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Dare to know! The existential costs of a faith in science

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ABSTRACT

We explored the differing dimensions of science beliefs and how they relate to existential benefits such as meaning in life and feelings of significance. Across two studies involving American adults and American STEM workers ($N = 1001$), scientism and scientific reductionism were negatively associated with existential benefits. In contrast, optimism towards science was positively associated with existential benefits. Our findings suggest that a dogmatic view of science does not serve as a substitute for the meaning and significance that religion often provides. The results also highlight the importance of treating faith in science as a multi-dimensional construct.

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The Enlightenment was a period of dramatic change in the ways that people related to their worlds. Whereas previous generations often turned to divine explanations, during the Enlightenment the world began to be perceived as a rational and predictable place, with an increased focus on science as an explanatory tool (e.g. Pinker, 2018). These trends of increasing secularization continue to this day. In several countries, such as China, Estonia, Japan, and the Czech Republic, non-religious people are now in the majority (World Population Review, 2022). Even in the US, the most religious of major industrialized countries (Fahmy, 2018), people are turning away from God at an accelerating rate (Pew, 2015). The proportion of American adults who described themselves as atheist, agnostic or 'nothing in particular', increased from 17% in 2009 to 26% in 2019, with particularly high rates of disbelief among the youngest generations (Pew, 2019). While an increased faith in science has undeniably helped people to better understand the world around them, it's less clear whether it has helped people to better understand their own existence. In 1784, Immanuel Kant declared the Enlightenment's motto to be 'Dare to know!' Implicit in this proclamation is the idea that something was at risk when one turned to science to understand the world. We question here whether what is jeopardized by a faith in science is one's sense of meaning in life.

Meaning in life has been defined as 'the sense made of, and significance felt regarding, the nature of one's being and existence' (Steger et al., 2006, pp. 81). A converging set of findings has revealed that meaning in life consists of three related facets: First, belief that one's life has coherence – the various beliefs about oneself all relate to each other in expected and internally-consistent ways (Martela & Steger, 2016). Second, people feel that their lives are guided by a clear sense of purpose; they feel there are clear and important reasons for why they do what they do (Martela & Steger, 2016). Third, people feel that they matter; people who feel that their lives are significant and make a difference derive a clear sense of meaning (Costin & Vignoles, 2020). Whether one feels a sense of meaning in life is of much consequence, as it is positively associated with life satisfaction, self-esteem, and physical health, and is negatively associated with depression and mortality (Krause, 2009; Steger et al., 2006, 2009). As such, it is important to understand what drives a sense of meaning.

People in all cultures turn to religious beliefs to make sense of their worlds (Brown, 1991), and religious faith is one of the more reliable predictors of a meaningful life (e.g. Hood et al., 2018; Stroope et al., 2013). For example, Oishi and Diener (2014) found that while people in poorer nations tended to report more meaning in life than those in wealthier nations, this difference was mediated by religiosity; that is, people in poorer countries had more meaning in life because of their higher religiosity. There are several reasons why religion may be linked with greater meaning. First, religiosity may increase meaning in life by allowing people to attribute

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greater significance to their suffering (e.g. Frankl, 1959; Prinzing et al., 2021; Stephens et al., 2013). In addition, religions tend to provide the existentially comforting belief of the immortality of the soul (e.g. Laurin & Kay, 2017). Furthermore, religion provides a framework that imposes structure on an otherwise chaotic and random world (Hood et al., 2018; Laurin & Kay, 2017), which allows individuals to better make sense of their lives and their place in the universe. As such, the increased sense of coherence offered by religion may be partly responsible for its association with meaning in life. Overall, there are many ways in which religiosity and a belief in God can contribute to an increased feeling that one's life is meaningful (but see Vail & Soenke, 2018).

Similar to religions, science can provide an overarching structure for making sense of the world around us (Laurin & Kay, 2017; Rutjens & Preston, 2020), which can contribute to a sense of meaning. As Edward O. Wilson (1999, p. 7) put it, 'Preferring a search for objective reality over revelation is another way of satisfying religious hunger'. Worldviews can be conceived of as a set of complex representations that relate to big questions, such as 'What exists?' and 'What is real?' and they afford a process of continuous questioning and revising of information (Droogers, 2014). On this account, science and atheism can be conceived of as worldviews – similar to religious worldviews – as they make claims about reality (e.g. 'the earth is 4.5 billion years old') and provide answers to big questions (e.g. 'try to maximize pleasure for the largest number of people' (Taves et al., 2018). Scientific explanations may also provide existential comfort because they can reduce feelings of uncertainty by making the world appear to be more predictable (e.g. Rutjens et al., 2010, 2013).

Of course, there is more than one dimension along which people could endorse a scientific worldview. Arguably the most dogmatic form of a scientific worldview is scientism. While there are many definitions of scientism (Boudry & Pigliucci, 2017), a common definition is an excessive belief that science can answer all forms of questions (e.g. including moral and philosophical questions), and that the only valid form of knowledge is a scientific one (Blackford, 2017). Related to scientism is a tendency to explain all religious or mystical phenomena in decidedly scientific terms (e.g. reductionism). Scientism and scientific reductionism seem to be particularly at odds with religious worldviews, given that they leave little room for explanations not perceived as being grounded in scientific reasoning. Indeed, recent research has found that people believe the conflict between religion and science is at its greatest within the domain of 'explanations' (e.g. explaining the origins of human life, natural disasters, or why people get sick; Leicht et al., 2021). Even though science cannot definitively answer existential questions such as what happens after death, the most extreme versions of scientism and reductionism do not believe that other, non-scientific or non-material perspectives have anything to offer. For this reason, these science beliefs may not provide existential benefits akin to that provided by religion. That being said, scientism may provide a sense of coherence, because such a worldview offers a strong explanatory framework for the nature of reality, even if such explanations may not be particularly existentially comforting.

An additional component of a scientific worldview that is less concerned with explanation is simply optimism towards science. Although many people may not think science can answer *all* the questions about the world and our place in it (i.e. scientism), they may still believe that scientific progress is of much value. For example, many people may take existential comfort in the fact that science is allowing our species to overcome various challenges, such as developing the COVID vaccines in a record time, and searching for ways to combat climate change. Such beliefs may provide feelings of meaning, purpose, and significance because people view human scientific progress as a net positive and see themselves as part of a larger whole that is exerting a positive influence on the world. In contrast, a lack of optimism towards science may have existential consequences because viewing scientific progress as a blight on the world may be associated with existential distress (e.g. 'eco-anxiety'; Passmore et al., 2023).

The present research

Given that it thus remains unclear whether science can provide existential relief – if at all – here we sought to investigate whether science beliefs were associated with a sense of meaning in life. We employed three previously used scales of science beliefs and factor analyzed them to identify an underlying structure of science beliefs (see SOM for the development of the measure). This resulted in three underlying dimensions of science belief which we term scientism, scientific optimism, and scientific reductionism. These three subscales are part of a measure we developed which we refer to as the Multi-dimensional Science Beliefs Scale. We then investigated the relationship between these three constructs and meaning in life in a sample of American Prolific users (Study 1) and a sample of American Prolific users who work in science, technology, engineer, or math (STEM) fields (Study 2). All studies received ethical approval from the University

of British Columbia (H19–02527) and all participants provided informed consent.

Study 1

Method

Participants

A total of 521 US Prolific participants completed the study. Of these participants, 20 were removed for failing an attention check, resulting in a final sample of 501 participants (age: $M = 36.35$; $SD = 13.24$; 59% women). This sample size gave us 80% power to detect correlations of $r = .12$ or greater.

Measures

Demographic variables

Participants answered a variety of demographic measures such as their age, gender and ethnicity.

Political orientation

We used two items ('What is your political orientation on social issues?' and 'What is your political orientation on economic issues?'; α = .89) on a scale from 1 ('Very liberal') to 7 ('Very conservative'). Participant's responses on the items were averaged.

Religiosity

We included 4 separate measures of religious faith/spirituality (Gervais & Norenzayan, 2012; Kaur et al., 2017; see the full list of measures at https://tinyurl.com/4hh2a7dr). For the analyses presented here, we use a 3-item measure of religiosity. This measure included items such as 'I believe in God', with response options ranging from 1 ('Strongly disagree') to 6 ('Strongly agree'; α = .91).

We present the results of our analyses using a composite of all four measures in the SOM. The results of this analysis are essentially identical to the results we present here with the 3-item measure of religiosity. We chose to use the three-item measure of religiosity, because the regression with the composite of all four items resulted in extremely high multicollinearity (e.g. variance inflation factors [VIF] > 40), whereas using the 3-item measure did not result in similar multicollinearity problems.

Science beliefs

We included three separate measures of scientific beliefs, which we combined in a new measure. A 6-item Positive Science Attitudes scale (McPhetres et al., 2018), a 5-item Faith in Science scale (Farias et al., 2013; Rutjens et al., 2018), and a 9-item Anti-Science Beliefs scale (Carey, 2012). Because these individual scales had much conceptual overlap, we conducted an exploratory factor-analysis of this initial set of items that resulted in a 3-factor measure of science beliefs (see SOM for more details on how we factor-analyzed the scale and reduced the number of items). We called the first factor scientism, which consisted of 4-items measuring the extent to which participants privileged scientific knowledge over other forms of knowledge (e.g. 'The only real kind of knowledge we can have is scientific knowledge'.; α = .88). We called the second factor scientific optimism, which consisted of 4-items measuring the extent to which people think science is making a positive impact on the world (e.g. 'Science and technology are making our lives healthier and easier'.; α = .83). And we called the third factor scientific reductionism, which consisted of 4-items measuring the extent to which people sought to explain religious phenomena in scientific terms (e.g. 'I am comfortable with the idea that the world is just atoms and molecules' α =.80). The scientism and scientific optimism items were measured using a six point scale (1 = 'Strongly disagree' to 6 = 'Strongly agree'), while the scientific reductionism items were measured using a five point scale (1 = 'Strongly disagree' to 5 = 'Strongly agree'. The items of these three factors are presented in Table 1.

Table 1. Factor loadings of EFA for three subscales of multi-dimensional science beliefs scale.

Item	Scientism	Scientific optimism	Scientific Reductionism
Science tells us everything there is to know about what reality consists of.	**0.84**	0.00	−0.04
The scientific method is the only reliable path to knowledge.	**0.92**	−0.01	−0.01
The only real kind of knowledge we can have is scientific knowledge.	**0.84**	−0.06	0.07
Science is the most efficient means of attaining truth.	**0.68**	0.19	0.08
Because of science and technology, there will be more opportunities for the next generation.	−0.07	**0.85**	−0.01
Even if it brings no immediate benefits, scientific research that advances the frontiers of knowledge is necessary and should be supported by the federal government.	0.00	**0.61**	0.19
Science and technology are making our lives healthier and easier.	0.06	**0.79**	0.02
Most scientists want to work on things that make life better for the average person.	0.11	**0.66**	−0.13
There are things in this world too complicated to happen on their own. (R)	−0.05	0.01	**0.75**
Reports of so-called "near-death experiences" don't prove there is an afterlife.	−0.03	0.02	**0.69**
I believe there is something beyond this material universe. (R)	0.09	−0.04	**0.75**
I am comfortable with the idea that the world is just atoms and molecules.	0.18	0.07	**0.52**

We conducted a confirmatory factor analysis of this 3-factor structure in Study 2. We used these three factors in our investigation of the relations between science beliefs and meaning in life. We refer to this final measure as the Multi-dimensional Science Beliefs Scale, and the final 12-items and their respective subscale can be found in Table S2 in the SOM.

Meaning in life

Participants completed the 16-item Multi-dimensional Meaning in Life scale (Costin & Vignoles, 2020).[1] This previously validated multi-dimensional scale consists of an overall meaning in life subscale (α=.92), as well as three subscales corresponding to each of its three facets: significance (e.g. 'Even considering how big the universe is, I can say that my life matters'; α = .88), purpose (e.g. 'I have certain life goals that compel me to keep going'; α = .90), and coherence (e.g. 'I can make sense of the things that happen in my life'; α = .84). Participants responded using a scale from 1 ('Strongly disagree') to 7 ('Strongly agree').

Search for meaning in life

We included the 5-item Search subscale of the MLQ (α = .95; Steger et al., 2006). Participants indicated their agreement with statements such as 'I am searching for meaning in my life'. (1 = 'Absolutely untrue' to 7 = 'Absolutely true').

We also included some other measures that are not relevant to this investigation. The full set of the measures included in the survey is available on the OSF at: https://tinyurl.com/4hh2a7dr.

Results

Exploratory factor analysis

We detail the validation of our three-factor measure of science beliefs in the SOM. However, we present a brief overview of the development and exploratory factor analysis here. We began with items from three previous measures (Carey, 2012; Farias et al., 2013; McPhetres et al., 2018; Rutjens et al., 2018) purporting to measure people's beliefs about science. Because there was much conceptual overlap with the different scales we conducted an initial factor analysis of the 20-items which yielded a three-factor solution. However, there was substantial crossloading and we wanted to narrow down the item pool to increase model fit. As such, we narrowed down the initial 20-item pool to a smaller subset of 12 items (based on face validity and the results of the initial 20-item EFA) that appeared to be measuring the three unique constructs. An EFA of just these 12-items revealed they were tapping into 3 distinct constructs, which we refer to as 'scientism', 'scientific optimism', and 'scientific reductionism' (see Table 1). We created composite scores of these three factors by taking the mean score of the four items that primarily loaded onto each factor. These composite scores were then used as predictors in our regression analyses below. In Study 2 we conducted a confirmatory factor analysis of this structure. We note that these analyses were conducted after the data from the original 20-items were already collected. The analyses reported below as such should be considered exploratory.

Regression analyses

First, we summarize the correlations between the different measures in Table 2. Scientism was significantly negatively associated with meaning in life, $r = -.22$, $p < .001$, 95% CI = [−.30, −.14], significance, $r = -.31$, $p < .001$, 95% CI = [−.39, −.23], and purpose, $r = -.10$, $p = .02$, 95% CI = [−.19, −.02], but not with coherence, $r = -.07$, $p = .12$, 95% CI = [−.16, .02]. Likewise, scientific reductionism was significantly negatively associated with meaning, $r = -.19$, $p < .001$, 95% CI = [−.27, −.10] and significance, $r = -.40$, $p < .001$, 95% CI = [−.47, −.33]. However, there was no significant relationship between scientific reductionism and purpose, $r = -.04$, $p = .40$, 95% CI = [−.12, .05] or coherence, $r = .01$, $p = .85$, 95% CI = [−.08, .10]. In contrast, scientific optimism was significantly positively correlated with meaning,

Table 2. Correlations between variables of interest (Study 1).

	M (SD)	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.
1. Scientism (scale: 1–6)	3.65 (1.26)	1.00									
2. Scientific Optimism (scale: 1–6)	4.85 (0.80)	0.42[c]	1.00								
3. Scientific Reductionism (scale: 1–5)	2.91 (0.94)	0.61[c]	0.29[c]	1.00							
4. Religious faith (scale: 1–6)	3.71 (1.71)	−0.54[c]	−0.27[c]	−0.76[c]	1.00						
5. Conservatism (scale: 1–7)	3.20 (1.69)	−0.33[c]	−0.35[c]	−0.35[c]	0.44[c]	1.00					
6. Meaning in life (scale: 1–7)	5.23 (1.41)	−0.22[c]	0.12[b]	−0.19[c]	0.24[c]	0.13[b]	1.00				
7. Significance (scale: 1–7)	4.43 (1.58)	−0.31[c]	−0.03	−0.40[c]	0.42[c]	0.25[c]	0.77[c]	1.00			
8. Coherence (scale: 1–7)	4.77 (1.22)	−0.07	0.15[c]	0.01	0.07	0.11[b]	0.72[c]	0.53[c]	1.00		
9. Purpose (scale: 1–7)	5.04 (1.42)	−0.10[a]	0.17[c]	−0.04	0.09[a]	0.10[a]	0.78[c]	0.56[c]	0.74[c]	1.00	
10. Search for meaning (scale: 1–7)	4.62 (1.48)	−0.07	0.00	−0.25[c]	0.20[c]	0.02	−0.06	0.00	−0.21	−0.09	1.00

[a]= <.05; [b]= <.01; [c]= <.001.

$r = .12$, $p = .009$, 95% CI = [.03, .20], purpose, $r = .17$, $p < .001$, 95% CI = [.09, .26], and coherence, $r = .15$, $p < .001$, 95% CI = [.07, .24]. There was no significant association between scientific optimism and significance, $r = -.03$, $p = .53$, 95% CI = [−.12, .06].

Given that we sought to investigate the unique association between our three science beliefs constructs and meaning in life, we conducted a series of multiple regressions with scientism, scientific optimism, and scientific reductionism as predictors and one of meaning in life, significance, purpose and coherence as the outcome variable. Additionally, we included conservatism and religiosity as covariates, given that these constructs' already established relationship to meaning in life (e.g. Hood et al., 2018; Newman et al., 2019). Thus, we conducted 4 regressions in total. Multicollinearity was not an issue for any of predictors in the regression models, as the maximum VIF for any of the five predictors was 2.01.

The detailed results of these regressions are found in Table 3. Controlling for the other variables, scientism was significantly negatively associated with meaning in life, significance, purpose, and coherence. Scientific optimism, on the other hand, was significantly positively associated with meaning in life, significance, purpose, and coherence. Scientific reductionism was significantly negatively associated with significance and positively associated with coherence. It was not, however, significantly related to meaning in life and purpose, perhaps because of the construct's close relationship with religious faith, which was also a predictor in the model.

Study 1 discussion

Study 1 revealed that the three dimensions of science beliefs were related to existential benefits in varying ways. This was especially the case with scientism and scientific optimism. While scientism was negatively associated with all of our existential outcome variables, scientific optimism was actually strongly positively associated with meaning in life, significance, purpose and coherence. These associations held while controlling for religious faith and conservatism. Thus, it appears that dogmatic beliefs about the explanatory power of science are associated with perceptions that life is less meaningful, whereas being optimistic about the benefits of science and technology is positively associated with existential benefits. In other words, the way science is framed in terms of how it can improve people's lives may lead to positive associations with meaning in life (also see Rutjens et al., 2016), while focusing on how science provides answers to existential questions is related to lower meaning in life. Another possibility is that the latter may be perceived as science infringing on what many believe is religious territory (e.g. science and religion are perceived as in conflict or as non-overlapping magisteria; Gould, 1999; Rutjens & Preston, 2020).

Study 2

The results of Study 1 indicated that some beliefs about science are at odds with having meaning in life. However, these negative associations may be because the participants in Study 1 did not identify strongly with science (e.g. Većkalov et al., 2024). To the extent that it is not a large part of one's life, one may see science as colder, rational, and less beautiful or poetic in comparison with someone who closely identifies and concerns themselves with science. Thus, it seems possible that these science beliefs would be more likely to be positively associated with meaning in life among people who have dedicated their careers to science, namely scientists and people who work in science, technology, engineering, and math (STEM) related fields. To investigate this possibility, in Study 2, we sought to conduct a replication of Study 1 with a sample of participants who exclusively worked in STEM-oriented fields. Additionally, we conducted a confirmatory factor analysis (CFA) testing the proposed three-factor structure of our science beliefs items from Study 1. The detailed results of the CFA are provided in the SOM, though we briefly highlight the findings below.

Method

Participants

We recruited 517 US participants from Prolific Academic. To be eligible for participation, the participants must have responded to the Prolific pre-screen questionnaire question 'Which of the following best describes the sector you primarily work in?' with the answer 'Science, technology, engineering and mathematics'. After removing 17 participants for failing the attention check, our final sample consisted of 500 participants (age: $M = 30.89$, $SD = 9.75$; 54% female). As in Study 1, this gave us 80% power to detect $r = .12$.

Measures

The measures used in our analyses were identical to that of Study 1, except we also included the 6-item Life Orientation Test – Revised (Scheier et al., 1994) as a measure of general optimism. The measure includes items such as, 'I'm always optimistic about my future', with response options ranging from 1 ('Disagree a lot') to 5 ('Agree a lot'). We included this measure to assess how highly correlated our measure of scientific optimism was with general optimism, but they were essentially

Table 3. Regression results, Study 1.

	Meaning in Life				Significance				Purpose				Coherence			
Predictors	*B*	*95% CI*	*t*	*p*	*B*	*95% CI*	*t*	*p*	*B*	*95% CI*	*t*	*p*	*B*	*95% CI*	*t*	*p*
Scientism	−0.25	−0.36 – −0.13	−4.35	**<.001**	−0.12	−0.22 – −0.01	−2.16	**.031**	−0.21	−0.33 – −0.10	−3.68	**<.001**	−0.18	−0.29 – −0.06	−3.07	**.002**
Scientific Optimism	0.28	0.19–0.37	5.90	**<.001**	0.17	0.08–0.26	3.75	**<.001**	0.30	0.20–0.39	6.05	**<.001**	0.26	0.17–0.36	5.37	**<.001**
Scientific Reductionism	0.05	−0.09–0.18	0.65	.516	−0.18	−0.31 – −0.05	−2.72	**.007**	0.11	−0.03–0.25	1.50	.135	0.18	0.04–0.33	2.56	**.011**
Religious faith	0.18	0.04–0.31	2.60	**.009**	0.22	0.09–0.34	3.35	**.001**	0.08	−0.06–0.22	1.15	.251	0.12	−0.02–0.26	1.67	.096
Conservatism	0.09	−0.01–0.18	1.81	.070	0.12	0.03–0.21	2.55	**.011**	0.13	0.03–0.23	2.64	**.008**	0.15	0.06–0.25	3.09	**.002**
Observations			497				497				497				497	
R^2 adjusted			.124				.218				.080				.071	

uncorrelated (see Table 4). We only included the same 3-item measure of religiosity as in Study 1 but did not include the additional religiosity measures. As such, we do not have additional regression analyses for Study in the SOM (as we did not have additional religiosity measures). The complete set of measures included in Study 2 is available at: https://tinyurl.com/4hh2a7dr.

Results

Confirmatory factor analysis

The CFA of our three-factor model uncovered in Study 1 suggested our model was a good fit for the data (RMSEA = .074 and CFI = .940). The chi-square test was significant, $\chi^2(50) = 185.46$, $p < .001$, but this is unsurprising given our relatively large sample size (see SOM for detailed results of the CFA).

Regression analyses

The correlations between our variables of interest are presented in Table 4. As in Study 1, scientism was negatively associated with meaning in life, $r = -.10$, $p = .02$, 95% CI = [−.19, −.02] and significance, $r = -.24$, $p < .001$, 95% CI = [−.32, −.15], and not associated with coherence, $r = -.00$, $p = .97$, 95% CI = [−.09, .09]. In contrast to Study 1, scientism was not significantly associated with purpose, $r = .04$, $p = .40$, 95% CI = [−.05, .13]. Similar to Study 1, scientific reductionism was significantly negatively associated with meaning in life, $r = -.22$, $p < .001$, 95% CI = [−.31, −.14], significance, $r = -.43$, $p < .001$, 95% CI = [−.50, −.35], but not significantly associated with purpose, $r = -.04$, $p = .32$, 95% CI = [−.13, .04] or coherence $r = 0.00$, $p = .94$, 95% CI = [−.09, .08]. Finally, scientific optimism was positively associated with meaning in life, $r = .09$, $p = .04$, 95% CI = [.00, .18], purpose, $r = .14$, $p = .002$, 95% CI = [.0522], and coherence, $r = .12$, $p = .01$, 95% CI = [.03, .20]. Surprisingly, however, scientific optimism was significantly negatively associated with significance, $r = -.11$, $p = .01$, 95% CI = [−.20, −.03].

As in Study 1, we conducted regression analyses with our three science beliefs constructs predicting the meaning in life variables, with religiosity and political orientation included as covariates. Multicollinearity was again not a problem for any of the predictors in the model (maximum VIF = 2.80). As seen in Table 5, in our sample of STEM workers, scientism no longer negatively predicted meaning in life, significance, purpose or coherence. However, scientific optimism significantly predicted meaning in life, purpose, and coherence. Unlike Study 1, however, scientific optimism was no longer significantly positively associated with

Table 4. Correlations (Study 2, full sample).

	M (SD)	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.
1. Scientism (α = .85; scale: 1–6)	3.81 (1.11)	1										
2. Scientific Optimism (α = .74; scale: 1–6)	4.99 (0.75)	0.38[c]	1									
3. Scientific Reductionism (α = .80; scale: 1–5)	3.18 (0.95)	0.47[c]	0.31[c]	1								
4. Religious faith (α = .95; scale: 1–6)	3.42 (1.73)	−0.45[c]	−0.24[c]	−0.78[c]	1							
5. Conservatism (α = .88; scale: 1–7)	2.85 (1.54)	−0.19[c]	−0.26[c]	−0.41[c]	0.41[c]	1						
6. Meaning in life (α = .89; scale: 1–7)	5.29 (1.25)	−0.10[a]	0.09[a]	−0.22[c]	0.31[c]	0.14[b]	1					
7. Significance (α = .86; scale: 1–7)	4.22 (1.50)	−0.24[c]	−0.11[b]	−0.43[c]	0.44[c]	0.22[c]	0.66[c]	1				
8. Coherence (α = .73; scale: 1–7)	4.91 (1.02)	0.00	0.12[a]	0.00	0.09	0.10[a]	0.59[c]	0.34[c]	1			
9. Purpose (α = .85; scale: 1–7)	5.24 (1.20)	0.04	0.14[b]	−0.04	0.15[b]	0.14[b]	0.68[c]	0.43[c]	0.61[c]	1		
10. Search for meaning (α = .94; scale 1–7)	4.73 (1.38)	−0.05	0.04	−0.22[c]	0.16[c]	−0.07	−0.01	0.09[a]	−0.16[c]	−0.09[a]	1	
11. General Optimism (α = .85; scale 1–5)	3.41 (0.84)	−0.09[a]	0.08	−0.06	0.11[a]	0.09	0.51[c]	0.37[c]	0.44[c]	0.45[c]	−0.10	1

[a]=<.05; [b]=<.01; [c]= <.001.

significance. As in Study 1, scientific reductionism significantly negatively predicted significance, but positively predicted coherence.

Study 2 discussion

In Study 2, we again found that scientism tended to be significantly negatively associated with existential beliefs regarding a meaningful life, even for those people working in science-adjacent fields. We also found that scientific optimism was again significantly positively associated with these same existential benefits except for significance. After controlling for the other science beliefs and religiosity and conservatism, however, scientism was no longer significantly associated with any of the existential beliefs. Scientific optimism, on the other hand, remained a significant positive predictor meaning in life, purpose and coherence. As in Study 1, scientific reductionism was negatively associated with significance, but positively associated with coherence.

Thus, this study suggests that even for people who work in STEM fields, viewing science as the ultimate explanatory tool (i.e. scientism and scientific reductionism) is negatively associated with existential benefits regarding a meaningful life. However, the results also again suggest that positive views towards science outside of a purely explanatory domain (i.e. scientific optimism) are significantly predictive of existential comforts. Thus, believing science is the only explanatory tool is existentially detrimental, but believing that science provides positive outcomes is associated with existential benefits.

General discussion

One of the most enthusiastic champions of science, Richard Dawkins, wrote 'The feeling of awed wonder that science can give us is one of the highest experiences of which the human psyche is capable . . . It is truly one of the things that makes life worth living' (Dawkins, 2000, p. xii). While we share his enthusiasm for the knowledge that science provides, the present results add important nuance to this idea. Across two studies of STEM workers and the general public, we found evidence suggesting that some aspects of science beliefs (i.e. scientism and reductionism) are not associated with existential benefits (with the exception that reductionism may predict a sense of coherence), while other types of science beliefs (i.e. scientific optimism) are strongly positively related to existential benefits. Thus, the dogmatic views towards science characterized by scientism and scientific reductionism are not associated with the same existential benefits that tend to be strongly associated with religious belief (e.g. Hood et al., 2018; Oishi & Diener, 2014; Stroope et al., 2013). While optimism towards science is associated with existential benefits such as meaning in life, our results suggest that a belief in science as a means of obtaining truth is associated with existential discomfort. Even when controlling for religiosity and conservatism, scientism and scientific reductionism were either no longer associated with meaning in life or significance, or still negatively associated. Indeed, even in Study 2 which consisted solely of individuals working in STEM-related fields, scientism was never positively associated with any existential benefits in any of our analyses, whereas scientific reductionism was only positively associated with feelings of coherence.

But why are scientism and scientific reductionism not associated with the same feelings of meaning and significance as religion? While science undoubtedly provides a structure for making sense of the world and our place in it (Laurin & Kay, 2017; Rutjens & Preston, 2020), this structure likely fails to provide the existential comforts that are associated with religious belief. Indeed, scientism and reductionism represent a rejection of religious or spiritual explanations, and as such, it is unlikely such worldviews will be able to provide answers to existential questions such as 'why are we here?' Thus, at best, these components of science belief have no answers with respect to the largest of existential

Table 5. Regression results of Study 2 (full sample).

	Meaning in Life				Significance				Purpose				Coherence			
Predictors	*B*	*95% CI*	*t*	*p*	*B*	*95% CI*	*t*	*p*	*B*	*95% CI*	*t*	*p*	*B*	*95% CI*	*t*	*p*
Scientism	−0.02	−0.12–0.08	−0.46	.647	−0.02	−0.12–0.07	−0.47	.635	0.05	−0.06–0.15	0.88	.379	−0.02	−0.13–0.08	−0.46	.645
Scientific optimism	0.19	0.10–0.28	4.05	**<.001**	0.03	−0.06–0.12	0.66	.513	0.18	0.08–0.27	3.65	**<.001**	0.15	0.05–0.25	3.08	**.002**
Scientific Reductionism	−0.00	−0.14–0.14	−0.00	.998	−0.20	−0.33 – −0.07	−3.03	**.003**	0.14	−0.00–0.28	1.92	.055	0.16	0.02–0.31	2.19	**.029**
Religious faith	0.32	0.18–0.45	4.55	**<.001**	0.27	0.14–0.40	4.06	**<.001**	0.26	0.12–0.40	3.60	**<.001**	0.19	0.05–0.34	2.68	**.008**
Conservatism	0.05	−0.04–0.15	1.15	0.250	0.03	−0.06–0.12	0.59	.553	0.15	0.05–0.25	3.04	**.002**	0.13	0.03–0.22	2.53	**.012**
Observations	497				497				497				497			
Adjusted R^2	.116				.204				.069				.038			

questions, and at worst, they provide answers that may be actively existentially distressing (i.e. that there is no 'deeper' meaning to life). The explanations offered by religion are also typically in line with people's intuitions (Norenzayan, 2013), while the explanations offered by science may run counter to intuition; thus, it may be more effortful to acquire a scientific than a religious worldview in the first place (McCauley, 2011). Religious belief suggests that one is connected with God, which can provide a sense of significance (e.g. Prinzing et al., 2021; Stephens et al., 2013). In contrast, findings from sciences such as astronomy consistently challenge 'our posturings, our imagined self-importance, [and] the delusion that we have some privileged position in the Universe' (Sagan, 1997, pp. 7). Of course, it is conceivable that some people could derive meaning from a dogmatically scientific worldview, yet our results suggest that, on average, such a worldview is not associated with similar benefits as a religious worldview. It is worth noting, however, that the negative relationship between scientism and meaning, significance, and purpose was descriptively smaller in our sample of STEM workers. This difference does hint that strong scientific worldviews such as scientism may be less existentially hampering, when one identifies with science more closely (e.g. by working in a science-related field).

Past research has demonstrated that people tend to find comfort in science when faced with uncertainty (Rutjens et al., 2010, 2013). This suggests that science may provide people with feelings of a sense of order, which is one benefit that has also been attributed to religion (Hood et al., 2018; Laurin & Kay, 2017). Yet, scientism and scientific reductionism were not significantly correlated with coherence in either study and reductionism was only weakly, albeit positively, associated with coherence after controlling for other variables. Such weak relationships might be due to the construct of coherence, and its focus on how people understand their *own* lives. Indeed, Martela and Steger (2016) defined coherence as 'a sense of comprehensibility and one's life making sense' (pp. 531). Likewise, the measure of coherence used in the present studies asks participants to indicate their agreement with statements such as 'I can make sense of the things that happen in my life' (Costin & Vignoles, 2020). In this sense, it is not surprising that neither scientism nor reductionism had a strong positive relationship with coherence, because they fail to provide personalized explanations that provide structure to the narrative of one's own life. In other words, a Darwinian worldview may help to explain the colorful plumage of the birds in our backyard, but it struggles to provide a comforting explanation for why we just lost a loved one.

A similar line of reasoning can explain why scientism and scientific reductionism were either negatively associated with, or not at all associated with, purpose in life. Although it is conceivable that beliefs regarding scientism and scientific reductionism could be related to people feeling a purpose to try to use the scientific method to answer open questions, our results do not suggest this is the case. Even among our sample of STEM workers, these constructs were not positively associated with purpose. This may also be due to purpose being an inherently self-focused construct – a 'direction in life' (Martela & Steger, 2016, pp. 531) – that overly scientific worldviews have nothing to offer, even among people who work in science-related fields.

In contrast to scientism and scientific reductionism, however, scientific optimism was consistently positively associated with purpose, meaning in life, and coherence in both studies. Viewing what is arguably humanity's largest project (scientific/technological progress) in a positive manner may be more existentially comforting because one can see themselves as a part of a larger whole that is helping humanity reach its full potential. Thus, a more positive view of progress may also be reflected in a more positive outlook on one's own life, which could explain the positive association with coherence.

Together, the existential benefits associated with scientific optimism dovetail with past research detailing the benefits of hope and optimism (Hedayati & Khazaei, 2014; Ju et al., 2013; Yalçın & Malkoç, 2015) and falls in line with Rutjens et al. (2010) finding that people are more likely to support increased funding for science when feeling a lack of control. However, our results do seem to contrast with the findings that people increase their faith in science in response to mortality threats (Farias et al., 2013); the lack of an association between scientism, scientific reductionism, and existential benefits would seem at odds with this finding.

It is possible that the existential cost of a strong belief in science might actually contribute to the success of science.[2] It is likely that beliefs that provide existential meaning and in which people are deeply invested, would be less prone to belief updating, which is a crucial element of the scientific process (e.g. paradigm shifts, falsification; Kuhn, 1970; Popper, 1959/2012). As such, an existential investment in science might directly counter the Mertonian norms of disinterestedness and organized skepticism (Merton, 1973; Rutjens et al., 2018) that are crucial for the functioning of science.

Of course, the correlational nature of our findings preclude causal conclusions. There may be potential third variables that underlie the observed relations, such as a preference for intuitive versus analytic thinking (e.g. Pennycook et al., 2015), a preference for mystical thinking (Carey, 2012), or a need for closure (Kruglanski & Webster, 1996). Manipulations of a faith in science or of evidence for God might be able to shed light on these relations, yet it is questionable how well people's worldviews can be manipulated within an experimental paradigm. Our findings do, however, point to the importance of measuring distinct dimensions of science beliefs, as opposed to treating positive attitudes towards science as unidimensional construct. While a simple unidimensional examination may have revealed that faith in science is broadly negatively associated with existential benefits, our analyses revealed the three components of science beliefs were uniquely related to the components of meaning in life. Given the findings presented here, we believe a similar multi-dimensional approach to science beliefs may lead to fruitful results in other domains. For example, it is possible that scientism, scientific reductionism, and scientific optimism have unique relationships with other attitudes, such as vaccine hesitancy, or climate change skepticism, that unidimensional measures of science beliefs may miss.

While we investigated the relationship between science beliefs and existential beliefs in two distinct samples of the general population and workers in STEM-related fields, the present study still relied solely on American samples. It is possible that the tension between science and religion is felt more strongly among Americans than in other cultures. It is unclear whether the same relationships would be uncovered in largely secular countries (e.g. Denmark, Sweden) or in countries with few nonbelievers (e.g. Romania, Pakistan).

Overall, our results suggest that any lost meaning in life that may accompany the falling rates of religion (Pew, 2015, 2019; World Population Review, 2022) will not be replaced by a dogmatic belief in science. Thus, people who de-identify with their religion in favor of a dogmatically scientific worldview may bear existential costs. That being said, individuals who leave their religion for other spiritual pursuits may not pay such a steep existential price (Jettinghoff et al., 2023). Indeed, many individuals who have left their religion still retain habits and beliefs associated with religiosity (e.g. McLaughlin et al., 2022; Van Tongeren et al., 2023), underscoring the fact that scientific and religious worldviews are not mutually exclusive. Moreover, the strong positive association between scientific optimism and existential benefits uncovered here suggests that being pro-science does not automatically entail less meaning. In fact, these results optimistically suggest that a commitment to science as a tool for solving human problems may be a reliable source of meaning in life.

Of course, religion and science are not the only component of a meaningful life; feeling connected to others, feeling productive, and helping others are among the many other correlates of what many refer to as the 'good life' (Baumeister et al., 2013). As such, it is not as though an increasingly secular world will necessarily be an increasingly meaningless one. Nonetheless, our results do suggest that Kant (1784) was right to imply that something was at risk when he declared the Enlightenment's motto to be 'Dare to know!'

Notes

1. Our survey included an exploratory meaning *of* life measure, which asked identical questions to the meaning *in* life measure except the questions referred to life in general (e.g. instead of the item 'My life as a whole has meaning', we used 'Life as a whole has meaning'. Given the high correlation between the meaning in/of life measures ($r = .67$) and the similarity in results, we do not discuss the meaning of life measure in the main text. However, in the SOM we provide the correlations between this scale and the other constructs.
2. The authors thank Dr Will Mason-Wilkes for raising this point.

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Open Practices Statement

The surveys, data, and R code used in Studies 1 and 2 are available on the OSF at: https://tinyurl.com/4hh2a7dr.

Data availability statement

The surveys, data, and R code used in Studies 1 and 2 are available on the OSF at: https://tinyurl.com/4hh2a7dr

Open scholarship

This article has earned the Center for Open Science badges for Open Data, Open Materials and Preregistered. The data and materials are openly accessible at https://tinyurl.com/4hh2a7dr

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