Research Article

# Intelligence and Individual Differences in Astrological Belief

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**Abstract:** Astrology is a theory of individual differences. Owing substantially to the influence of Hans Eysenck, it has been taken seriously and tested scientifically by psychologists, but has nevertheless been found wanting of any predictive validity. Despite its appearance of being a pseudoscientific account of individual differences, astrology has millions of believers; who are they, and why do they believe it? In a sample of 8,553 Americans from the General Social Survey, we undertake a high-powered study of the correlates of astrological belief. Of our psychological measures we find intelligence, as measured with Wordsum, to have the largest effect size, negatively predicting belief in astrology. Education also predicts disbelief, supporting the "superficial knowledge" hypothesis. Measures of religiosity and spirituality had null effects, in contradiction of the "metaphysical uncertainty" hypothesis that a need for metaphysical beliefs causes one to believe in astrology. We find that right-wing individuals are less likely to believe in astrology, in contradiction to Theodore W. Adorno's "authoritarian" of astrology. We also find no effect of scientific trust on astrological belief. Our research highlights how prior hypotheses poorly account for individual differences in astrological belief.

**Keywords:** astrology, intelligence, scientific trust, religiosity, authoritarianism

Astrology is a theory of individual differences. It has been studied across history; in ancient Babylon, the court of Han dynasty China, and in Renaissance Italy by Kepler and Galileo. Astrology is still used today by fortune-tellers, entertainers, and mobile applications. Nevertheless, across all these eras of practice a core dictum of astrology has been that the positions of celestial bodies at birth influence the character of a person. Astrology has an accompanying instrument for estimating individual differences – the horoscope. This is a map of the planets, which when filled in for an individual's birthdate yield classifications of their personality. For example, the horoscope for Psychologist Han Eysenck born on March 4th 1916 reveals that his sun sign is in Pisces, showing him to be empathetic and sensitive (Kent, 2016, p. 69).

Many scientists have dismissed astrology as a pseudoscience at face value (e.g., Rensberger, 1975). Karl Popper (1962, pp. 97–126) famously used astrology as a prime example of a pseudoscience, since he believed that it had no testable predictions. However, Hans Eysenck (1984) pointed out that astrology could make testable predictions regarding personality and character. Taking a different understanding of the term "pseudoscience," Eysenck thought that astrology could only be considered a pseudoscience if its predictions failed. If the predictions proved correct, then positions of celestial bodies could scientifically be considered a principal cause of individual differences alongside genetics, for example.

Eysenck formulated astrological hypotheses and tested them. With co-authors, he found that extraverts were born with odd-numbered Zodiac signs and neurotics were born under water signs (Mayo et al., 1978). Eysenck was far from the first to empirically test astrology. Attacking astrology, Saint Augustine of Hippo (Hipponensis, 426, Book 5, chapter 2–6) anticipated behavioral genetic techniques by noting that twins could be remarkably dissimilar despite being born on the same day, under the same constellations. Nevertheless, Eysenck popularized efforts to empirically test astrology to modern audiences with his co-authored book *Astrology: Science or Superstition?* (Eysenck & Nias, 1982). Although the book regarded most research to be of poor quality, the authors were impressed with the apparent replicability of the "Mars Effect" (Gauqelin, 1955), which showed elite athletes were more likely to be born just after Mars had arisen. Referring to this work in particular, they wrote "while this possibility [that it fails to replicate] must be granted, it does not seem to us at all likely," (Eysenck & Nias, 1982, p. 209) owing to the perceived rigor of Gauqelin's work.

And yet, astrological predictions did fail to replicate. The Mars Effect failed to replicate and Gauqelin's significant results seem to be due to p-hacking, by varying the

definition of eminence post hoc (Kurtz et al., 1997). Eysenck (Eysenck & Nias, 1982, p. 57) himself had already noted that his own results as part of Mayo et al. (1978) may not be robust due to "self-attribution." Individuals who know astrology may be more likely to describe their personality in the directions predicted. Eysenck suggested that many had participated in the study of Mayo et al. (1978) because they already held interest or belief in astrology. Later research would find the result only replicated when subjects were cued with the information that they were participating in a study about astrology and if they already knew about astrology (Pawlik & Buse, 1979; van Rooij, 1994). Most research on astrology had small samples; however, when Hartmann et al. (2006) tested a range of astrological predictions in two samples totaling more than 14,000 people, they failed to find any astrological predictions that were significantly different from chance.

Despite research failing to find robust evidence in support of astrology, the theory remains remarkably popular. In a Pew survey, 29% of Americans report believing in astrology (Gecewicz, 2018). These individuals appear to be somewhat sincere in their belief; as of 2021, one quarter of young women ages 18–25 had downloaded the astrology mobile app Co-Star (Kokalitcheva, 2021). Of those who do not believe astrology, many seem to at least hold interest or sympathy for it. For example, more Americans know their astrological sign (66%) than their blood type (51%) (Quest Diagnostics, 2023).

This all begs the question, in face of all the evidence against astrology, who still believes in astrology and why? Why is this pseudoscientific theory of individual differences so popular? Answering this question of the individual differences causing belief in astrology forms the motivation for our study. We use a large sample of 8,553 Americans in the General Social Survey (GSS) who were surveyed whether they thought astrology was scientific. The sample size provides us with excellent power to test four explanations previously raised in the literature. These hypotheses are named as follows: superficial knowledge, metaphysical unrest, authoritarian, and scientific trust hypotheses. We find evidence that low intelligence and low education are associated with belief in astrology consistent with the superficial knowledge hypothesis and find little support for other hypotheses.

## Hypothesis: Superficial Knowledge

In the preface to his book *Astrology, Science or Superstition?* (Eysenck & Nias, 1982), Eysenck offers one hypothesis for why people believe in astrology. He states, "For them [scientists], it is an ancient superstition that survives only in the minds of suggestible people who lack any knowledge of the scientific methods." In other words, Eysenck suggests the popular prejudice among scientists is that astrology appeals to the unintelligent and uneducated. Bauer and Durant (1997) referred to this idea as the "superficial knowledge" hypothesis, which we adopt here.

There is certainly some evidence supporting the scientists' prejudice. Intelligence correlates negatively with belief in what Pennycook et al. (2015) called "pseudo-profound bullshit" (PPBS), a class of seemingly profound but meaningless statements. Astrology shows obvious resemblance to PPBS. Allum (2011) found that scores on a quiz of scientific knowledge predicted belief astrology is unscientific. Similarly, Bauer and Durant (1997) showed scores on a test of scientific understanding predicted being less likely to believe in astrology. However, in a sample of astronomy students, Sugarman et al. (2011) found no relationship between scientific literacy and belief in astrology. This curious result might be explained by a ceiling effect on their test and range restriction in using a student sample. Andersson et al. (2022) would be the first to use intelligence tests to predict belief in astrology, finding a significant effect ($\beta = -0.15$, $p < .05$), but only in a convenience sample of 264 respondents.

Regarding the effect of education, the National Science Foundation surveyed Americans from 1970 to 2016 about whether they believed astrology to be scientific. As of 2016, 24% of respondents with a bachelor's degree considered astrology "sort of" or "very" scientific (National Science Foundation, 2018). However, this figure rose to 43% among those whose highest level of education was a high school diploma. Similarly, Allum (2011) found a negative correlation between education and belief in astrology in a European survey.

## Hypothesis: Scientific Trust

Although we know scientific knowledge is associated with less belief in astrology, it is unclear whether this is because knowledge and intelligence cause one to believe in astrology or whether it is because some appreciation of science causes one to be skeptical of astrology. In this paper, we also test whether trust in science predicts believing astrology is unscientific. Since scientists have a negative view of astrology, we might expect individuals who do not trust science in general to be less skeptical about astrology in particular. After all, distrust in science is associated with a range of unscientific beliefs such as vaccine skepticism (Sturgis et al., 2021) and conspiracy theories (Vranic et al., 2022).

## Hypothesis: Metaphysical Unrest

Although education and intellect may help protect people from belief in astrology, it does not explain why astrology proves so attractive in the first place. Perhaps people gain

satisfaction from non-scientific or magical beliefs? The philosopher Blaise Pascal (1670) wrote that "What, then, do this avidity and impotence make known to us, if not that there was once in man a true happiness, of which there now remains to him only the mark and the empty mould, which he tries in vain to fill from all that which surrounds him, seeking in absent things the succour which he does not find in present things, which are all incapable of it, because the infinite gulf can be filled only by a being infinite and immutable, that is to say, by God Himself?"

Pascal proposed that humans have a need to believe in the other-worldly, or else they feel empty. In modern times, the phrase God-shaped hole has begun to describe a feeling of restlessness, owing to not having a comforting explanation for the mysteries of life (Chesnut, 2005). Atheists have inverted the phrase pejoratively as "God of the gaps" (Richardson & Bowden, 1983), whereby people believe in god to satisfy the mysteries of the universe not yet explained by science.

Could astrology help fill that God-shaped hole, explaining to believers the mysteries of why individuals differ, and what makes them unique? Bauer and Durant (1997) defined this as the "metaphysical unrest" hypothesis, whereby the more spiritual people, having a greater need for spiritual explanation of the world, are led to astrology. Since religious people are more spiritual, we might also expect them to believe in astrology. On the other hand, religion could act as a substitute for astrology, filling in the God-shaped hole so that astrology is unnecessary. After all, astrology has often been condemned as incompatible with religious beliefs. Martin Luther (1566, sec. DCCXCVIII) spoke on the topic declaring faith and astrology as substitutes, saying, "What is done by God, ought not to be ascribed to the stars."

Results for the metaphysical hypothesis have proven mixed. In a sample of Europeans, Allum (2011) found that belief in God, identification with Catholicism and being spiritual all predicted the belief that astrology was scientific. By contrast, Bauer and Durant (1997) found astrology to be less popular among the less religious, implying the two are competing for the same space. A Pew survey (Gecewicz, 2018) found 29% of Christians believed in astrology, compared to only 3% of Atheists. The religiously unaffiliated however were similar to Christians, with 32% believing in astrology. This suggests that whilst an absolute rejection of the metaphysical, seen in atheists, may reduce astrological belief, the absence of following any religious doctrine may not have an effect.

### Hypothesis: Authoritarian

Adorno et al. (1950) would suppose that there was an authoritarian personality, which they attempted to measure with their F (fascist) scale. The authors designed the scale by using facets which they believed to capture aspects promoted in fascist propaganda, including "authoritarian submission" toward in-group authority figures and "superstition and stereotopy" which capture rigid thinking and belief in predetermined fate. Adorno (1957), after reading an astrology column in the Los Angeles Times, noticed what he believed to be striking similarities between authoritarian personalities and belief in astrology. Both involved a thoughtless act of faith in a self-proclaimed authority figure. The astrologer would make demands of his readers, without any scientific rationale. The certainty of astrology predictions and the clear categories in the Zodiac signs was also reminiscent of rigid thinking.

Adorno's theory would be empirically tested forty years later. In a British sample, Bauer and Durant (1997) found no significant effect of an egalitarianism-authoritarianism scale, but they found a significant effect of social efficacy ($r = -.21$), meaning a sense of control over your life. Allum (2011) found authoritarianism to modestly predict belief that astrology was scientific ($\beta = 0.22$, $p < .001$) in a European survey. Allum controlled for education and scientific knowledge, suggesting the result may not be explained by any confound with intelligence. Nilsson et al. (2019) found political conservatism was associated with receptivity to "psuedo-profound bullshit," which may be in keeping with Adorno's theory since political conservatism is moderately correlated with authoritarianism (Crowson et al., 2005). The published empirical work seems to support Adorno's theory.

A working paper (Lindgren, 2014) used the GSS, the same survey we use, to examine this question. Lindgren finds Republicans to be significantly less likely to believe astrology is scientific. However, without controlling for obvious confounds, such as survey year, race, age, and sex, the result can only be regarded as tentative. Lindgren used only survey data till 2012, since then the number of individuals who answered the item has doubled.

## Methods

### Participants

Data were obtained from the General Social Survey (Davern et al., 2024), which is a national sample of US adults surveyed every 1–2 years since 1972. The GSS uses probability sampling, so its participants are roughly representative of the US population. However, the survey samples households and then only allows one person per household to be interviewed. This means individuals living in larger households are less likely to be selected. To adjust for this, the GSS provides sample weights, which are named WTSSALL.



 

The study sample consisted of $N = 8{,}553$ participants who had a valid response for the astrology item. There were slightly more female than male respondents, with an average for all years of 56.03% female and 43.97% male. 75.11% of participants self-identified as White, 14.94% as Black, and 9.95% as the category of Other. The average age of the sample was 48.06 and the standard deviation was 17.5.

## Measures

The outcome variable of interest is astrological belief, measured by the item "Do you believe astrology is scientific?". Participants could choose one of three answers, *not at all scientific*, *sort of scientific*, and *very scientific*, which we coded as being of value 1, 2, and 3, respectively. This item was given to all participants in the 2008 wave of the GSS, and it was randomly assigned to two-thirds of participants in the following waves: 2006, 2010, 2012, 2014, 2016, and 2018. We use all of these waves. Of the 8,866 participants who were given the item, 23 did not give an answer and 290 could not choose an answer. These individuals were removed from our analyses via listwise deletion. Sample sizes are limited by the Astrology item's overlap with questions from other years. 63.5% of participants believe astrology is not at all scientific, 29.8% say astrology is sort of scientific and 6.7% say astrology is very scientific. In Table 1, we present the percentage of people who believe astrology is scientific, stratified by sex and ethnicity.

Intelligence was measured with Wordsum, a set of 10 questions that range in difficulty. Answers are presented in multiple choice format. The goal of the Wordsum intelligence test is to gauge an individual's ability to match related words. Participants were asked to choose the word most closely related to a target word. Wordsum correlates with other, more complex IQ tests at .8 demonstrating its validity in predicting intelligence (Malhotra et al., 2007; Miner, 1957). Education was operationalized as years in education. This was pre-calculated in the GSS from a series of questions asking the participant what level of education they have completed.

Scientific trust was measured with an one-item question asking participants what their level of confidence was in the scientific community. The options were *hardly any*, *only some*, and *a great deal*, which we coded as 1, 2, and 3, respectively. Higher numbers thus indicated greater trust in science.

Spirituality was measured with the item "To what extent do you consider yourself a spiritual person?" Response options were *not spiritual at all*, *slightly spiritual*, *moderately spiritual*, and *very spiritual* which were coded from 1 to 4 with 4 being most spiritual. Religiosity was measured with an extremely similar question "To what extent do you consider yourself a religious person?" ranging from *not religious at all* to *very religious*, again being coded from 1 to 4.

**Table 1.** Percentage who believe astrology is scientific

| | Percentage who described astrology as | | |
|---|---|---|---|
| Demographic | Not at all scientific | Sort of scientific | Very scientific |
| Sex | | | |
| Female | 59.9% | 33.2% | 6.9% |
| Male | 68.1% | 25.6% | 6.4% |
| Ethnicity | | | |
| White | 68.4% | 26.8% | 4.8% |
| Black | 45.9% | 39.6% | 15.5% |
| Other | 53.0% | 38.1% | 9.9% |

Political views were measured, with one item asking individuals whether they considered themselves to be liberals or conservatives. Options were *extremely liberal*, *liberal*, *slightly liberal*, *moderate*, and then there were parallel options for conservatives. The response was coded from 1 to 7 with 1 = *extremely liberal* and 7 = *extremely conservative*.

Demographic variables included self-reported sex, age, and race for which the options were "White," "Black," or "other." Each of our continuous variables was standardized using the *z*-score transformation, while categorical variables were left unstandardized. Population estimates of means and standard deviations were used in the *z*-score transformation. These were calculated with sampling weights using the *survey* package in R (Lumley, 2010). We give descriptive statistics and correlations among continuous measures in Table 2.

## Regression Analysis

Our main analysis uses multiple regression. We estimate a null model which uses just demographic variables. We then examine each hypothesis individually, testing the putative causes alongside controls for demographic factors which could act as confounders. An additional "kitchen sink" model is used, including all the variables. The explanatory variables may act as confounds of each other, or may be affected by shared confounding factors. For example, it has been suggested that intelligence may cause sociopolitical attitudes (e.g., Edwards et al., 2024). Likewise, attitudes toward religion, science, and liberalism/conservatism might be caused by shared ideological beliefs. Including all the explanatory variables together thus might get us closer to estimating the direct causal effect of each of the variables. Since we are uncertain about what the true causal model is, finding consistent patterns across different combinations of explanatory variables may give us more confidence in the robustness of our results.

As mentioned, the GSS only interviews one person per household. To adjust for the lower probability of sampling

**Table 2.** Descriptive statistics and correlation matrix

| Variable | *M* | *SD* | Miss | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|---|---|---|---|
| 1. Astrology | 1.43 | 0.62 | 3.53% | – | | | | | | |
| 2. Age | 48.00 | 17.50 | 0.34% | −.11** | – | | | | | |
| 3. Wordsum | 6.03 | 1.97 | 2.10% | −.25** | .10** | – | | | | |
| 4. Years of education | 13.70 | 2.97 | 0.14% | −.20** | −.04** | .43** | – | | | |
| 5. Scientific trust | 2.35 | 0.61 | 4.50% | −.06** | −.07** | .16** | .19** | – | | |
| 6. Religiosity | 2.57 | 0.99 | 0.89% | .03* | .22** | −.08** | −.08** | −.14** | – | |
| 7. Spirituality | 2.89 | 0.95 | 1.42% | .03* | .13** | .06** | .05** | −.08** | .54** | – |
| 8. Political views | 4.10 | 1.45 | 3.83% | −.05** | .11** | −.06** | −.08** | −.11** | .25** | .12** |

*Note.* *M* = mean; *SD* = standard deviation; Miss = percentage of participants who did choose not to respond to the item, despite being given it. For simplicity, descriptive statistics are not calculated using sample weights. ***$p < .001$; **$p < .01$; *$p < .05$.



individuals in larger households, we adjust our regressions with sampling weights using the *survey* package in R. The GSS also reports the variance primary sampling unit and variance stratum which allows our standard errors to be corrected for design effects. Since our dependent variable is highly skewed, we expect our errors not to be normally distributed, which would cause the standard errors to be underestimated using ordinary least squares regression. To deal with this problem, we use bootstrapped standard errors, using 200 replicate weights. Further details on how to adjust regression models with sampling weights are given by Lumley (2010).

Another issue with using linear regression, is that we are assuming the explanatory variables are linearly related to the dependent variable, when in fact the relationship maybe non-linear. One approach to better model ordinal data is to use an ordered probit regression. It has been suggested that the use of a linear model in this situation can lead to inflated Type I and Type II errors, and estimates that are of the opposite sign to the true effects on the latent dependent variable (Liddell & Kruschke, 2018). As a test, we re-performed all our regressions using both ordered probit and linear regression, without using sampling weights or bootstrapped standard errors. Across each regression, the *t*-statistics of the parameters from each model type correlated almost perfectly ($R^2 > 0.99$), suggesting it is innocuous to use linear regression in our study. For simplicity, we therefore keep using linear regression.

Listwise deletion was used to remove individuals with missing values. Missing values exist because either the participant was not given the question item, or because they did not give a response. In the former case, this is because not all questions are asked each year and some questions are assigned randomly within years. For these missing observations, it is reasonable to assume the data is missing completely at random. Refusal to answer a survey item, however, may result in selection bias. Table 2 reports the percentage of participants who refused to answer each item. Refusal to respond is lowest for education at 0.14% and highest for scientific trust at 4.50%. Overall non-response is so low, that we need not be concerned with its biasing effects on regression parameters.

## Results

Table 3 presents regression models of whether respondents believe astrology is scientific. Model 1 included only the demographic predictors: sex, race, and age. Age had a small effect size ($\beta = -0.10$, $p < .001$). Being female was associated with increased belief in astrology ($\beta = 0.12$, $p < .001$). Compared to the White participants, Black participants were more likely to believe astrology was scientific ($\beta = 0.51$, $p < .001$), as were individuals in the "other" category ($\beta = 0.26$, $p < .001$).

Model 2 showed education ($\beta = -0.12$, $p < .001$) and Wordsum ($\beta = -0.16$, $p < .001$) to negatively predict belief in astrology, in line with the superficial knowledge hypothesis. The results appear almost identical in model 6 when additional variables were controlled for. Education might cause and be caused by intelligence, making the regression slopes difficult to interpret. It is plausible that the effect of intelligence is mediated by education, meaning model 2 will underestimate the total effect of Wordsum. Although we do not report the full model, we also ran regressions controlling for demographics and either education or Wordsum alone. In these models, Wordsum ($\beta = -0.21$, $p < .001$) and education ($\beta = -0.19$, $p < .001$) had slightly larger effects.

Trust in the scientific community slightly negatively predicted belief in astrology ($\beta = -0.03$, $p = .040$) in model 3, although the effect size was trivial. The effect was not significant in model 6 with the inclusion of additional controls ($\beta = 0.01$, $p = .721$). Overall, the evidence points to scientific trust correlating slightly with belief in astrology, only due to confounding factors. The regression models provided no evidence for the metaphysical unrest hypothesis, with

 

**Table 3.** Regression results

| | Dependent variable: Astrology is scientific | | | | | |
|---|---|---|---|---|---|---|
| Variable | Model 1 | Model 2 | Model 3 | Model 4 | Model 5 | Model 6 |
| Sex (Female) | 0.12*** | 0.16*** | 0.10*** | 0.12*** | 0.12*** | 0.16*** |
| | (0.02) | (0.03) | (0.03) | (0.03) | (0.03) | (0.05) |
| Race | | | | | | |
| Black | 0.51*** | 0.40*** | 0.49*** | 0.50*** | 0.50*** | 0.32*** |
| | (0.04) | (0.05) | (0.05) | (0.04) | (0.04) | (0.05) |
| Other | 0.26*** | 0.12*** | 0.16*** | 0.26*** | 0.27*** | −0.02 |
| | (0.04) | (0.05) | (0.05) | (0.04) | (0.04) | (0.07) |
| Age | −0.10*** | −0.09*** | −0.10*** | −0.10*** | −0.09*** | −0.09*** |
| | (0.01) | (0.01) | (0.02) | (0.01) | (0.01) | (0.02) |
| Wordsum | | −0.16*** | | | | −0.17*** |
| | | (0.02) | | | | (0.03) |
| Education | | −0.12*** | | | | −0.14*** |
| | | (0.02) | | | | (0.02) |
| Scientific Trust | | | −0.03 | | | 0.01 |
| | | | (0.02) | | | (0.02) |
| Religiosity | | | | 0.01 | | −0.04 |
| | | | | (0.02) | | (0.03) |
| Spirituality | | | | 0.01 | | 0.03 |
| | | | | (0.02) | | (0.03) |
| Political views | | | | | −0.02 | −0.04 |
| | | | | | (0.01) | (0.02) |
| $R^2$ | .06 | .10 | .06 | .06 | .06 | .11 |
| Sample size | 8,524 | 5,742 | 5,812 | 8,397 | 8,245 | 3,122 |

*Note.* This table presents OLS regression estimates. Standard errors are in parentheses. Continuous variables are *z*-score transformed using estimates of the population mean and standard deviation. The excluded reference category for Race was White. Omitted from the table are survey year fixed effects, which control for when respondents took the survey. The number above each column labels each model. ***$p < .001$; **$p < .01$; *$p < .05$.



neither religiosity (β = 0.01, $p = .501$) nor spirituality (β = 0.01, $p = .659$) having any significant effect on belief in astrology in model 4. This did not change when other variables were controlled for, either. Political views did not significantly predict belief in astrology (in model 4: β = −0.02, $p = .186$; in model 6: β = −0.04, $p = .126$).

## Discussion

The goal of this study was to test theories of why some individuals believe in astrology. Of the four theories tested, only the superficial knowledge hypothesis performed well, with both intelligence and education predicting belief that astrology is not scientific. This replicated prior work finding intelligence (Andersson et al., 2022), scientific knowledge (Allum, 2011; Bauer & Durant, 1997), and education (National Science Foundation, 2018) predicted lack of belief in astrology. We introduced the hypothesis that trust in science would predict believing that astrology is not scientific, but linear regression suggested it had minimal effect, if any.

We were unable to find evidence supporting the metaphysical unrest hypothesis and the authoritarian hypothesis; neither religiosity nor spirituality were significantly associated with belief that astrology is scientific. This is perhaps unsurprising given the current literature reports conflicting results with Allum (2011) reporting significant positive effects of religious and spiritual beliefs and significant positive effects of authoritarianism, while Bauer and Durant (1997) find negative effects for religious beliefs and no significant effects of authoritarianism. It is probably not worth speculating on the reasons why results have differed for the effect of religiosity and spirituality, since the effect sizes of the prior studies were very small. Allum's effect of belief in God was β = 0.08 ($p = .04$) and Bauer and Durant found religious beliefs correlated at $r = -.10$ with belief in astrology. Such small effects could be caused by any number of minor influences.

The failure to find right-wing beliefs associated with belief in astrology is perhaps more surprising given the strength of the association Allum (2011) found in a European sample between right-wing authoritarianism and belief in astrology (β = −0.22, $p < .001$). One possibility for Allum's results is that European right-wingers are of a different character to the American right-wingers in our study, or the British individuals in Bauer and Durant's (1997).

Another possibility, is that right-wing approximations of authoritarianism, such as the self-identified political views which we use, or the "authoritarianism-egalitarianism"

scale used by Bauer and Durant (1997), have different relationship to astrology. Adorno et al. (1950) in the Authoritarian Personality, implicitly assume authoritarianism to be right-wing, after all their focus was understanding the "potentially fascistic" individual. Since measures of right-wing authoritarianism do correlate strongly with other measures of right-wing ideology, measures of right-wing attitudes might be a suitable proxy for the construct considered by Adorno et al. (1950). However, it is plausible to imagine left-wing authoritarianism as well as right-wing authoritarianism (e.g., Conway et al., 2023). It could be that belief in astrology is only related to uniquely authoritarian characteristics rather than left versus right characteristics. In Adorno's (1957) work highlighting similarities between astrology and authoritarianism, he does not give us reason to suppose the similarities only hold true for right-wing authoritarianism. Use of measures of right-wing and left-wing authoritarianism would be desirable to test the hypothesis more clearly.

## Limitations

A key limitation is the narrowness of our measure of astrological belief. The item asks whether the respondent believes astrology is scientific, not whether they believe in astrology. There could be many people who use it and even believe it without thinking it is scientifically sound. This limitation is not unique to our study. Both Allum (2011) and Bauer and Durant (1997) relied on the same single question regarding whether astrology is scientific. The issue is relevant to interpretation of our results. For example, it is possible that spiritual people believe in astrology because they do not care if it is scientific, or precisely because it is not scientific. Likewise, the same could obviously hold true for people who do not trust science in general. These hypotheses ought to be retested in a sample using a broader range of measures of belief in astrology. Andersson et al. (2022) in their study relating intelligence to astrological belief, used the validated belief in astrology inventory from Chico and Lorenzo-Seva (2006). Although their study used a small sample and ours used a narrow measure of astrological belief, the combined evidence strongly points toward intelligence being related to belief in astrology.

Another issue with measuring belief in astrology is that many people might not know what astrology is. Indeed, they may not know the difference between astrology and astronomy. Allum (2011) found the strongest predictor of believing that astrology is scientific, is believing that astronomy is scientific ($\beta = 0.32$, $p < .01$). By contrast, Allum did not find an effect of believing astronomy is scientific on the believing that horoscopes were scientific, implying many participants were confusing astrology with astronomy but were not confusing horoscopes with astronomy. Allum's findings, however, were robust to using horoscope belief as the dependent variable instead of astrological belief. Future research should use similar logic, testing astrological belief without using the term astrology to avoid confusion.

We used the GSS because it is a very large publicly available survey to use. However, while the measure of astrological belief was limited, so too were the number of hypotheses we could test. Andersson et al. (2022) recently found that agreeable and extraverted people were more likely to believe in astrology. Further research should seek to explore new theories and new variables possibly relevant to astrology.

## Conclusion

Despite the lack of evidence for the validity of astrology, it remains an extremely popular theory of individual differences. Why some people believe in it, and others do not, remains a mystery. While most of the theories we test fail to characterize belief in astrology, we demonstrate in a large study that intelligence and education are good predictors of astrological disbelief. Future research on the question should collect a wider variety of psychological constructs to test and use careful measures of astrological belief.

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