age before which no one in the subsample has died. Second, we compare the sex and age-specific life expectancy between the Nobel Laureate and the population cohort from the country of birth of the Laureate or the country in which the Laureate obtained her highest education (i.e., relative life expectancy). Data on age-specific life expectancy were collected from the Human Life Table Database.[19] While comparing winners' lifespan with the expected lifespan of the respective nominees (see, e.g., Rablen & Oswald, 2008 for Nobel Prizes and Redelmeier & Singh, 2001a, b, and Sylvestre et al., 2006 for Oscar prize winners) provides higher internal validity (i.e., counterfactual comparison), accessibility and availability of such data remains a major issue. For example, information on the Nobel Prize nominations after 1966 (1953 for Physiology or Medicine Prize) are yet to be released to the public as the statutes of the Nobel Foundation specify that only material older than 50 years can be disclosed.[20] Hence, this not only imposes a major limitation on the sample available for a potential analysis, it would also suffer from selection issues (focuses early cohort Nobelists). Nevertheless, the current approach can be extended by comparing the expected life expectancy of other same birth cohort scientists.[21]

In section 'Correlation between lifespan and timing of award bestowal' we examine in greater detail the issues with analyzing the relationship between Nobel Prize conferral age and total lifespan.

Descriptive statistics

We show the summary statistics for our main variables in Table 1 and detail the differences in average ages and years by field in Fig. 4 for (a) age at highest recognition (Nobel Prize conferral), (b) age at first major award, (c) lifespan, and (d) number of years lived after prize conferral. As Table 1 shows, the mean age at receipt of the Nobel Prize is 54.9 (SD = 11.48) years across the disciplines, with individual means of 55.5 (SD = 10.52), 52.5 (SD = 12.21), and 56.6 (SD = 11.16) for chemistry, physics, and physiology/medicine, respectively. Physicists tend to win the Nobel Prize at a younger age on average than either chemist (by 3.03 years, $p = 0.073$) or scholars in physiology/medicine (by 4.15 years, $p = 0.003$); there appears to be no statistically significant difference between scholars in chemistry and physiology or medicine in terms of age at Nobel Prize conferral (Fig. 4a).[22]

[19] See https://www.lifetable.de/cgi-bin/index.php. In cases where laureates have multiple nationality, we use the one associated with their country of birth. For Leopold Stephen Ruzicka and Marie Curie, we use their Switzerland and France as their nationality as age-specific life expectancy is not available for Croatia and Poland, respectively.

[20] See https://www.nobelprize.org/nomination/archive/

[21] For example, one could construct a dataset of scientists' expected lifespans using biographical sources such as Wikipedia entries or *Who's Who*.

[22] Pairwise comparisons of means with equal variances, with p values adjusted for multiple comparisons using Bonferroni's method.

Table 1 Descriptive statistics

Variable	N	Mean	SD	Min	Max	ρ_{NY}	ρ_{YOB}
Age when Nobel Prize awarded	460	54.87	11.48	25	87	0.34***	−0.08†
Chemistry	131	55.50	10.52	35	83	0.41***	0.05
Physics	159	52.47	12.21	25	84	0.40***	−0.03
Physiology or Medicine	170	56.62	11.16	33	87	0.22**	−0.20**
Age of first major award [a]	460	44.10	10.93	17	79	0.06	−0.17***
Chemistry	131	43.88	10.84	17	79	0.09	−0.09
Physics	159	42.45	10.11	20	73	0.07	−0.18*
Physiology or Medicine	170	45.80	11.54	20	75	0.03	−0.20**
Longevity [b]	387	80.65	10.67	44	103	0.39***	0.28***
Chemistry	113	79.10	11.19	53	100	0.45***	0.35***
Physics	129	80.67	9.57	53	100	0.34***	0.28**
Physiology or Medicine	145	81.84	11.10	44	103	0.38***	0.23**
Years of life after Nobel Prize [b]	387	24.95	13.03	1	58	−0.09†	0.20***
Chemistry	113	23.26	12.19	1	56	−0.03	0.20*
Physics	129	27.30	13.89	2	58	−0.23**	0.11
Physiology or Medicine	145	24.19	12.65	1	55	0.02	0.29***
Relative life expectancy	387	5.43	9.94	−26.0	28.5	0.10*	0.16**
Chemistry	113	3.95	10.05	−17.4	23.5	0.18†	0.20*
Physics	129	6.19	9.48	−18.4	28.5	−0.02	0.11
Physiology or Medicine	145	5.90	10.20	−26.1	25.5	0.15†	0.17*

Notes: [a] If a laureate had received no major award before Nobel Prize conferral, or received a major award after the Nobel Prize, we use age when Nobel Prize was awarded (n = 79)

[b]Excludes Nobel laureates still living as of September 2021. $\rho_{NY=}$Pearson's correlation with Nobel Prize year and $\rho_{YOB=}$Pearson's correlation with the year of birth. †$p<0.1$, *$p<0.05$, **$p<0.01$, ***$p<0.001$

The mean age of first major award reception over all three academic disciplines is about 44 years (SD = 10.93), with individual means of 43.9 (SD = 10.84), 42.5 (SD = 10.84), and 45.8 (SD = 11.54) for chemistry, physics, and physiology/medicine, respectively. Although the pattern of differences for timing of first major award is similar to that of age at Nobel Prize conferral, the only statistically significant difference is that between physiology/medicine and physics (by 3.35 years, $p = 0.016$, Fig. 4b). The cross-tabulation between Nobel Prize conferral age and age of receiving the first major scientific award is provided in Table 7 in the Appendix.

The average age at death for Nobel Prize winners is 80.7 years (SD = 10.67). Although Laureates in physiology/medicine, at 81.8 years, enjoy slightly longer lifespans on average than Laureates in the other two fields, the difference is not statistically significantly different to the other two fields (Fig. 4c). Nevertheless, using the nonparametric log-rank test, the survival distributions are not statistically distinguishable between fields (Fig. 5). With respect to years of life after receiving the Nobel Prize, on average, scholars enjoy post-Prize lifespans of 24.95 years (SD = 13.03). With a mean of 27.3 years, physicists have the highest number of years lived post conferral, exceeding the 23.3 year mean for chemistry ($p = 0.047$). The difference between physiology/medicine (mean of 24.2 years) and physics ($p = 0.142$) and chemistry ($p = 1.00$) is not statistically significant (Fig. 4d). On average, Laureates live 5.43 years longer than the average person in the respective population who had survived to the age when the Laureate received the Nobel Prize. Whilst Physics (Chemistry) Laureates have the largest (smallest) difference to age-specific life expectancy (6.207 and 3.94 years, respectively), we do not find statistically significant differences between fields. In addition, we observe no statistically significant differences across any of the three fields in the means of the birth year or the total number of major awards by ages 30, 40, 50 and 60 (see Table 8).

The correlations between our main variables and time (year of the Nobel Prize awarded or year of birth) suggest that both age at conferral and longevity are positively correlated with year of conferral ($\rho_{NY}=0.34$ and $\rho_{NY}=0.39$; both $p<0.001$). These outcomes indicate that the average age at conferral increases over time and that earlier awardees have shorter lifespans than more recent laureates. On the other hand, age at first major award is uncorrelated with award timing (with a correlation coefficient of $\rho_{NY}=0.07$ that is not significantly different from 0). While longevity is also positively correlated with year of birth ($\rho_{YOB}=0.25$; $p<0.001$), age at first major award is negatively correlated with year of birth, indicating that scientists who were born more recently received recognition earlier in life ($\rho_{YOB}=-0.18$; $p<0.001$). Interestingly, more recently born winners in Chemistry ($\rho_{YOB}=0.16$; $p=0.099$) and Physiology or Medicine ($\rho_{YOB}=0.29$; $p<0.001$) have longer post-Prize lifespans. The results thus provide strong justification for controlling for a cohort effect. Lastly, we observed that the positive correlations between relative life expectancy with either birth year or Nobel Prize reception year are smaller than those with longevity, indicating that the former reduces the issues stemming from increasing life expectancy over time. These positive relationships remain statistically significant (generally, at lower levels), except for Physics Nobel Prize winners.

Correlation between lifespan and timing of award bestowal

In terms of associations between our main variables (Table 9), the age at highest accolade (Nobel Prize conferral, NP) is positively and significantly correlated with age of first major award (FMA) for both the pooled sample (correlation coefficient of $\rho=0.523$, $p<0.001$) and each of the individual subsamples (fields), with the largest correlation coefficient across sub-samples being 0.548 for Nobel Prize winners in physics. Age at Nobel Prize conferral is also positively correlated with longevity for the pooled sample ($\rho=0.326$, $p<0.001$) and each of the sub-samples, with the largest correlation coefficient across sub-samples being 0.387 ($p<0.001$) for Nobel Prize winners in chemistry. In contrast, the relation of age at first major award and longevity (lifespan), although positively correlated for both pooled samples and within each field, is weak and not statistically significant.

While the strong positive correlation between age at Nobel Prize conferral and total lifespan may suggest that receiving the Nobel Prize later in life can increase one's longevity, it could also be an artefact from the fact that only living persons are eligible for the Nobel Prize. Specifically, few issues that arise from such eligibility can give false impressions about the effect of timing of recognition on one's longevity. First, by construction, Laureates who receive the Nobel Prize late in life accumulate longer 'immortal time'—years survived before conferral—compared to those who receive the Nobel Prize early.[23] Secondly, there is a selection effect that late winners are inherently healthier. Therefore, it is easy to see that comparing the total lifespan between the two groups would favour those

[23] See also Hanley and Foster (2014) for discussion.

receiving the Nobel Prize late in life. On the other hand, comparing the mortality after Nobel Prize reception between early and late winners is also problematic since mortality is age-dependent (higher for an older person) and could be conflated with the effect of receiving the Nobel Prize early or late. We illustrate these issues using simple Kaplan–Meier survival estimates in Fig. 6a and b.

To overcome the 'immortal time' issue, we thus focus our analysis on the relative life expectancy variable, which is the difference between the number of years the Laureate lived after receiving the Nobel Prize and the expected remaining life of a person (of the same sex and born in the same year and nationality of the Laureate) who had survived until the age when the Nobel Prize was conferred. Because the life expectancy is age (and thus birth year), sex, and country-specific, comparison of the variable between Laureates is less likely to suffer from immortal time bias.

Furthermore, we adopt an approach similar to McCann (2003), dealing with life expectancy and selection biases by constructing different subsamples of Laureates who obtained the Nobel Prize before a certain age cut-off x, and who died at or after age x. For example, setting x equal to 60 would mean that the subsample comprises only Laureates who have won the Nobel Prize before reaching the age of 60 and have lived to 60 years of age and beyond. We then examine the relationship between the age of Nobel Prize conferral and the deviation in remaining life after 60 to the average population (i.e., relative life expectancy at age cut-off). However, this approach gives rise to another problem: precluding winners who die 'prematurely' (before the cut-off age) creates another selection effect in which the early winners included may be inherently healthier (remaining alive at the cut-off age). Such a selection effect becomes larger as the cut-off age increases. On the other hand, applying a low cut-off age will effectively exclude Laureates who received the Nobel Prize late, which may reduce the statistical power. Therefore, the potential negative effect on the longevity of winning the Nobel Prize early is a conservative estimate and likely to be underestimated if the cut-off is set too high or too low. The youngest age at death among all deceased Nobel Laureates is in our sample 44, and the oldest age at Nobel Prize reception is 87. For transparency, we also show the results of subsample analysis with age cut-offs from 50 to 80.

To assess the relationship between longevity and the timing of first major scientific recognition, we use a slightly different approach by constructing subsamples of laureates who receive the Nobel Prize at similar ages (within 5 years). Such an approach has an additional advantage as it exploits the variation in age of first major recognition of laureates with relatively homogeneous expected mortality. Nevertheless, as the number of laureates receiving the Nobel Prize before 45 and after 65 is small, we restrict our subsample analysis to those between this age range.

Regression analysis

To further test the above hypotheses on the timing of the Nobel Prize conferral in the sciences, we regress Nobel Laureate *relative life expectancy* on a number of factors; (1)

scientific discipline, (2) death by radiation, (3) death during World War I, (4) death during World War II, and (5) death by suicide. Also included on the right-hand side of the specification is (6) gender (coded 1 for female), (7) theoretical research, (8) of the Nobel Prize won, (9) real value of the prize money and (10) the prize money actually received (interaction of (8) and (9)), and (11) decade of birth as life expectancy has improved over the years. The OLS results for all deceased Nobel laureates are reported in Table 3. For robustness, we replicate the regression results using relative life expectancy based on age-specific life expectancy from the country where the Laureate received their highest educational degree (Table 10).[24] In Table 4, we substitute age at Nobel Prize conferral with dummy variables to investigate possible non-linear effects[25] and include the variable age at conferral of the first major award. Furthermore, we examine whether the number of major awards obtained at an early age affects longevity in Table 5. To do this, we include the number of major awards won by age 30, 40, 50 and 60, respectively. Lastly, to examine the effect of duration between when the Nobel Prize-worthy research was conducted and Nobel Prize reception, in Table 6, we include a set of dummy variables to distinguish laureates who were awarded the Nobel Prize within/beyond 10, 15, 20, 25, or 30 years from completing their Nobel Prize work.

Empirical analysis

Correlation between lifespan and timing of award bestowal

Using the *relative life expectancy* measure (vertical bars in Fig. 1a), we find a negative correlation with Nobel Prize conferral age ($\rho = -0.09$, $p = 0.079$) as well as age when Laureate received the first major award ($\rho = -0.16$, $p = 0.0015$) in the pooled sample (Fig. 1b). However, the negative relationship between the deviation of life expectancy and Nobel Prize reception age seems to be driven by Laureates in physics ($\rho = -0.24$, $p = 0.0057$) while the correlations for chemistry and physiology or medicine are not statistically significant (Table 2). On the other hand, the negative correlation between the age of first major award and relative life expectancy is stronger for physics ($\rho = -0.19$, $p = 0.0275$) and physiology or medicine ($\rho = -0.19$, $p = 0.0195$) Nobel Prize winners, and not statistically significant for chemistry ($\rho = -0.09$, $p = 0.356$).

In Fig. 2, we report for each subsample (a) the Pearson's correlation between deviation in remaining life and Nobel Prize age, (b) independent samples *t* test of mean relative life expectancy between Laureates with award age below median award age (early recognition) and those above median (late recognition), (c) independent samples *t* test of mean relative life expectancy between Laureates with award age below the 33rd percentile of the award age (early recognition) distribution and those above the 66th percentile (late recognition). The individual statistical significance (*p* value of two-tailed test) of each test is shown in Fig. 2d.

We find that the correlations between Nobel Prize winning age and relative life expectancy among subsamples (Fig. 2a) are, on average, negative but small (average $\rho = -0.018$,

[24] In our sample, 69 deceased Laureates completed their highest degree in another country different to their nationality.

[25] We group Laureates who received the Nobel Prize in their 20 s and 30 s together, as Sir William Lawrence Bragg is the only person who received the Prize in his 20 s (25 years old).

Table 2 Correlation between relative life expectancy and age of achievement

$\rho_{Deviation\ from\ average}$ life expectancy	*Age at NP*	*Age at FMA*
All Nobel Prize winners	−0.09†	−0.16**
Chemistry	0.03	−0.09
Physics	−0.24**	−0.19*
Physiology or Medicine	−0.03	−0.19*

† $p<0.1$, * $p<0.05$, ** $p<0.01$, *** $p<0.001$

SD$\rho=0.062$) and most of the individual correlation coefficients are not statistically different from zero (even at 20% level of statistically significance, which accounts for the loss of power given the subsample analysis).[26] The average mean difference in relative life expectancy between those with late (above median age at conferral of the subsample) and early (below median age at conferral of the subsample) recognition (Fig. 2b) among all subsamples is − 0.39 years (SD = 1.54) and not statistically significant ($p=0.997$, two-tailed one-sample t test with Šidák procedure). Similarly, using more restrictive criteria, i.e., comparing longevity between those above the 66th to those below the 33rd percentile of age at conferral in the subsample (Fig. 2c), indicates that laureates with late recognition have a shorter lifespan of 0.64 year (SD = 1.6) but is not statistically significant ($p=0.658$, two-tailed one-sample t test with Šidák procedure).

Nevertheless, we observe that the correlation coefficients, as well as the difference in mean, increase in value as the age cut-off increases. In particular, when splitting the subsamples into two groups by age cut-off 65, we find that for the earlier subsample (i.e., 15 subsamples with cut-off below 65), the negative correlations and differences in mean are statistically significant (adjusted $p<0.01$ for all three statistics).[27]

On the other hand, we find a positive relationship (correlation and positive difference in relative life expectancy of late and early recognition) between conferral age and longevity (adjusted $p<0.05$ for all three statistics).[28] This indicates that laureates who received the Nobel Prize relatively early in life (before 65) benefit from the early recognition while those who were awarded the Nobel Prize later in life enjoy extra years of life by the delay in the bestowal of the Nobel Prize.

As shown in Fig. 3a, the correlations between age at first award and relative life expectancy are all negative (average $\rho=-0.242$, SD of $\rho=0.096$); one-sample two-tailed t test with multiple testing correction (16 subsamples) indicates the mean correlation is statistically significant ($p<0.001$). The average relative longevity difference between Laureates who received their first major award at an age below and above the median (late–early first major award recognition) is − 4.5 years (SD = 2.2, $p<0.001$ for one-sample two-tailed t test) (Fig. 3b). Those with very early recognition (below 33rd percentile of age at conferral) lived, on average, 5.09 years (SD = 2.11, $p<0.001$ for one-sample two-tailed t test)

[26] We also test whether the distribution of correlation coefficients is statistically different from zero by a one-sample t test. As such an analysis involves 31 subsamples, we adjusted the p-values using the Bonferroni and Šidák procedure to account for multiple testing correction. We conclude that the mean correlation coefficient is not statistically significant.

[27] Correlation: $\rho=-0.072$, $p<0.001$; Mean difference (by median): − 1.62 years, $p=0.005$; Mean difference (by first and last tertiles): − 1.99 years, $p<0.001$.

[28] Correlation: $\rho=0.032$, $p=0.007$; Mean difference (by median): 0.76 years, $p<0.001$; Mean difference (by first and last tertiles): 0.62 years, $p=0.01$.

Table 4 OLS Results for all deceased Nobel Laureates

Dependent variables: relative life expectancy						
Independent variables	(1)	(2)	(3)	(4)	(5)	(6)
Receive Nobel Prize in Age 20 s or 30 s	2.184	.5401	.1902	.4191	1.671	1.73
	(2.333)	(2.412)	(2.421)	(2.381)	(2.374)	(2.228)
Receive Nobel Prize in Age 40 s	1.524	.7975	.6423	.453	.6563	.5765
	(1.531)	(1.539)	(1.538)	(1.54)	(1.492)	(1.502)
Receive Nobel Prize in Age 60 s	1.807	2.46†	2.335†	2.078	2.121	1.443
	(1.29)	(1.262)	(1.283)	(1.283)	(1.287)	(1.343)
Receive Nobel Prize in Age 70 s	−.0619	1.615	1.519	1.537	1.738	−.7005
	(1.379)	(1.484)	(1.506)	(1.502)	(1.633)	(1.753)
Receive Nobel Prize in Age 80 s	−3.214*	−1.14	-1.481	−1.086	−2.329	−2.695
	(1.43)	(1.902)	(1.957)	(2.062)	(2.222)	(2.105)
Age of first major award		−.1577**	−.1627***	−.1574**	−.1128*	−.0926†
		(.0479)	(.0484)	(.0483)	(.0503)	(.0495)
Nobel Prize in Physics			.1631	.0381	.6684	.3114
			(1.227)	(1.226)	(1.227)	(1.217)
Nobel Prize in Chemistry			−2.017	−2.118†	−1.224	−1.382
			(1.286)	(1.279)	(1.33)	(1.3)
Theoretical			−.8097	−.8406	−1.28	−.9869
			(1.263)	(1.254)	(1.274)	(1.262)
Female				−6.419†	−6.415†	−6.118
				(3.452)	(3.76)	(3.946)
Death by radiation					−7.702	−7.264
					(5.481)	(5.439)
Died during WWI					−5.795**	−8.08***
					(2.129)	(2)
Died during WWII					−2.007	.3392
					(1.867)	(2.348)
Suicide					4.605	3.47
					(5.188)	(5.792)
Fraction of prize won					28.96	59.75
					(59.98)	(59.99)
Total real prize value					−2.141	.3989
					(2.673)	(2.802)
Prize money received					−2.122	−4.073
					(3.945)	(3.944)
Constant	4.528***	11.5***	12.53***	12.6***	44.89	−7.978
	(.9373)	(2.336)	(2.482)	(2.481)	(40.4)	(43.72)
Birth cohort FE	No	No	No	No	No	Yes
N	387	387	387	387	387	387
R^2	0.0119	0.0355	0.0457	0.0549	0.114	0.183
Adj. R^2	−0.00104	0.0202	0.0229	0.0297	0.0728	0.119

Reference group: Laureates who received the Nobel Prize during their 50 s; Nobel Prize in Physiology/Medicine. Robust standard errors are in parentheses. †$p < .10$; *$p < .05$; **$p < .01$; ***$p < .001$

Table 3 OLS Results for All Deceased Nobel Laureates

Dependent variables: relative life expectancy					
Independent variables	(1)	(2)	(3)	(4)	(5)
Nobel Prize conferral age	− .0759†	− .0758†	− .0739†	− .0778†	− .1148**
	(.0405)	(.0418)	(.0416)	(.0449)	(.0423)
Nobel Prize in Physics		.1072	− .0108	.6056	.1892
		(1.223)	(1.218)	(1.216)	(1.202)
Nobel Prize in Chemistry		− 2.012	− 2.125†	− 1.233	− 1.353
		(1.293)	(1.287)	(1.336)	(1.292)
Theoretical		− .5201	− .5815	− 1.039	− .9199
		(1.27)	(1.259)	(1.263)	(1.244)
Female			− 7.476*	− 7.266†	− 6.919†
			(3.436)	(3.802)	(3.914)
Death by radiation				− 8.329	− 7.792
				(5.444)	(5.414)
Died during WWI				− 6.579**	− 8.541***
				(2.466)	(2.101)
Died during WWII				− 2.542	.1434
				(1.823)	(2.383)
Suicide				4.309	3.303
				(5.216)	(5.912)
Fraction of prize won				31.58	56.58
				(59.81)	(58.19)
Total real prize value				− 1.768	.4357
				(2.669)	(2.65)
Prize money received				− 2.331	− 3.881
				(3.936)	(3.826)
Constant	9.654***	10.3***	10.46***	39.85	− 6.329
	(2.477)	(2.79)	(2.778)	(39.66)	(40.71)
Birth cohort FE	No	No	No	No	Yes
N	387	387	387	387	387
R^2	0.00800	0.0174	0.0303	0.0970	0.176
Adj. R^2	0.00542	0.00715	0.0175	0.0681	0.124

Reference group: Nobel Prize in Physiology/Medicine. Robust standard errors are in parentheses. †$p < .10$; *$p < .05$; **$p < .01$; ***$p < .001$

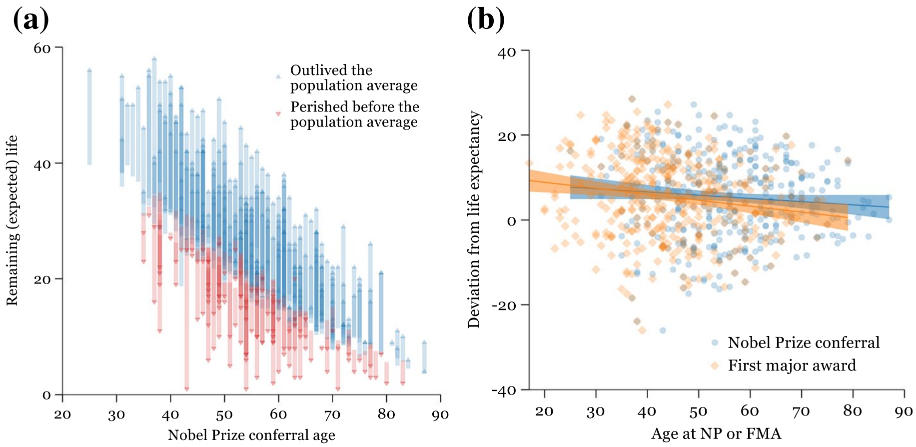

Fig. 1 Life expectancy and timing of the achievement. **a** Each marker represents the number of years lived after receiving the Nobel Prize. The trail of each marker indicates the deviation between theLaureate's life span and age, sex, and country-specific life expectancy. Laureate who outlived (perished before) the average individual is marked as blue (red). **b** Shows the relationship between the lifespan–life expectancy difference and age when Laureate received the Nobel Prize (blue circles) and first major award (orange diamonds). Shaded areas represent 95% CI of the linear fit

longer than the respective population compared to those with very late recognition (above 66th percentile of age at conferral) (Fig. 3c).

Timing of the achievement and longevity

Using the regression approach, overall, we find a negative relationship between Nobel Prize conferral age with Laureate's relative life expectancy whereby Laureates awarded earlier in life enjoy a longer lifespan (compared to the relevant population) than those who achieved the academic pinnacle later in life (Table 3). On average, being awarded the Nobel Prize 10 years earlier would result in an additional 0.7–1.1 years of life compared to the average life expectancy. Hence, our results suggest that the health benefits of receiving the Nobel Prize cascade and cumulate across the person's life span.

Additionally, Nobel Laureates in chemistry have slightly shorter relative lifespans than those in physiology/medicine (at 10% level in specifications (3) and (4)), while the relative life expectancy of Laureates whose Nobel Prize-winning work was theoretical is not significantly different from empiricists. Nonetheless, compared to male Laureates, female Nobel Prize winners have a smaller difference in life expectancy to the respective female population. In fact, on average, the life expectancy of the eight female Laureates is not significantly different to the average female, in contrast to the 5.6 years additional life years for their male counterpart. Thus, we do not find a statistically meaningful link between one's relative life expectancy and the *share* of prize and prize money received.

In general, while Laureates who received the Nobel Prize in their 50 s seem to have the second shortest relative life expectancy (following those who were awarded in their 80 s),

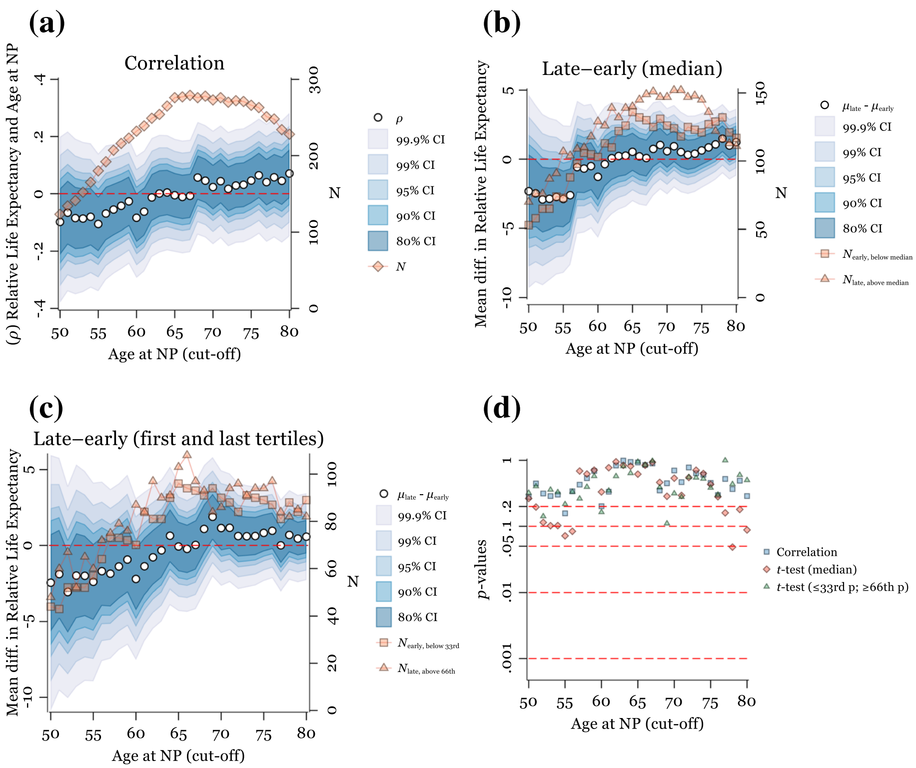

Fig. 2 Longevity and timing of the Nobel Prize. Subsamples are constructed using various cut-offs from receiving the Nobel Prize (before and being alive at age of 45 to 85). **a** Pearson's correlation between relative life expectancy and Nobel Prize age; **b** mean relative life expectancy difference between laureates with late (above subsample median Nobel Prize reception age) and early (below subsample median Nobel Prize reception age) recognition; **c** mean relative life expectancy difference between the bottom 33rd percentile and the top 33rd percentile in terms of timing of recognition (trichotomised); **d** statistical significance of correlation (**a**) and *t*-test (**b** and **c**) of each subsample

such non-linearity effect is not substantially supported (Table 4).[29] However, we do find a very robust effect that receiving major recognition early in life is positively related to a Nobel Laureate's relative life expectancy. Holding other factors constant, receiving a major scientific prize 10 years sooner increases the difference from expected lifespan compared with the reference population by 0.93 to 1.6 years (Table 4). Such effect is stronger for the restricted sample of most Nobel Prize winners who receive the award under 65 years old (effect size ranging from − 0.16 to − 0.25, see Table 11).[30]

While we find that the effect of the number of major awards received at different (early) life stages on increasing laureates' life expectancy is in general negative—which might

[29] We also observe that once age of first major recognition is controlled for (specification 2), the coefficients for the Nobel Prize receipt age from specification (1) changes quite drastically. This is likely due to the fact that 81 Laureates in the sample did not have any major recognition before the winning the Nobel Prize, increasing the collinearity between the two variables.

[30] Again, the mean and median age of Nobel Prize reception for all deceased laureates is 55.7 and 55, respectively. The effect is also robust to relative life expectancy calculated using age-specific population life expectancy from the country where the Laureate received their highest education.

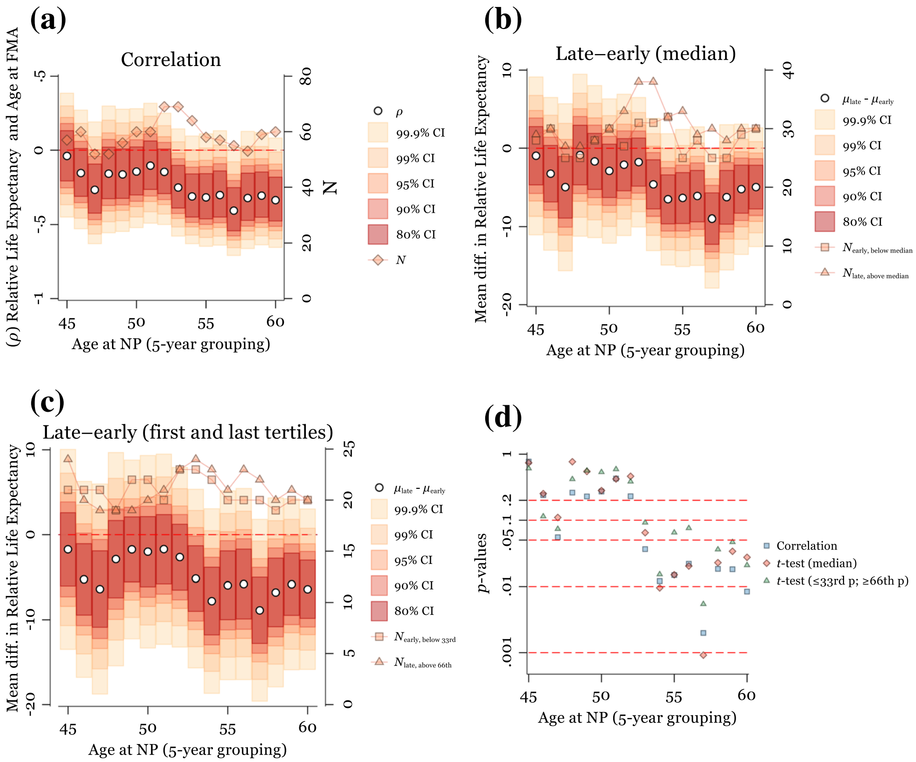

Fig. 3 Longevity and timing of first major recognition. Subsamples are constructed using a 5-year window of Nobel Prize reception age. **a** Pearson's correlation between relative longevity and age at first major award; **b** Mean relative longevity difference between Laureates with late (above subsample median first major award age) and early (below subsample median first major award age) recognition; **c** Mean relative longevity difference between the bottom 33rd percentile and the top 33rd percentile in terms of timing of recognition (trichotomised); **d** Statistical significance of correlation (**a**) and *t* test (**b** and **c**) of each subsample

suggest an increase in stress levels accompanying overwhelming achievements at an earlier age—we do not find such effects to be statistically significant (Table 5). We do not find substantive statistical evidence suggesting that a long waiting time between the Nobel Prize conferral and when the work was conducted (Chan & Torgler, 2013) shortened one's lifespan (Table 6) except for a waiting time beyond 15 years (at 10% level of statistical significance).[31] Moreover, although lacking statistical significance, the effects of long waits (e.g., more than 25 years of award gap) are positively correlated with relative life expectancy, we cannot rule out the possibility that award delay can have a non-linear effect on life expectancy.

[31] The null results are consistent with using a categorical classification of waiting time of less than 10 years, 11–20 years, 21–30 years, and more than 30 years.

Table 5 OLS Results on the number of major awards received

Dependent variables: relative life expectancy				
Independent variables	(1)	(2)	(3)	(4)
Number of major awards at age 30	−.1971			
	(1.088)			
Number of major awards at age 40		−.5708		
		(.4401)		
Number of major awards at age 50			−.2477	
			(.2761)	
Number of major awards at age 60				−.1356
				(.1688)
Nobel Prize conferral age	−.079	−.097†	−.1009*	−.1385**
	(.0501)	(.0519)	(.05)	(.0458)
Age of first major award	−.0773	−.1016†	−.0981†	−.0888†
	(.0516)	(.0537)	(.0553)	(.05)
Constant	−10.72	−11.7	6.878	−4.904
	(41.15)	(41.02)	(39.93)	(38.78)
Controls	Yes	Yes	Yes	Yes
Birth cohort FE	Yes	Yes	Yes	Yes
N	387	387	385	373
R^2	0.181	0.185	0.171	0.182
Adj. R^2	0.124	0.129	0.113	0.123

Robust standard errors are in parentheses. †$p<.10$; *$p<.05$; **$p<.01$; ***$p<.001$. Controls include *field dummies, theoretical, female, death by radiation, died during WWI or WWII, suicide, fraction of prize won, total real prize value,* and *prize money received*

Nevertheless, our overall results on both the age of conferral of the Nobel Prize and other major scientific recognitions contradict McCann's (2001) precocity-longevity hypothesis, such that early recognition may lead to premature deaths. Such contradiction is likely due to methodological differences. While McCann (2001, 2003) has employed a similar approach in tackling the 'survivor' bias,[32] which naturally favors the precocity-longevity hypothesis, by analyzing sub-samples in which individuals included were alive before a certain age cutoff[33] his studies failed to control for other attributes such as birth cohort. Controlling for birth cohort is important as more recent winners might be more likely to receive the Nobel Prize later in life due to higher life expectancy based on improved living conditions. On the other hand, our approach takes into account the age-specific life expectancy of the general population from the same birth cohort.

[32] McCann (2001) refer to it as life expectancy artifact and Simonton selection artifact.

[33] E.g., determined by the sample characteristics where sub-sample size is maximised.

Table 6 OLS Results on Nobel Prize work–award gap

Dependent variables: Relative life expectancy					
Independent variables	(1)	(2)	(3)	(4)	(5)
Years between Nobel Prize work and award > 10	−.7395				
	(1.26)				
Years between Nobel Prize work and award > 15		−2.203†			
		(1.216)			
Years between Nobel Prize work and award > 20			−.0725		
			(1.21)		
Years between Nobel Prize work and award > 25				.9063	
				(1.426)	
Years between Nobel Prize work and award > 30					.6638
					(1.638)
Nobel Prize conferral age	−.0612	−.019	−.0766	−.0965†	−.0878
	(.0546)	(.0581)	(.0578)	(.0581)	(.0565)
Age of first major award	−.0773	−.0824†	−.075	−.0709	−.0725
	(.0498)	(.0493)	(.0502)	(.0508)	(.0506)
Constant	−9.204	−14.79	−10.05	−7.164	−6.048
	(40.92)	(40.89)	(40.95)	(40.98)	(42.32)
Controls	Yes	Yes	Yes	Yes	Yes
Birth cohort FE	Yes	Yes	Yes	Yes	Yes
N	387	387	387	387	387
R^2	0.182	0.188	0.181	0.182	0.181
Adj. R^2	0.125	0.132	0.124	0.125	0.124

Robust standard errors are in parentheses. †$p < .10$; *$p < .05$; **$p < .01$; ***$p < .001$. Controls include *field dummies, theoretical, female, death by radiation, died during WWI or WWII, suicide, fraction of prize won, total real prize value,* and *prize money received*

Concluding remarks

The story of Rockefeller University professor Ralph Steinman's quest to survive pancreatic cancer long enough to accept the 2011 Nobel Prize in medicine, only to die 3 days before conferral, is more than a story of personal courage and determination. In addition, it underscores aspects of the competition for prestigious awards that figure prominently in two separate branches of economics research that have goal-oriented motivation as a key element: namely, the economics of status and prestige and the economics of awards and recognition. In this study, therefore, we test the assumption that such motivation impacts not only scholarly success but also the natural lifespan by determining whether the timing of Nobel Prize conferral and other major scientific recognition affects Laureate longevity. Since the Nobel Prize represents the pinnacle of academic achievement, we wonder whether the stress of subsequently replicating or even surpassing earlier scientific work might link early receipt of the Nobel Prize to early death, or whether early conferral may increase longevity by mitigating work-related stress and/or promoting healthier behaviours. In fact, according to our regression results for the sample of 387 Nobel Prize winners, receiving the Nobel Prize at a young age results in an increase in relative life expectancy; that is, being awarded the Nobel Prize or a major scientific award 10 years earlier is associated with an increase in expected lifespan difference to the average population by around 1 year. In addition, the strong negative correlation between the age of receiving other major scientific awards and relative life expectancy further indicates the early career recognition benefit. On the other hand, we do not find support for the *number* of early recognitions received or the gap between the Nobel Prize work and the actual Nobel Prize award (waiting time) having a significant effect on Laureates' longevity. Thus, our study complements previous efforts in understanding the potential health benefits of awards (e.g., Rablen & Oswald, 2008) by exploring in more detail the conferral timing. We also provide evidence that contradicts McCann's (2001) precocity-longevity hypothesis.

Appendix

See Figs. 4, 5, 6 and Tables 7, 8, 9, 10, 11.

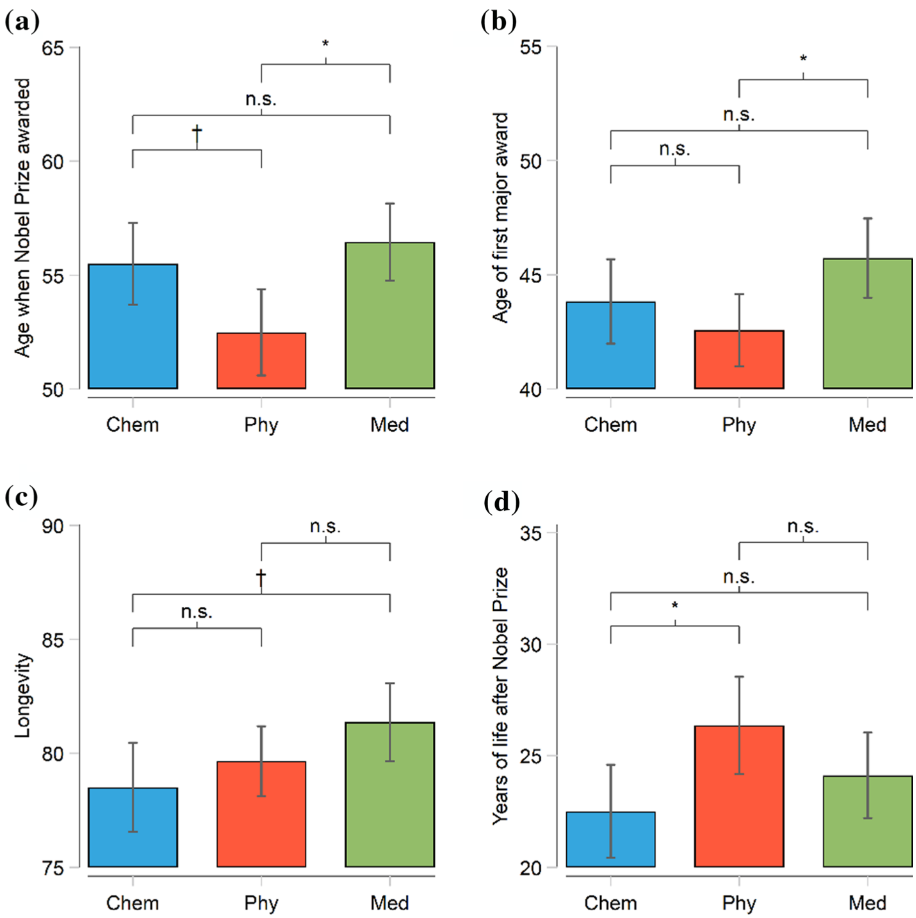

Fig. 4 Differences in average ages and years by field. †$p < 0.1$, *$p < 0.05$, **$p < 0.01$, ***$p < 0.001$, *n.s.* not significant. Error bars denote 95% confidence interval of the mean. *P* values are adjusted for multiple comparisons using Bonferroni's method

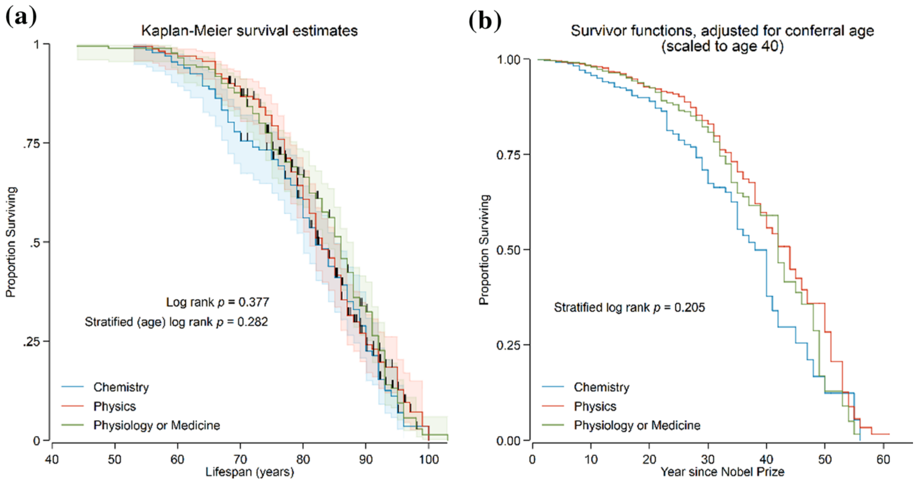

Fig. 5 Nobel laureate survivor functions by field. **a** Kaplan–Meier survival estimates by field over lifespan. Hash marks represent censored observations. Coloured areas represent 95% confidence interval. Reported are p-values of the overall log rank test (unstratified) and log rank test stratified by 10-year interval of Nobel Prize conferral age. **b** Years lived since Nobel Prize reception by field. Estimates are adjusted for age and scaled to age 40

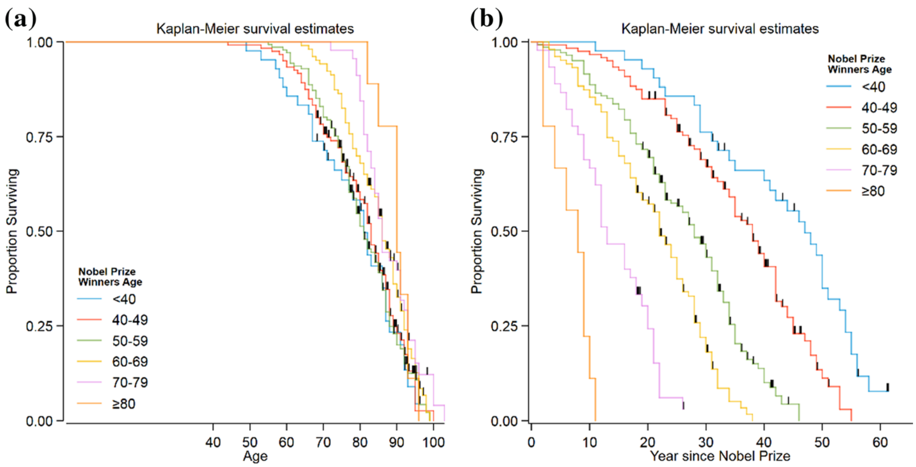

Fig. 6 Simple survival function by Nobel Prize winning age. **a** Survival estimates of total lifespan. **b** Survival estimates of years since Nobel Prize conferral by Nobel Prize winning age. Nobel Laureates are grouped by the 10-year interval age at Nobel Prize conferral. Hash marks represent censored observations. Groups receiving Nobel Prize later in life remain 'immortal' until conferral (**a**). Removing 'immortal time': Age-specific mortality rate conflates with the effect of timing of the Nobel Prize (**b**)

Table 7 Laureates by age at Nobel Prize and first major scientific award

Age at FMA	age < 30	30 ≤ age < 40	40 ≤ age < 50	50 ≤ age < 60	60 ≤ age < 70	age ≥ 70	Total
Age at NP							
Age < 40	9	33	0	0	0	0	42
40 ≤ age < 50	5	47	68	0	0	0	120
50 ≤ age < 60	10	35	48	48	0	0	141
60 ≤ age < 70	8	18	26	30	21	0	103
70 ≤ age < 80	1	5	11	9	13	6	45
Age ≥ 80	0	1	2	1	4	1	9
Total	33	139	155	88	38	7	460

Table 8 Descriptive statistics on birth year and number of major awards across age

Variable	N	Mean	SD	Min	Max
Year of birth	460	1904.35	26.36	1835	1950
Chemistry	131	1903.53	26.03	1835	1948
Physics	159	1906.428	26.55	1837	1950
Physiology or Medicine	170	1903.047	26.49	1841	1947
Number of major awards by 30	460	0.09	0.45	0	5
Chemistry	131	0.08	0.48	0	5
Physics	159	0.119	0.54	0	4
Physiology or Medicine	170	0.076	0.29	0	2
Number of major awards by 40	460	0.85	1.59	0	11
Chemistry	131	0.76	1.33	0	7
Physics	159	1.031	1.73	0	9
Physiology or Medicine	170	0.741	1.62	0	11
Number of major awards by 50	458	2.46	2.64	0	16
Chemistry	131	2.44	2.62	0	14
Physics	159	2.522	2.24	0	11
Physiology or Medicine	168	2.423	3.00	0	16
Number of major awards by 60	446	4.38	3.70	0	30
Chemistry	125	4.27	3.39	0	14
Physics	155	4.123	2.90	0	15
Physiology or Medicine	166	4.711	4.49	0	30

Table 9 Correlation between lifespan and age of achievement

	Variable	Age at NP	Age at FMA	Lifespan
Overall ($N=385$)	*Age at NP*	1		
	Age at FMA	0.523***	1	
	Longevity	0.326***	0.056	1
Chemistry ($N=112$)	*Age at NP*	1		
	Age at FMA	0.458***	1	
	Longevity	0.387***	0.071	1
Physics ($N=128$)	*Age at NP*	1		
	Age at FMA	0.548***	1	
	Longevity	0.227†	0.041	1
Physiology/Medicine ($N=145$)	*Age at NP*	1		
	Age at FMA	0.532***	1	
	Longevity	0.368***	0.033	1

Pairwise correlations (excluding Nobel laureates still living as of September 2021) between (1) age at Nobel Prize conferral, (2) age at first major award, and (3) lifespan. †$p<0.1$, *$p<0.05$, **$p<0.01$, ***$p<0.001$

Table 10 Robustness checks – country of highest education as reference population

Dependent variables: relative life expectancy					
Independent variables	(1)	(2)	(3)	(4)	(5)
Nobel Prize conferral age	−.0726†	−.0722†	−.0703†	−.0744†	−.1114**
	(.0404)	(.0417)	(.0415)	(.0448)	(.0423)
Nobel Prize in Physics		.1546	.0365	.6586	.2564
		(1.219)	(1.214)	(1.209)	(1.194)
Nobel Prize in Chemistry		−1.997	−2.11	−1.196	−1.305
		(1.287)	(1.281)	(1.328)	(1.284)
Theoretical		−.5001	−.5615	−1.003	−.8658
		(1.268)	(1.257)	(1.261)	(1.241)
Female			−7.478*	−7.285†	−6.899†
			(3.429)	(3.802)	(3.913)
Death by radiation				−8.175	−7.733
				(5.528)	(5.458)
Died during WWI				−6.449**	−8.499***
				(2.461)	(2.115)
Died during WWII				−2.323	.3053
				(1.794)	(2.371)
Suicide				4.134	3.1
				(5.279)	(5.989)
Fraction of prize won				31.14	57.02
				(59.72)	(57.97)
Total real prize value				−1.81	.3973
				(2.662)	(2.639)
Prize money received				−2.311	−3.926
				(3.929)	(3.81)
Constant	9.475***	10.08***	10.24***	40.34	−5.747
	(2.473)	(2.777)	(2.765)	(39.56)	(40.46)
Birth cohort FE	No	No	No	No	Yes
N	387	387	387	387	387
R^2	0.00738	0.0169	0.0298	0.0971	0.176
Adj. R^2	0.00480	0.00663	0.0171	0.0681	0.123

Reference group: Nobel Prize in Physiology/Medicine. Robust standard errors are in parentheses. †$p < .10$; *$p < .05$; **$p < .01$; ***$p < .001$

Table 11 OLS results for deceased nobel laureates who received the Nobel Prize under 60

Dependent variables: relative life expectancy					
Independent variables	(1)	(2)	(3)	(4)	(5)
Receive nobel prize in age 20 s or 30 s	−.434	−.8547	−.5087	.8377	1.008
	(2.482)	(2.497)	(2.456)	(2.448)	(2.296)
Receive nobel prize in age 40 s	.3672	.1895	−.0954	.0928	.13
	(1.554)	(1.553)	(1.557)	(1.517)	(1.535)
Receive nobel prize in age 60 s	2.569†	2.267	1.898	1.825	1.324
	(1.427)	(1.466)	(1.465)	(1.472)	(1.53)
Age of first major award	−.2512***	−.2498***	−.241***	−.1892**	−.1568*
	(.0666)	(.067)	(.0668)	(.07)	(.0714)
Nobel prize in physics		.6006	.5657	1.295	1.329
		(1.443)	(1.438)	(1.442)	(1.445)
Nobel prize in chemistry		−2.382	−2.375	−1.145	−.9632
		(1.573)	(1.562)	(1.635)	(1.612)
Theoretical		−1.06	−1.092	−1.51	−.8278
		(1.48)	(1.465)	(1.485)	(1.491)
Female			−9.764**	−9.987*	−10.41**
			(3.437)	(4)	(4.014)
Death by radiation				−6.108	−7.056
				(5.784)	(5.855)
Died during WWI				−6.841***	−9.08***
				(1.704)	(2.402)
Died during WWII				−1.153	.0207
				(2.145)	(2.674)
Suicide				4.15	3.083
				(4.885)	(5.394)
Fraction of prize won				.966	81.46
				(74.69)	(76.18)
Total real prize value				−4.541	2.122
				(3.778)	(4.318)
Prize money received				−.2967	−5.572
				(4.928)	(5.01)
Constant	15.63***	16.42***	16.38***	84.71	−31.66
	(3.121)	(3.15)	(3.148)	(56.8)	(67.78)
Birth cohort FE	No	No	No	No	Yes
N	303	303	303	303	303
R^2	0.0462	0.0608	0.0769	0.148	0.219
Adj. R^2	0.0334	0.0385	0.0518	0.103	0.149

Reference group: Laureates who received the Nobel Prize during their 50 s; Nobel Prize in Physiology/Medicine. Robust standard errors are in parentheses. †$p < .10$; *$p < .05$; **$p < .01$; ***$p < .001$

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Declarations

Conflict of interest The second author, Benno Torgler, is a member of the Distinguished Reviewers Board for *Scientometrics*.

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