Age, Period, and Cohort Effects in Philosophy Journal Citations

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There are extremely strong age and period effects in citations in philosophy journals. The age effect is that citations are concentrated on articles published two to five years prior. The period effect is that recent years have seen an explosion in the number of articles published, and the number of citations per articles, so many articles are getting more citations per year than they ever had previously. But cohort effects are trickier to detect. In this note I argue that they exist. There are more citations to articles from eras of more dramatic change in philosophy, such as around 1970 and around 2010. And there are fewer citations to articles from periods of consolidation, especially in the late 1970s through the 1980s.

1 Introduction

Before looking at the data, here are two things I believed about philosophy citations. First, philosophers tend to cite very old papers. We still regularly teach a number of papers over half a century old in introductory classes; e.g., Frankfurt (1969), Thomson (1971), Singer (1972), Lewis (1973a). These aren't taught as history papers, but as early entries into the contemporary philosophical debate. And, I thought, that's how we cite. Second, the technological changes of the last quarter century meant that this practice was being slowly reversed. The spread of electronic communication in the late 20th century, and then the rise of archives (e.g., Arxiv, SSRN, PhilPapers) and eventually journals publishing in EarlyView, meant that papers could now be cited even before they were published, and certainly without the delays involved in printing and posting journals around the world.

Both of these thoughts were wrong. Historically, philosophy papers have tended, when they are citing other philosophy papers, to cite very recent ones. But this tendency is diminishing, not increasing, over time. I'll offer much more evidence for these claims as we go along, but to make them plausible, I'll start with two simple graphs.

The data for the graphs come from citation data I downloaded concerning XXX papers published from 1955-2021,[1] in one hundred leading philosophy journals. I focussed on the citations to and from journals in this dataset. So every citation is from one of these 100 journals between 1955 and 2021, and to one of these 100 journals between 1955 and 2021. (The details of the journals, including when they start getting indexed for this dataset, are in **?@sec-methodology**.) In total, that gives us YYY citations.

Say the *age* of a citation is the difference between the publication year of the citing article and the cited article. So if an article published in 1998 cites an article published in 1985, that's a 13 year old citation.

In Figure 1 I've plotted the number of citations in the dataset with each possible age. As you can see, it's very heavily tilted towards the left-hand edge. It is true that people still cite Frankfurt (1969). Indeed, it's one of the most cited papers in the last ten years. But it's just one paper; the bulk of citations are to recently published papers which, if history is any guide, will soon stop collecting citations.

In Figure 2 I've plotted the median and mode age of citations in each year from 1980 onwards. Before that the numbers are even lower, but since I'm only looking at citations to articles published after 1955 (or later if Web of Science started indexing the journal later than that), this is arguably an artifact of how I'm collecting the data. From 1980 onwards, however, there are many older articles that could be, but are not, getting cited. The upwards trends in both graphs look like a real change in citation practices, and not in the direction I antecedently expected.

There is a third surprise in the data, but it's a little more equivocal, and I'm not sure what to make of

[1] I would like to have more recent data, but this is the latest full year of data available through my university's contract with Web of Science. I do have substantial partial data for 2022, and it mostly confirms the trends shown here. But in this case I think it's better to leave off partial data than to try to correct for its incompleteness.

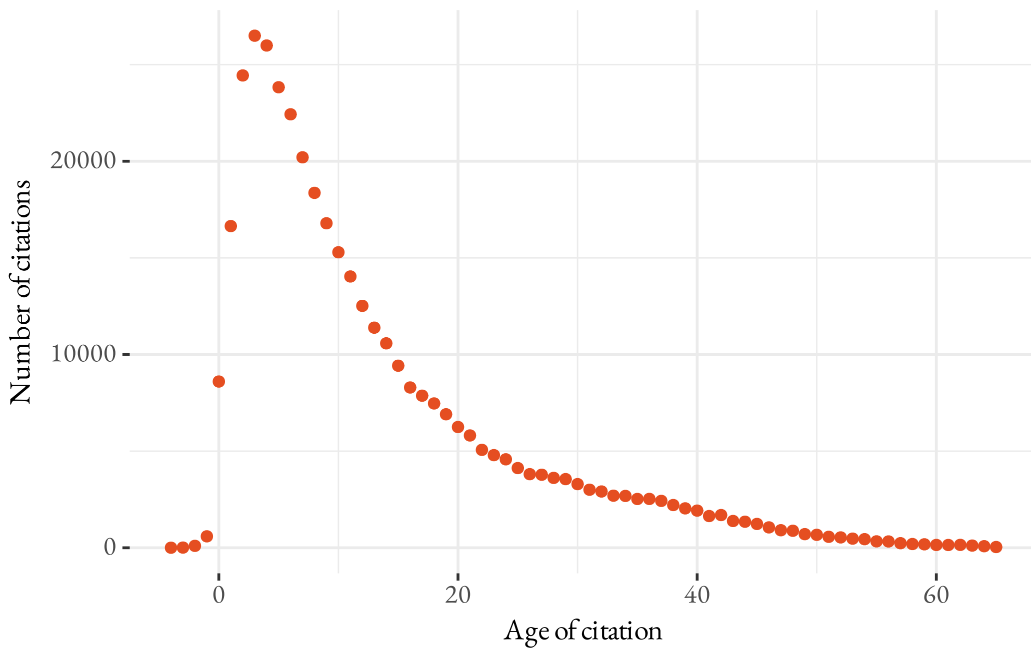
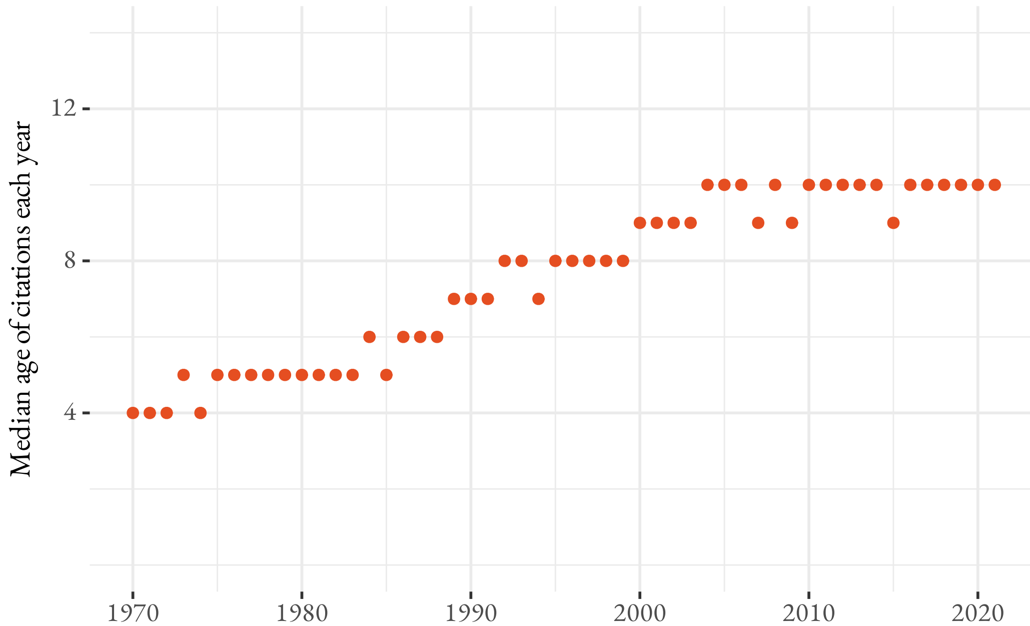
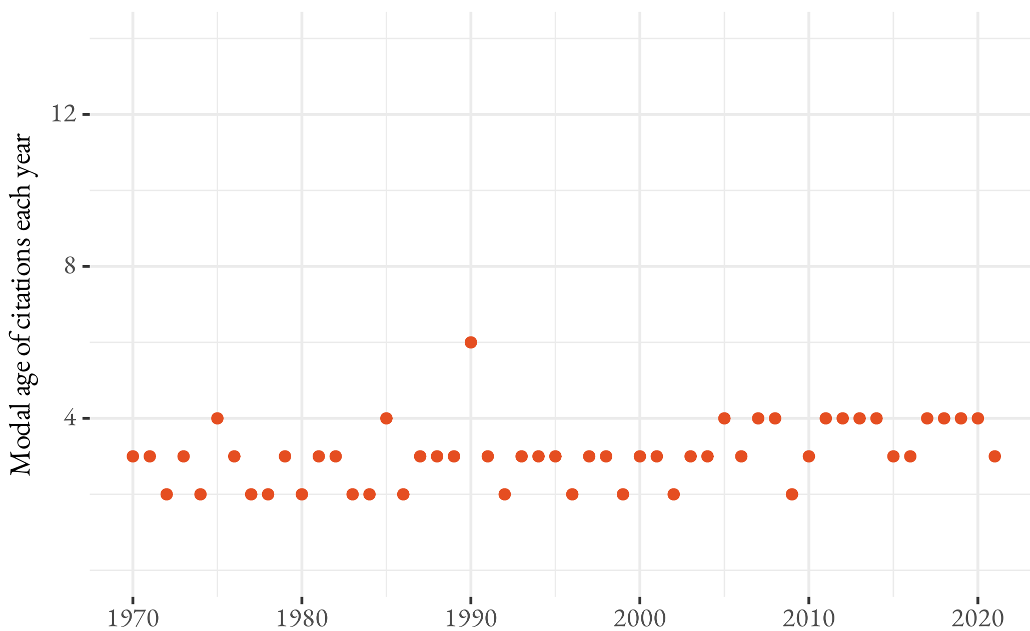


Figure 1: Number of citations with each age.

it. The 2010s seemed like, and to be honest still seem like, something of a golden age for philosophy. In metaphysics we saw the biggest paradigm shift in many years, away from modality and towards grounding. We saw the growth of important fields of social philosophy, including social epistemology, social metaphysics, and social philosophy of language. Though there were some earlier papers that have become important to the latter two fields (e.g., Haslanger (2000a), and Langton (1993)), it would have been a stretch to even call them 'fields' before 2010. Social epistemology was always a bit bigger, and you could point to earlier field defining work by, e.g., Jennifer Lackey (2008) and Adam Elga (2007a). But it grew phenomenally in the 2010s. I'd predicted that would show up in higher citations to work in the 2010s, as these changes were consolidated. The data are a bit messy, and it would be good to have much more data, but this does not look to have happened. There isn't as neat a graph for this, however, and we'll return to this point at the end.



(a) Median



(b) Mode

Figure 2: Summary statistics for outbound citations each year 1970-2021.

2 Age, Period, and Cohort

To help understand the citation patterns, I'll borrow some terminology that's common in both sociology and medicine. Imagine that we see, in the historical record, some interesting patterns among teenagers in the late 1960s, and we're wondering what could explain the pattern. Two types of pattern spring immediately to mind, along with ways to test them.

First, the behaviour could be explained by the fact the people involved are teenagers. If so, it is an **age effect**. The natural way to test this is to see if similar patterns show up with teenagers at different times.

Second, the behaviour could be explained by the fact that it was the 1960s, and lots of striking things happened in the 1960s. If so, it is a **period effect**. The natural way to test this is to see if the same pattern shows up with non-teenagers in the 1960s.

There is an important third kind of explanation. The people involved are born in the early 1950s, so they are part of the post-war baby boom. Colloquially, they are boomers. Maybe that could explain the pattern we see. If so, it is a **cohort effect**. The natural way to test this is to see if the same pattern shows up if we look at the same people in other stages of their life.

It's easy to overlook the importance of cohort effects. Sometimes they simply look like age effects. Ghitza, Gelman, and Auerbach (2023) argue that many hypotheses about age effects on voting, e.g., that older people are more naturally conservative, are really just cohort effects. Bump (2023) argues that understanding the distinctive role the boomers in particular play is crucial for understanding many aspects of modern American life.

There are mathematical reasons that it is hard to tease these effects apart too. Many statistical techniques for separating out influences start to fall apart when there are linear correlations between combinations of variables. In this case there is as tight a correlation as is possible. By definition, cohort plus age equals period. There are some things you can do to get around this problem - see Keyes et al. (2010) for a useful survey of some of the options - but it remains a challenge.

Even conceptually, it is hard to separate out these three effects in cases where there is evidence that the strength of the effects changes over time. As I noted at the start, the natural way to test hypotheses about which effect is strongest involve looking at other times. That works well when the age effects are constant. When they are not (and they might not be here), it is harder.

For most of our story, however, it helps just to have these three effects in mind. Using them, we can summarise the data reasonably quickly.

- The age effect is that articles get cited most when they are two to five years old, as shown in Figure 1.
- The period effect is that there are many more citations in recent years than in earlier years. This is in part because the number of articles published in these journals has been growing, and in part because the number of citations per article grew substantially over the 2000s and 2010s, and exploded in the 2020s.
- The cohort effect is that articles from the 1970s and 2000s get cited more than you'd expect given these age and period effects, articles from before the late-1960s get barely cited at all, and articles from 1980 through the mid-1990s also get cited considerably less than articles either side of that period. I'll offer some speculations at the end of the paper about the philosophical causes of, and consequences of, these cohort effects.

As I mentioned above, I'll go over the methodology in detail in **?@sec-methodology**. But there is one point that is important to note before we start. I'm using data from Web of Science, and they typically don't start indexing journals until well after the journal is established. So the first year of citation data I have for *Analysis* is 1975. Crucially, that means that "Is Knowledge Justified True Belief?" (Gettier 1963) is not included in this study. If it were, and in general if I had the data from *Analysis* to work from, some of the results about the early 1960s would look less dramatic, though as far as I can tell, the direction of the results wouldn't change.

3 Period Effects

Those 397368 citations are not distributed evenly over time. Instead, they grow rapidly. At the start, in 1956, there are only 5 citations. That's not too surprising; without the ability to cite preprints, there aren't going to be many citations of articles that have come out that year. By 2021, there are 56293. In Figure 3, I show how these grew; the striking thing to me is the big jump between 2020 and 2021.

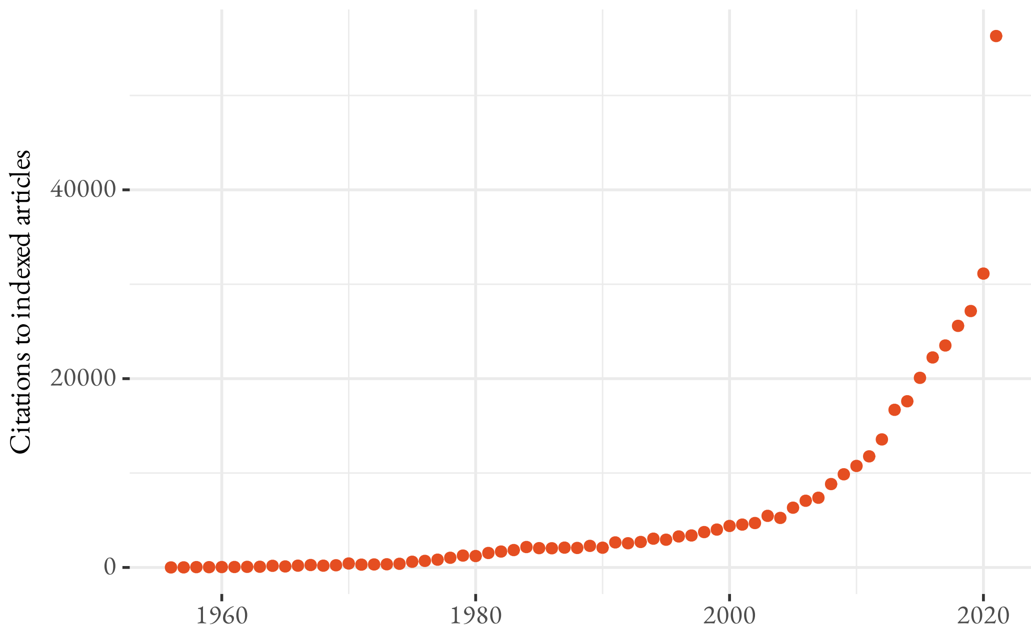


Figure 3: The number of citations in the dataset made each year.

What explains this dramatic growth? Part of the explanation is that more articles are being published, and more articles are being indexed. Figure 4 shows how many articles are in the dataset each year.

That explains some of the growth, but not all of it. The curve in Figure 4 is not nearly as steep as the curve in Figure 3. The number of (indexed) citations per article is also rising. In Figure 5 I've plotted the average number of citations to other articles in the dataset each year.

There are a few possible explanations for the shape of this graph.

At the left-hand edge, there are obvious boundary effects. Since we're only counting citations to articles

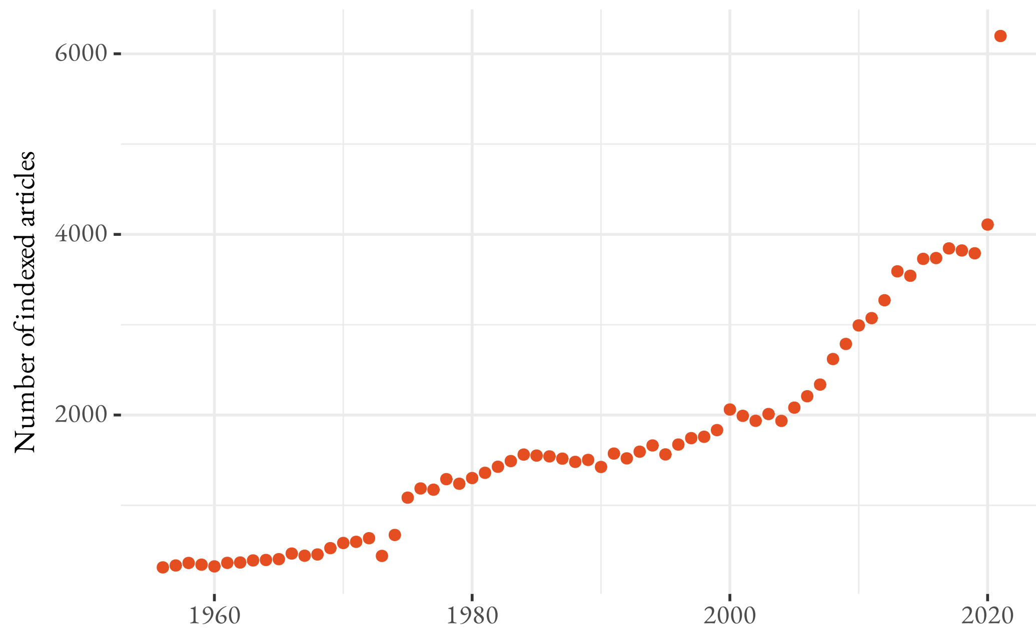


Figure 4: The number of articles in the dataset published each year.

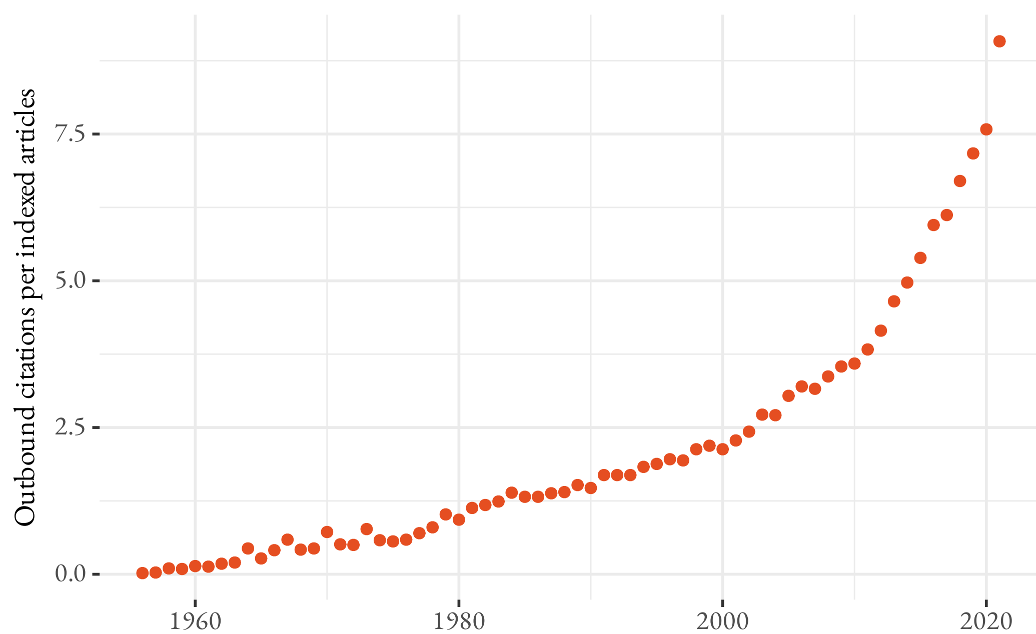


Figure 5: The average number of citations to indexed articles each year.

published since 1956, it isn't surprising that there aren't very many of them per article in the 1950s. Since articles rarely get unpublished, there are more articles available to cite every year.

That can't explain the massive jumps we see at the right hand edge of Figure 5. The jump there looks like the convergence of two cultural trends. One is a trend simply to greater numbers of citations. The most casual perusal of journals will confirm that trend. The other is a trend to greater citations of journals themselves, as opposed to books or edited volumes.

A sharp jump like this is a warning sign that there is something wrong with the data. It's impractical to cross-check every entry, but those I have checked look correct. The change seems led by the most prestigious journals. For each journal I calculated the average number of outbound citations (to these hundred journal) for both the 2010s, and the first two years of the 2020s. The ten journals with the largest increase between the decades are shown in Table 1.

Table 1: Mean outbound citations for some journals over the last two decades.

Journal	2010-2019	2020-2021	Difference
Philosophical Review	14.8	26.3	11.5
Philosophical Perspectives	11.3	19.6	8.3
Philosophy and Phenomenological Research	9.6	15.2	5.6
Journal of Philosophy	9.0	13.7	4.8
Philosophical Studies	9.0	13.6	4.6
Noûs	11.5	16.0	4.5
Philosophical Quarterly	8.8	13.3	4.5
Philosophy	4.0	8.3	4.3
Philosophy Compass	11.2	15.4	4.3
Philosophia Mathematica	6.3	10.1	3.8

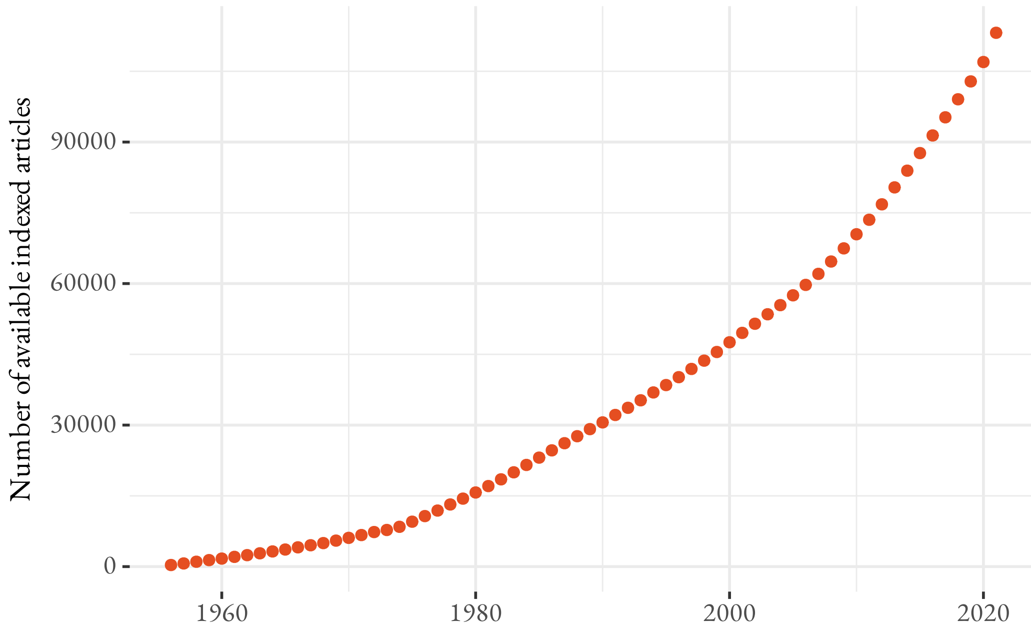
Since *Philosophical Review* only publishes 10 to 12 articles per year, it is not surprising that it shows the most variation on this list. Still, the change in the 2010s isn't only small sample size variation. Of the 22 articles it published in 2020 and 2021, only one of them (Oberman 2020) had fewer than 14.8 outbound citations. With a sample of just 22 anything could happen, but it would be surprising to have all but one end up on the same side of the historical average by chance.

Although the number of citations is going up, the number of articles available to be cited is also going up. Say an article is *available* if it is published in a year iff it is published in or before that year. That's not quite right in either direction; some articles are cited before publication, some articles that come out in December aren't in any real sense available to be cited in January. But it's close enough. Say an article is from a year that is *typically* cited iff it is between 3 and 10 years before the citing year. This notion will play a big role in Section 4; I'm going to use these as a way of getting something like a base rate for citations in a given year. Using these definitions, Figure 6 shows how many articles are available to be cited each year, and are from years that are typically cited.

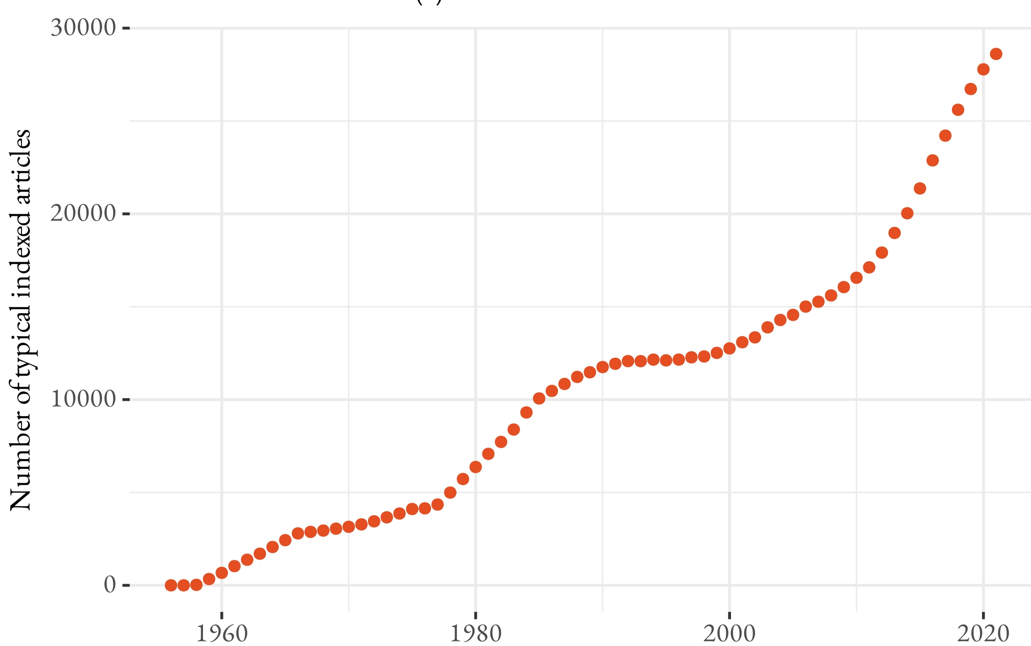
In Figure 7, I've shown how often, in each year, the available articles, and the 'typical' articles are cited. The 'available' graph is obviously similar to Figure 3; under 1% of citations are to articles published in future years. One thing that will be useful in Section 4 is that the graphs in Figure 7 have a similar shape.

Putting all these together we can work out how often, on average, available articles, and typical articles, are cited in each year. The results are in Figure 8.

Three things stand out about Figure 8. One is that the two graphs have pretty similar shapes. Using citations from 3 to 10 years prior to the citing year is a pretty good proxy for all citations, and it turns out to be stable in other ways. A second is that both graphs are fairly flat for a long time. Between the mid 1970s and early 2000s they bounce around without moving much. Then they take off, and go through the roof in 2021. The other thing is that these are low numbers. For most of this study, an arbitrary article in one of these hundred journals was cited in one of those journals once a *decade*. Actually, since

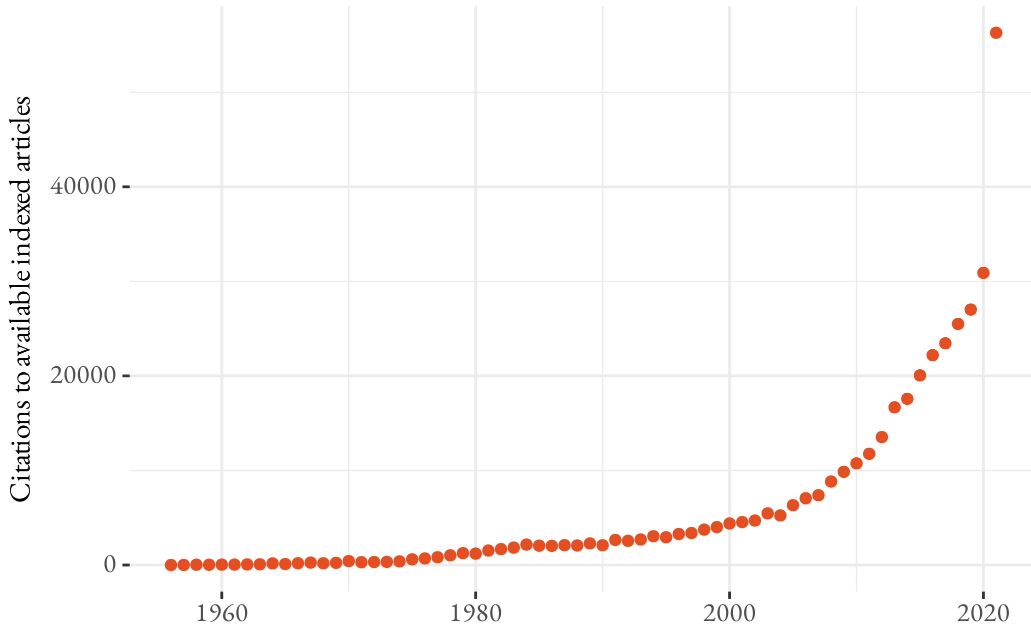


(a) Available articles

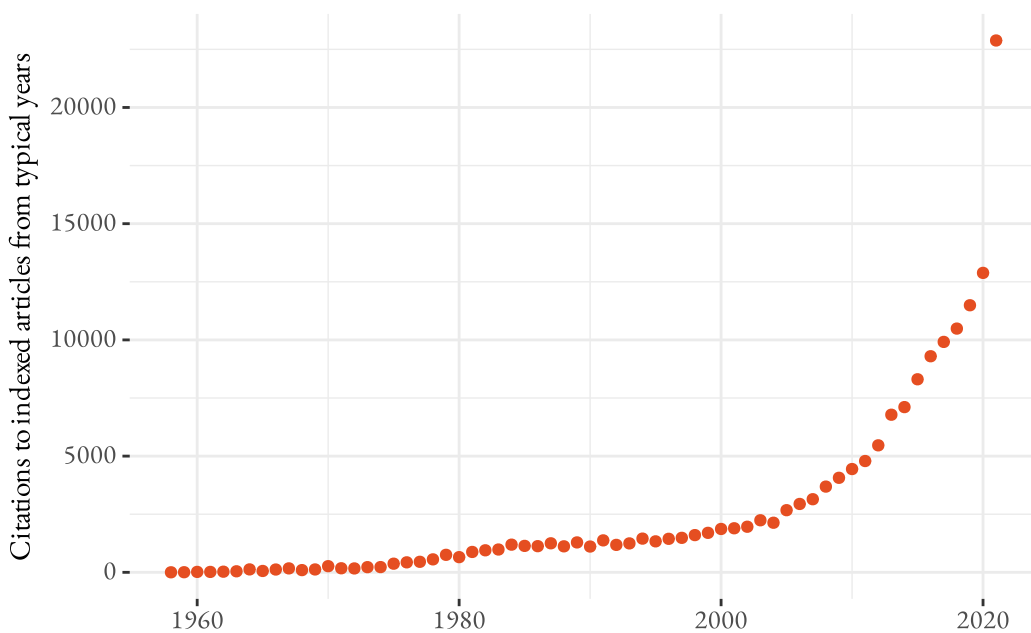


(b) Typically cited articles

Figure 6: Article counts.

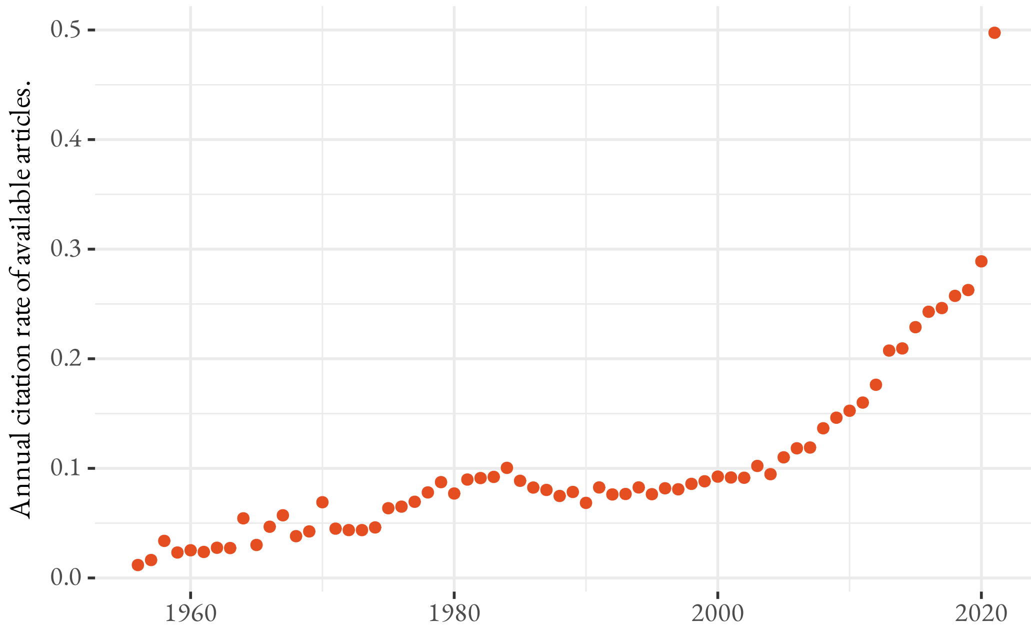


(a) Citations to available articles

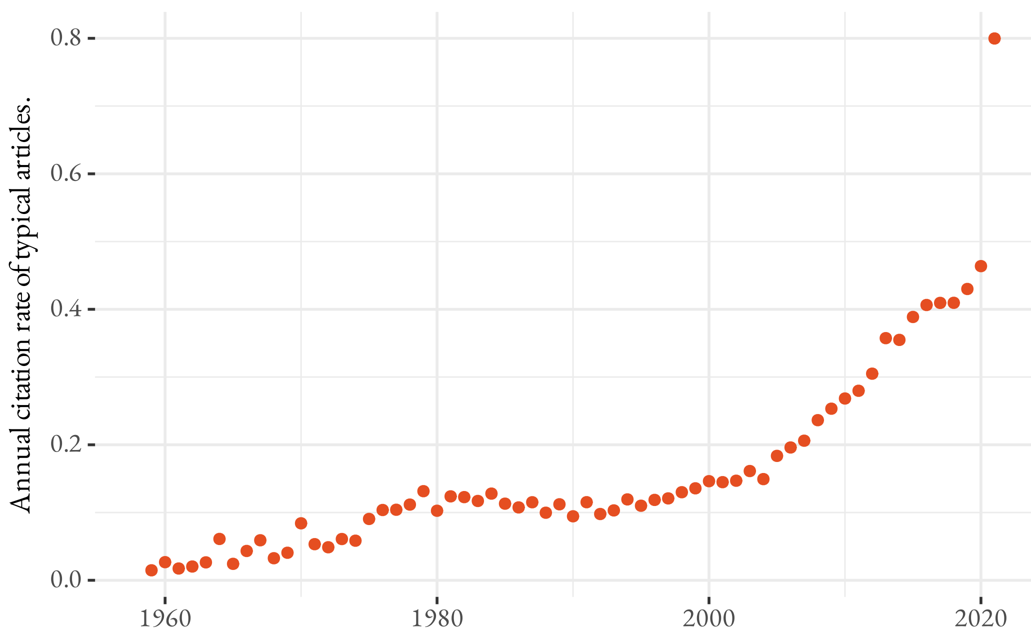


(b) Citations to typical articles

Figure 7: Citation counts.



(a) Available articles



(b) Typical articles

Figure 8: Mean annual citations to different article kinds.

citation rates are extremely long-tailed, and mean rates are well above medians, that somewhat overstates how often the 'average article' was being cited. Frequent citation is very much not the norm.[2]

The various period effects are substantial; to get an reliable picture of the trends in citation patterns, we're going to have to allow for them. The project here is to use citation data as a proxy for philosophical influence. It is, of course, a deeply imperfect proxy. But it is better than most other proxies; it is certainly better than going off of vibes, or of what one's friends are talking about.[3] If we're going to use citations this way though, we need to think about how to take into account the changes shown in Figure 3. I'm going to offer a proposal in terms of typical articles; to a first approximation, I'll measure an article's influence in a period by the ratio of how often it is cited to how often a typical article is cited. This is a little arbitrary, but I think it gets things at least roughly right. At the very least, it avoids the problems with three other natural proposals that I'll now present, and probably anything that avoids these problems will be fairly similar.

Start with the non-proposal of just using citations per year as a measure of influence. Simply eyeballing Figure 3 makes that a little implausible; there would be so much more influence now. It also has some implausible particular consequences. Tyler Burge's "Individualism and Psychology" (Burge 1986) was the fourth most cited paper of the 1990s, and if anything that understates its influence. In the 1990s (in these 100 journals) it had 68 citations, so 6.8 per year. In 2021, it had 7 citations, so slightly more per year. Now Burge's paper is still influential, and it connects in interesting ways to the social turn in philosophy that I'll discuss below, but it's implausible to say that it was more influential in 2021 than it was in the 1990s. When there are so many articles published, and a much lower bar to citation, seven citations a year doesn't signify as much influence.

A natural second proposal then is to measure what proportion of the year's citations any particular article has. By this measure, "Individualism and Psychology" was about twenty times as influential in the 1990s

[2] In the long run the average number of times an article is cited equals the average number of citations per article. So it shouldn't be too surprising that most article have just a handful of citations in philosophy journals.

[3] In North America, placement on graduate syllabi might be an even better proxy, but that data is hard to collect, and we'd need a different measure for other countries.

Table 2: Most cited articles in the 1990s, and in 2021.

(a) 1990s

Rank	Article	Citations	Citations per 1000
1	Frankfurt (1971)	82	2.69
2	Kim (1984)	72	2.36
3	Nagel (1974)	69	2.27
4	Burge (1986)	68	2.23
	...		
10	Kripke (1975)	52	1.71
	...		
34	Hull (1978)	33	1.08
35	Lewis (1979)	33	1.08
36	Fraassen (1984)	33	1.08

(b) 2021

Rank	Article	Citations	Citations per 1000
1	Lewis (1983)	96	1.71
2	Haslanger (2000b)	60	1.07
3	Machamer, Darden, and Craver (2000)	56	0.99
4	Clark and Chalmers (1998)	54	0.96
5	Schaffer (2010)	54	0.96
6	Elga (2007b)	52	0.92
7	Lewis (1973b)	51	0.91
8	Christensen (2007)	50	0.89
9	Schaffer (2016)	46	0.82
10	Nagel (1974)	46	0.82

as in 2021, which isn't obviously false.[4] Other cases, however, suggest this is too much of a correction. It's true that there are more citations now than there used to be. There are also more articles for these citations to be shared between. Holding fixed how influential an article is, you'd expect it to have a lower share of the citations when there are several times more articles available to be cited.

Again, it's easiest to see this with some examples. In Table 2, I've shown the five most cited articles for the 1990s (on the top), and for 2021 (on the bottom). I've also shown how often each is cited per 1000 citations, i.e., the proportion of citations each article gets. And I've extended the first table to make it easier to compare the scales.

[4]To be clear, the database contains about twice as many citations in 2021 as in the whole of the 1990s.

As influential as "A Matter of Individuality", "Counterfactual Dependence and Time's Arrow", and "Belief and the Will" were in the 1990s, I don't think they were more influential than all but one article was in 2021. Haslanger's article became a foundational text for one of the biggest fields in philosophy: social metaphysics. A measure of influence that puts it behind how influential 36 articles were in the 1990s seems wrong, and the intuitive reasoning about sharing citations around suggests why it is wrong.

A natural next move is to scale the citations not to all citations, but to the average number of citations that available, i.e., already published, articles get. This would solve the problem I just presented in a simple way. Having 1 cite per 1000 citations means a lot more when there are 100,000 articles that could have received that citation than when there are 10,000 such articles.

Again, this is an overcorrection. In theory, any article already published could be cited. In practice, long forgotten articles are long forgotten and hence not cited, and most articles are long forgotten. It's true that in 2021 articles have to 'share' citation space with more other articles. But in practice that normally means they share the space with other *recently published* articles.

We can sort of see this by redoing the calculation from Table 2, instead using the ratio of citations this article receives to citations the average available article receives.[5] I've done this in Table 3. First, I've shown the articles that, across the 1990s, had the highest average ratio of citations they received to citations the average available article received, and second, I did the same calculation for 2021.

None of the pairwise comparisons here seem obviously absurd. Was "To be F is to be G" more influential in 2021 than "Causation" was in the 1990s? I wouldn't have thought so, but it's not as clear as in the previous set of comparisons. But it is clear that the numbers in the second table in Table 3 are considerably higher than the first table, especially at the very top end. That suggests that the intuition that including so many articles from long ago in the comparison class was a mistake, and it has systematically increased the measure we're using for later years in implausible ways.

[5]On the first part of Table 3, I calculated this ratio for each year, and then displayed the average over the decade.

Table 3: Most cited articles in the 1990s compared to average citations, and in 2021.

(a) 1990s

Rank	Article	Ratio
1	Frankfurt (1971)	102.45
2	Kim (1984)	90.15
3	Nagel (1974)	85.95
4	Burge (1986)	85.05
5	Perry (1979)	78.28
6	Lewis (1983)	76.01
7	Jackson (1982)	71.51
8	Kripke (1975)	65.91
9	Cummins (1975)	65.29
10	Lewis (1973b)	64.95

(b) 2021

Rank	Article	Ratio
1	Lewis (1983)	192.98
2	Haslanger (2000b)	120.61
3	Machamer, Darden, and Craver (2000)	112.57
4	Clark and Chalmers (1998)	108.55
5	Schaffer (2010)	108.55
6	Elga (2007b)	104.53
	...	
12	Plunkett and Sundell (2013)	90.46
	...	
35	Dorr (2016)	66.34

Table 4: Most cited articles in the 1990s compared to typical citations, and in 2021.

(a) 1990s

Rank	Article	Ratio
1	Frankfurt (1971)	71.87
2	Kim (1984)	63.99
3	Nagel (1974)	60.03
4	Burge (1986)	59.88
5	Perry (1979)	55.46
6	Lewis (1983)	53.21
7	Jackson (1982)	49.90
8	Kripke (1975)	46.45
9	Churchland (1981)	45.63
10	Lewis (1973b)	45.25

(b) 2021

Rank	Article	Ratio
1	Lewis (1983)	120.04
2	Haslanger (2000b)	75.02
3	Machamer, Darden, and Craver (2000)	70.02
4	Clark and Chalmers (1998)	67.52
5	Schaffer (2010)	67.52
6	Elga (2007b)	65.02
7	Lewis (1973b)	63.77
8	Christensen (2007)	62.52
9	Schaffer (2016)	57.52
10	Nagel (1974)	57.52

So what I've settled on is using the ratio of how often this article is cited in a year, to how often a *typical* article is cited that year. By 'typical' I mean an article three to ten years old; as we'll see in Section 4, those are the typical ages of cited articles. That deals with the intuitive problems of the previous measures, and it gets the results roughly right. In Table 4, I'll do one last comparison between the 1990s and 2021 to make the point.

The numbers in the second table are a little higher, but not overly so. In any case, one would expect the top end of a scale like this to be higher when just looking at a single year, where there is more variation, than at an average over a decade.[6] So I'll take this as the measure of age-adjusted number of citations.

[6]If I did the same comparison year-by-year, there are individual years where "Meaning" (Grice 1957), "Justice as Fairness:

That is, to factor out the age effect on citations, I'll divide the number of citations an article receives in a year by the average number that a typical, i.e., 3-10 year old, article receives that year.

4 Age Effects

The simplest way to work out age effects would be to use the values in Figure 1. For any two articles with age *x* and *y*, we should adjust for age-effects by taking their citations at that age as something like the proportion of all citations of articles with that age as shown in Figure 1. Given how dramatic the period effects are, this makes no theoretical sense whatsoever. And it would get various details wrong. Somewhat surprisingly, it would nevertheless be roughly correct.

The picture in Figure 1 is fairly intuitive. Articles rarely get cited before they are published.[7] Then they take a little bit of time to get noticed, before hitting their peak citations between 2 and 5 years after publication. After that it's a rapid, and then a slow, decline. For the classic articles, citations never really stop; Anscombe (1956) is cited by Izgin (2020). But most articles reach the end of their citation life sooner or, occasionally, later.

Still, we'd like to be sure that what we're seeing in Figure 1 isn't just a side-effect of the period effects, or something about how the articles are aggregated. That's what I'll try to do in this section.

The key notion is what I'm going to call the *citation ratio*. This is a function that takes two years, which I'll call *old* and *new*, as input. Intuitively, it measures how often articles from *old* are cited in *new*, normalised for how many articles are published in *old*, and what the citation practices are in *new*. More formally, it is the following ratio:

Political not Metaphysical" (Rawls 1985) and "Concepts of Supervenience" (Kim 1984) have a higher ratio of citations to the average typical article than "New Work" does in 2021.

[7] Though in "Naive Validity, Internalization, and Substructural Approaches To Paradox" (Rosenblatt 2017), there are three citations to then forthcoming papers in Synthese which eventually appeared in 2021, giving them an age of -4.

- The numerator is how often the average article in *old* is cited in *new*. So we search the articles published in *new*, count up the number of citations of articles published in *old*, and divide by the number of articles published in *old*.
- The denominator is the rate a 'typical' article is cited in *new*. Remember that I'm defining, somewhat stipulatively, a typical article to be published between 3 and 10 years before *new*. So again we search the articles published in *new*, count the citations to articles published 3 to 10 years earlier, and divide by the number of articles originally published 3 to 10 years earlier.

Let's illustrate this with an example, using 1985 as *old* and 1997 as *new*. In 1997, indexed articles from 1985 were cited 95 times. There are 1551 articles published in 1985 in the index, so the numerator for the citation ratio is 95 / 1551, i.e., about 0.061. In the 3 to 10 years before 1985, there were 12276 indexed articles published. Those articles were, collectively, cited 1484 times in 1997. So the denominator, the average number of citations the typical article got in 1997, is 1484 / 12276, i.e., about 0.121. Putting those together, the citation ratio for 1985 in 1997 is (about) 0.507.

In Figure 9 and Figure 10 I've graphed this citation ratio for many pairs of years. In the graph, the individual graphs (the *facets*), are for each value of *old*, the x-axis is the value for *new*, and the y-axis is the citation ratio. Note that before 1965, we can't calculate the citation ratio because there isn't enough data to calculate the typical citation rate. So the y-axis starts at 1965. And for most years there are no dots on the left side of the graph, because I haven't calculated the citation ratio in years where *old* is later than *new*; there are few enough of these cases that they are best left out.

There are several notable things about Figure 9 and Figure 10. The most important is that after some weird results in the early years, probably due to the small sample sizes, the graphs for each year look remarkably similar. The citation ratio takes a year or two to take off from zero, gets to its peak within two to four years after publication, and then declines. In earlier years, the rise and the fall are more rapid than in later years. This is actually a surprising result, and I'll come back in **?@sec-culture** to why it might be. Still, it doesn't change that the shape of the curves is common enough to talk sensibly about an aver-

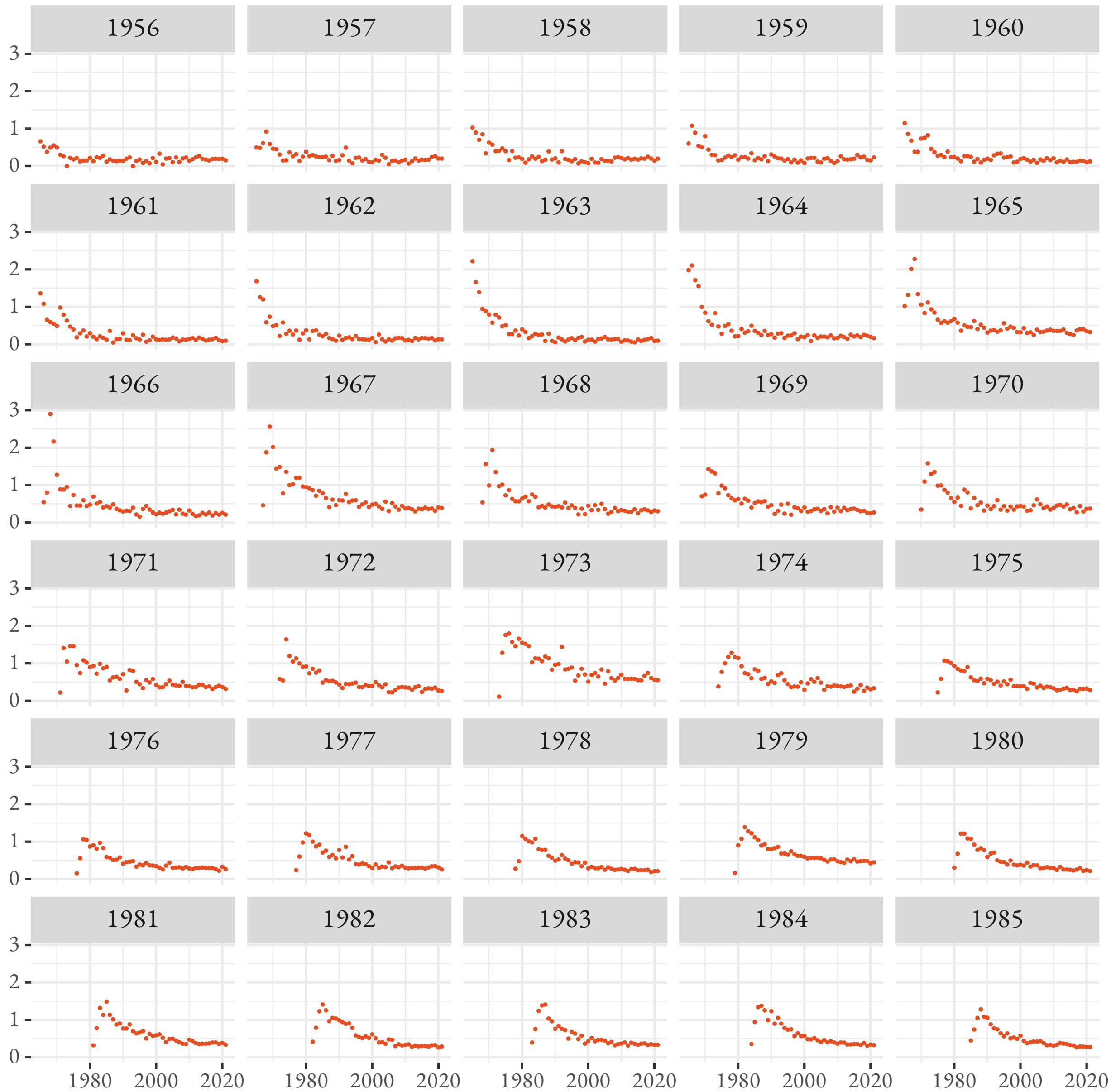


Figure 9: Each facet shows the relative citation rate for articles published that year at different ages.

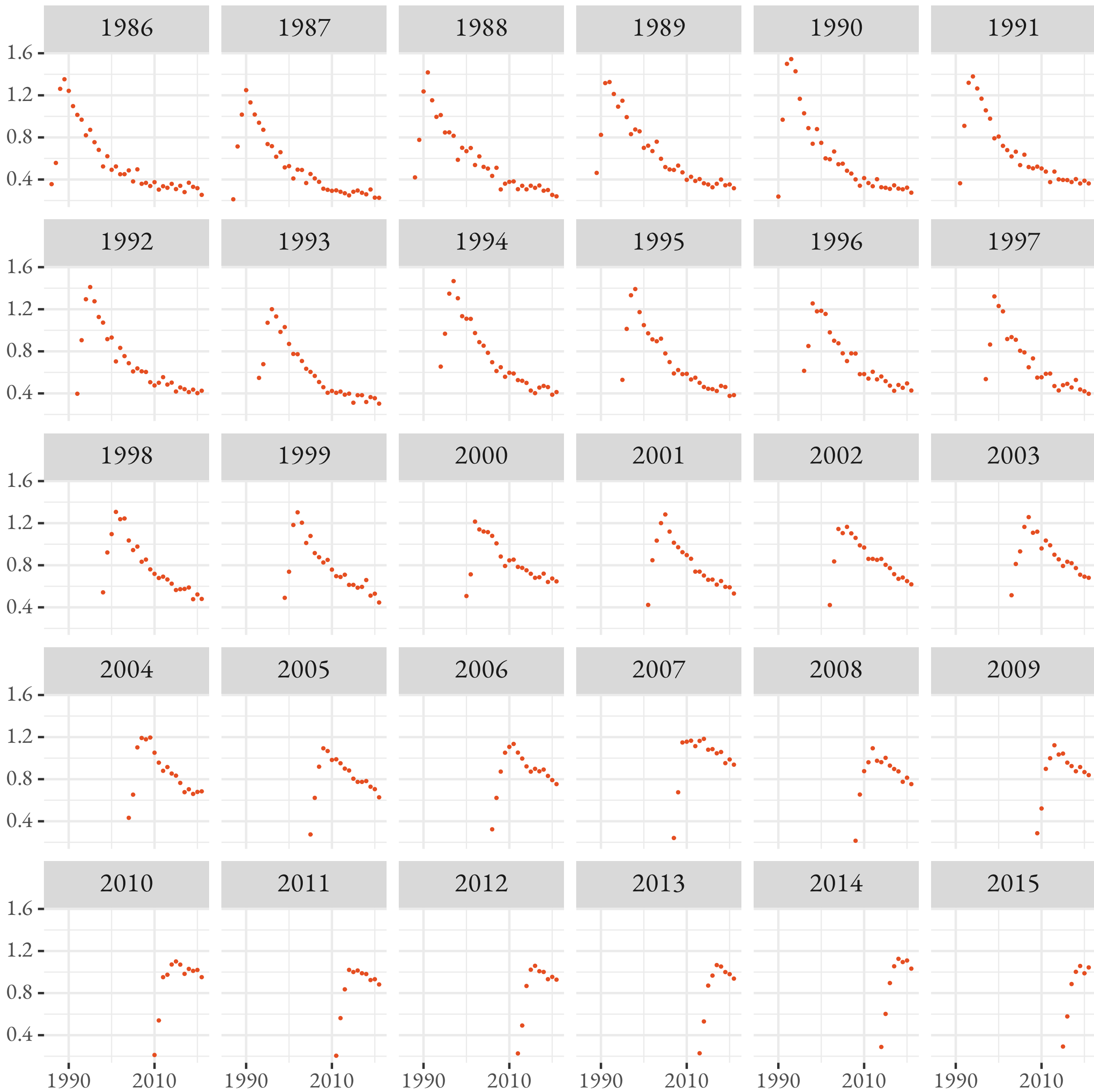


Figure 10: Each facet shows the relative citation rate for articles published that year at different ages.

age curve. In Figure 11, I've put most of the data from those two figures, with the x-axis now being age not the citing year, and the line showing the mean citation ratio by age. I say 'most' of the data because I didn't show the points for original publication years before 1975, where as you can see in the earlier graph, the data are much noisier with much smaller samples. But those years are used in the calculation of the average that's displayed.[8]

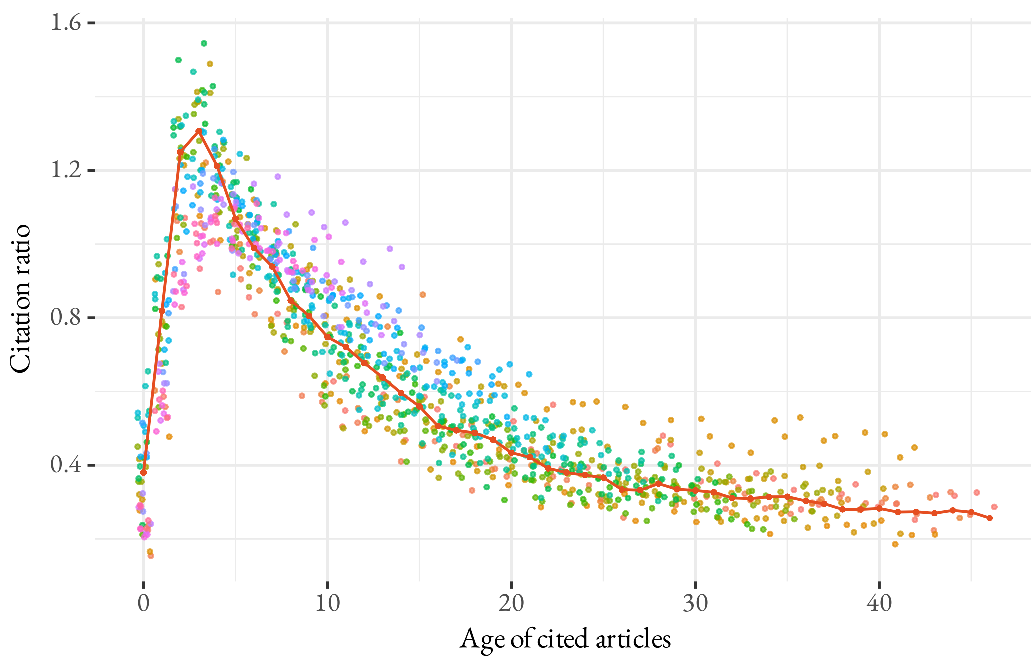


Figure 11: Age effects from 1970 onwards on a single graph, with the overall averrage shown.

The mean curve in Figure 11 is really similar to the unadjusted age curve in Figure 1. This is what I meant earlier by saying that after a lot of calculations, we'd get back to the same aging curve that we got from the simplest possibe measure.

The calculations did have one really notable effect though. The unadjusted age numbers give us a sensible aging curve overall, but they give us an absurd aging curve for individual years. For most years in the dataset, the year they are most cited is not two to five years after initial publication; it is 2021. The point of the various adjustments in this section has been to make better sense of what's happening in individual

[8]The graph also includes some 'jitter' to make the different points more easily visible. I've put each year of original publication in a different colour, with nearby years being in similar colours. But there are too many colours there to detect individual years, and we'll return to faceted graphs like Figure 9 and Figure 10 when I want to highlight individual years.

years.

The result is the striking lack of outliers in Figure 11. All the individual data points are fairly close to the mean. There is some deviation, and there would be much more if I included the earlier years where the data is much noisier. The deviation there is will be the focus of much of the rest of this paper. Still, it's notable how consistent the age curve is, once we use citation ratio to account for period effects.

There are two particularly interesting features Figure 9 and Figure 10 that are a little hard to see in the big graph. In Figure 12, I've graphed the maximum value the citation ratio reaches for each year of initial publication. This is a bit misleading before 1965, because I don't have enough data to calculate citation ratios when the citing year is earlier than that, so it might have left off what would have been the high point. But from then on it's useful.

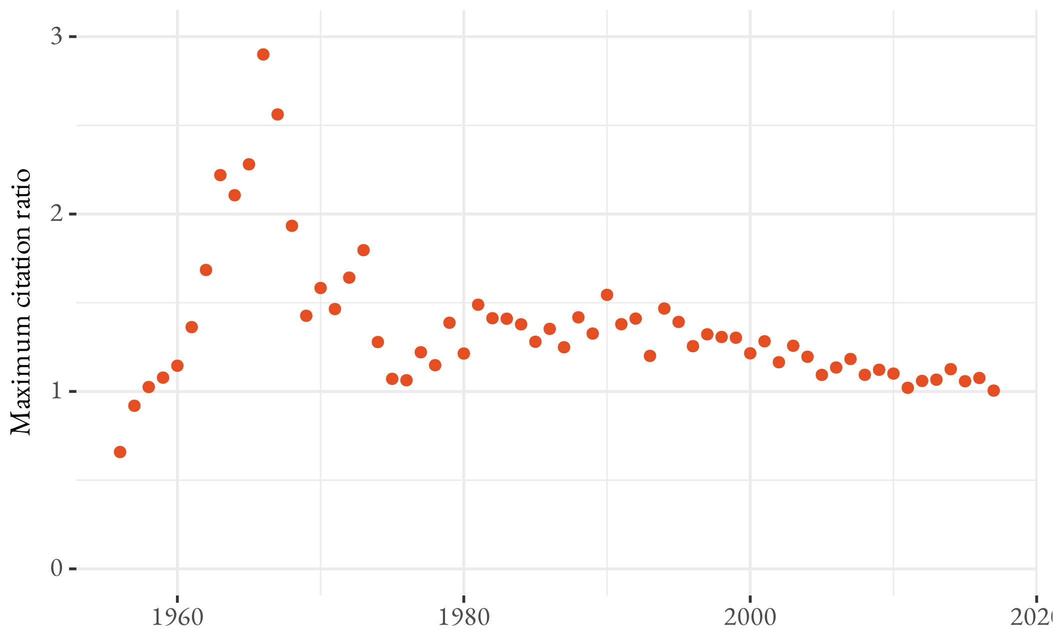


Figure 12: The maximum citation ratio in each facet in Figure 9 and Figure 10.

After the initial jump upwards, and the very high numbers in the mid-1960s, the trend is a decline. In Figure 13 I've graphed out which age those peaks are hit at, for different years of initial publication starting in 1963.

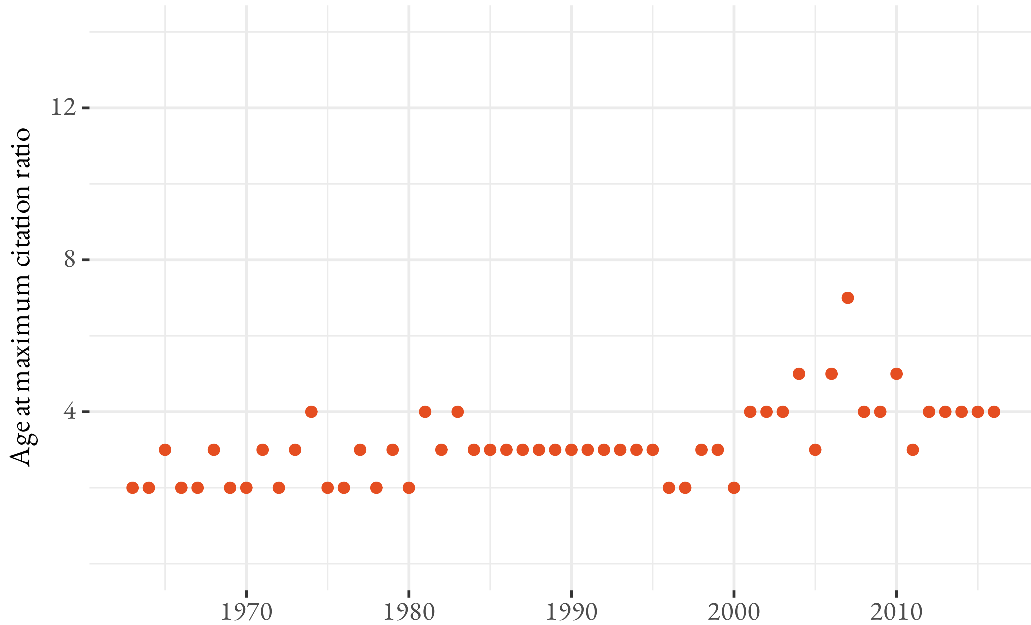


Figure 13: For each original publication year, the age it hits maximum citation ratio.

In Figure 13, the graph is going slightly upwards. Putting these last two figures together, we get the claim I was gesturing at earlier: citation curves are getting flatter. The peaks are coming later, and they are lower.

Finally, I want to note how much variation there is hidden within all the graphs I've shown so far. I'm mostly here classifying articles simply by their publication year. If we used more fine-grained classifications, some of the results would look rather different. In Figure 14 and Figure 15 I've shown what happens to Figure 11 if we first restrict attention to articles with 15 or more citations, and then to articles with fewer than 15 citations.[9] Obviously in the first graph the values will be higher; highly cited articles are, indeed, cited more often. But what I want to highlight here is the different shape of the curves.

Both graphs rise rapidly to a peak two to five years after publication, and then descend. But from that similarity, the differences are striking. For the highly cited articles, there is barely any dropoff by years 8 to 10. For the others, the dropoff starts in earnest in year 4, and by year 10, the average value is half of

[9] I picked this threshold because there are approximately as many citations to articles with at least that many citations as to the other articles.

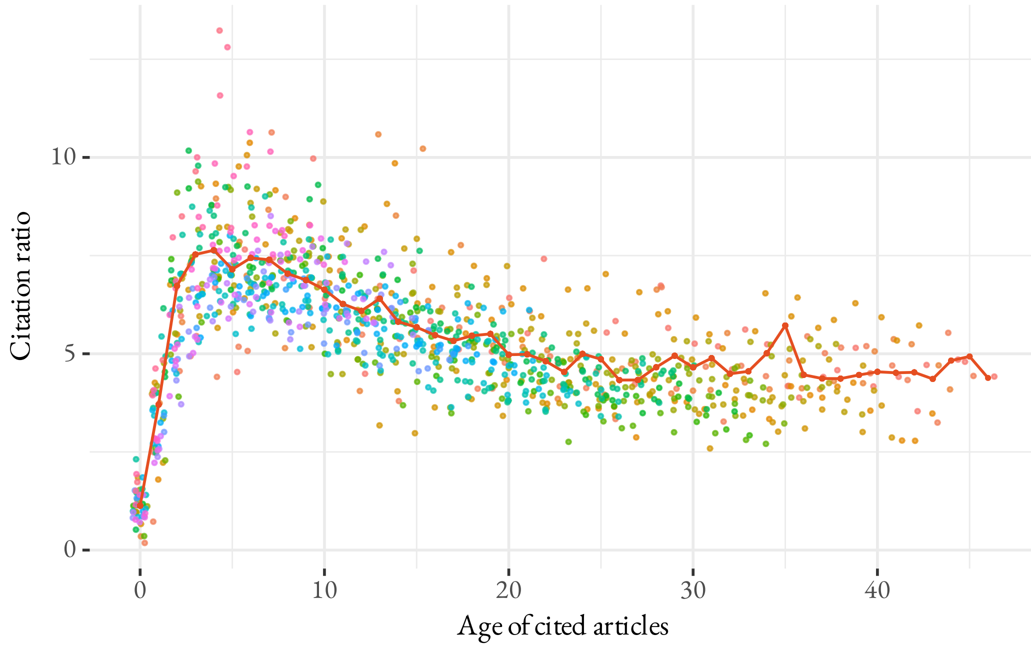


Figure 14: A version of Figure 11 just looking at highly cited articles

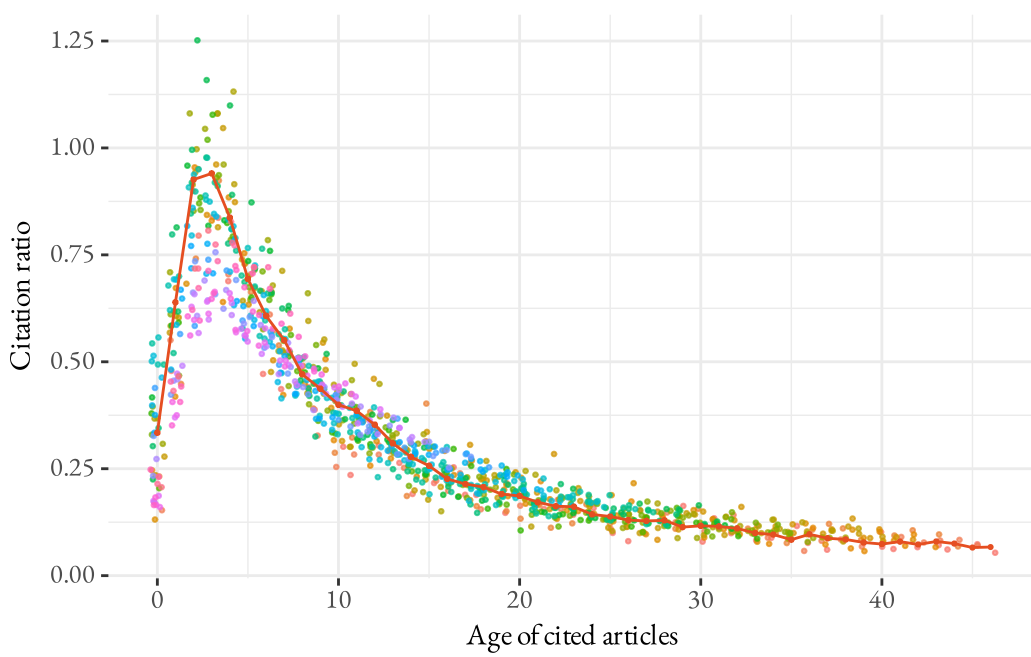


Figure 15: A version of Figure 11 just looking at not so highly cited articles

the peak. That graph doesn't quite go to 0, but mostly these articles are not making much impact after a couple of decades. On the other hand, for the highly cited articles, the age effects are very gradual. Several decades after their publication, they are (on average) being cited 2/3 as often as at their peak (adjusting for period effects).

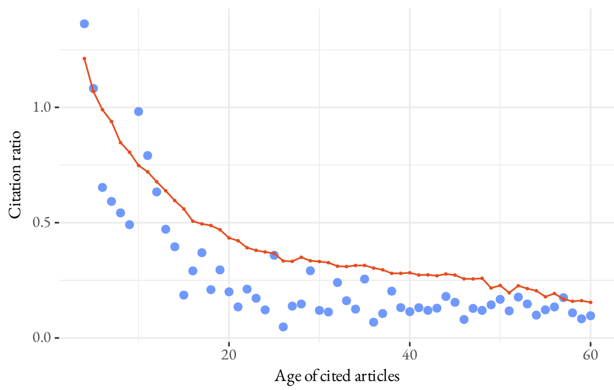
I think there is an important lesson in this. If the way you think about citations in philosophy comes from looking the history of famous articles, you'll get a misleading impression. The citation pattern for a highly cited article isn't like the citation pattern for a regular article, just scaled up. It has a very different temporal structure.

None of this a priori. There could be relatively rarely cited articles that get frequently cited long after their publication. Indeed, there are such papers in the database. Norman Malcolm's "Dreaming and Scepticism" (Curley 1975) didn't get much attention in the journals when it was firs published, but has been picked up a bit recently because of an increase in work on dreams. And there could be articles that are the center of attention for a while then get fewer citations. Some papers on supervenience fit that description (e.g., Difrisco (2018)), as well as some papers in philosophy of science. But in general, highly cited articles are highly cited not because they have a flurry of activity, but because they remain part of the conversation for years after publication.

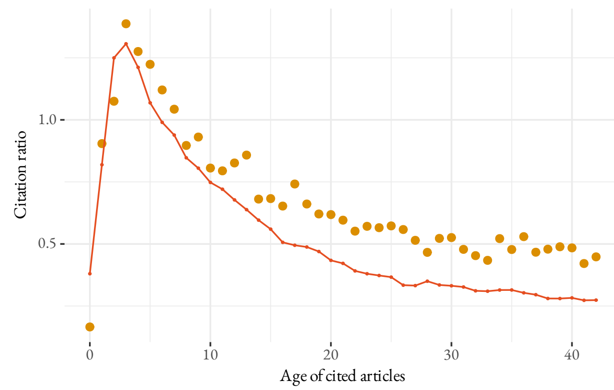
5 Cohort Effects

So far we've seen how period effects and age effects between them can explain a lot of the trends we see in citation patterns. But there are systematic deviations from those patterns which remain. In Figure 16, I've shown some of these. Each graph shows the citation ratio for articles published in a particular year, as compared to the average citation ratio at different ages.

In 1961 and 1985, the yearly values are predominantly below the mean line. In 1979 and 2007, they are predominantly above it, though this isn't true for the first few years of the 2007 data. Note that the graphs

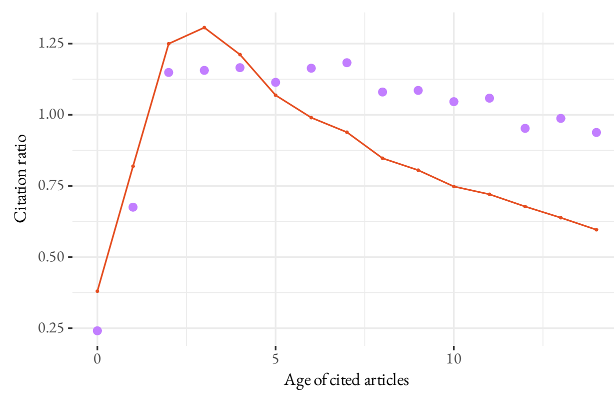


(a) 1961



(b) 1979

(c) 1985



(d) 2007

Figure 16: Mean annual citations to different article kinds.

have different lengths. Everything stops in 2021. And the 1961 data is cut off a little on the left because we only start calculating citation ratios in 1965. That's why the line showing the mean is differently shaped that year.

For each of year of original publication, we can calculate the mean difference between the citation ratio for that year, and the mean citation ratio for articles that age. That tells us how often articles published that year are cited, compared to how often you'd expect them to be cited knowing just the age and period effects. The results are in Figure 17.

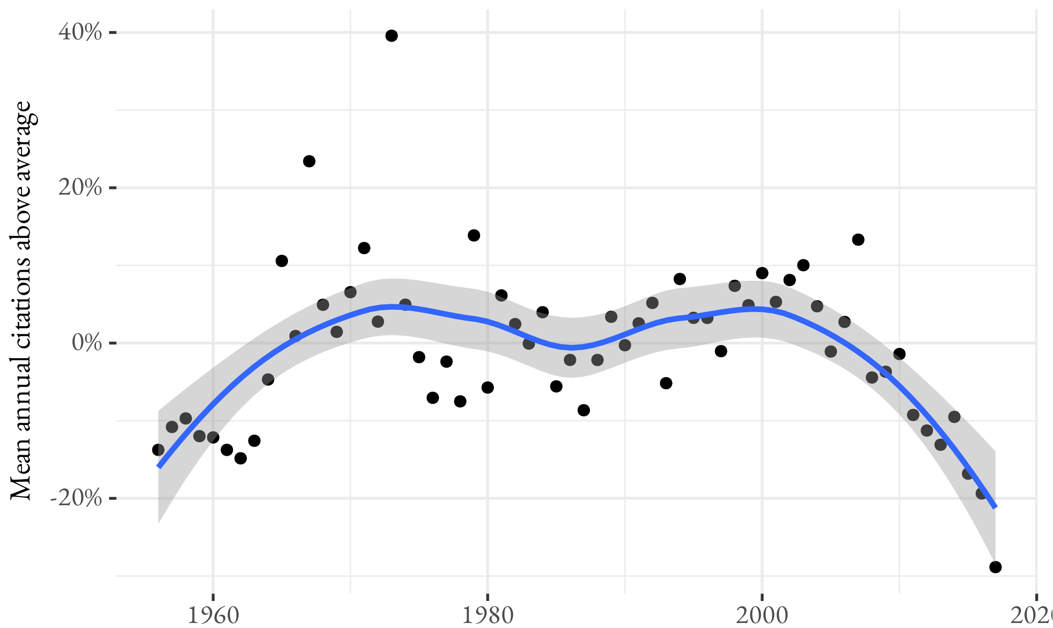


Figure 17: Cohort effects for different publication years.

A couple of quick technical notes on Figure 17. I've added a smoothed curve over the graph to help make some of the features of it stand out. And in calculating the mean, I only included years where we had at least five years worth of data to calculate the mean age effect. So that means I haven't included what happens to 1955 papers when they are cited after 2016. There isn't nearly enough data to say what one would 'expect' the usual aging curve to be at those points.

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