Alcohol and Asteroids

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Like every social scientist who has had to think about pregnancy for the first time, I quickly came across Emily Oster's book: Expecting Better: Why the Conventional Pregnancy Wisdom is Wrong—and What You Really Need to Know. Oster proposes using decision theory to use data on different activities during pregnancy to make decisions that best reflect your preferences.

The most controversial aspect of the book has been her claim that there is no risk to light drinking during pregnancy. This view has been criticized quite intensely, but I think these critiques don't get to the heart of the issue.[1] While I don't think the evidence is decisive either way on light drinking and pregnancy, Oster's analysis implicitly builds in some strong statistical assumptions that readers should carefully consider before they accept her conclusions.

Oster starts by saying:

> One phrase I kept coming across was "no amount of alcohol has been proven safe." The implication, I suppose, is that we know that there exists a level of drinking that is bad, so we should assume all other levels are bad until proven otherwise.

I think that is a slightly unfair read of what the conventional wisdom is saying. I think a charitable reading of the conventional wisdom is as follows: "We know that there is a level of drinking that is bad and that at some point (probably before literally zero drinking) its effect falls very close to zero".

This view implies a prior that looks something like the following:[2]

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[1] I'll talk through some of my issues with those studies in a future post.

[2] The distribution is simulated as follow in R: c(rep(0,10000), -rexp(10000) * 2, rexp(100)/5). 49.8% of the prior probability mass is on an effect of exactly zero, 49.8% spread over an exponential distribution in the negative direction and 0.5% spread over a positive exponential distribution.

Asteroid prior
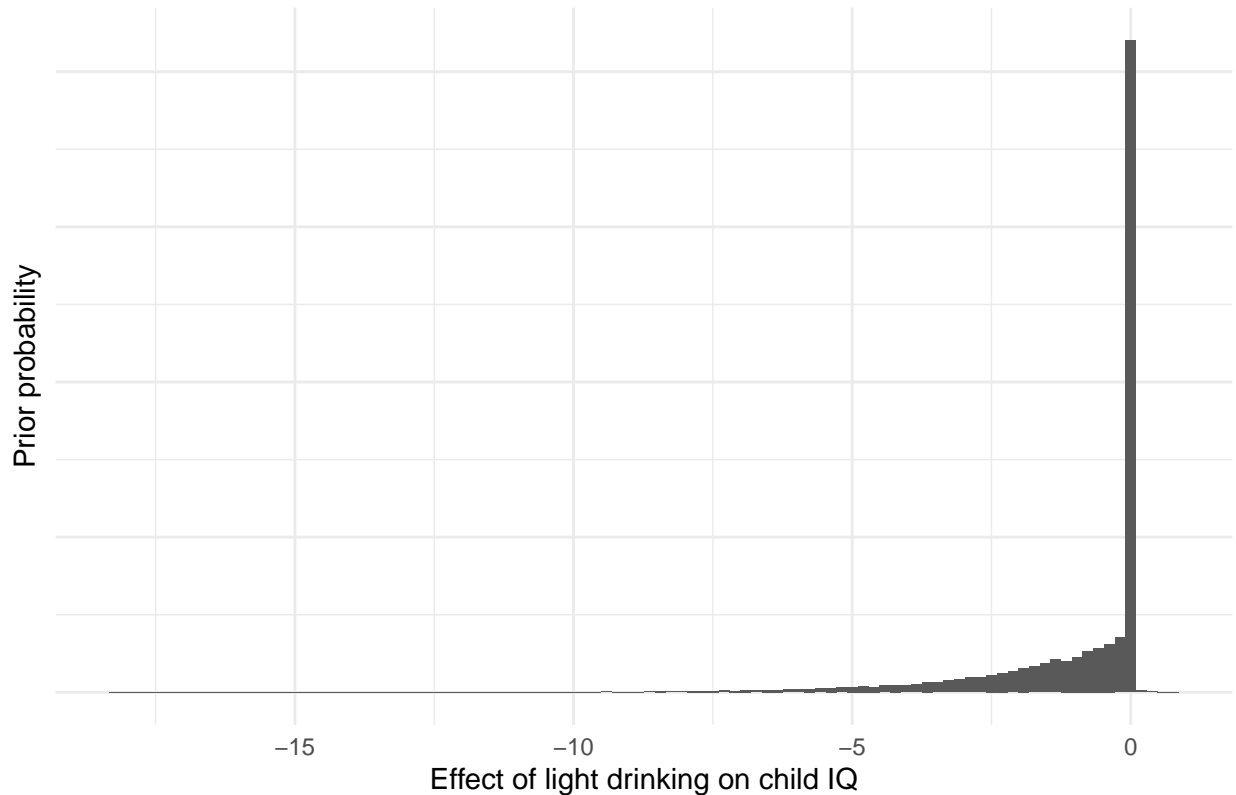
There's a large point mass at exactly zero, but a non-zero probability that the effect is actually negative. Crucially, this view gives zero (or trivially low) credence to the idea that light drinking might boost child IQ.

I'm going to refer to this colloquially as the asteroid prior. The effect of an asteroid is usually exactly zero (because it misses the earth or burns up in the atmosphere), but if it does get through, the outcomes are all some version of bad.[3] In this analogy, the scientific question is just whether alcohol makes it through to cause harm, no one disagrees about the direction of the effect if it does.

You might think that holding an asteroid prior such as this is unscientific and that no quality of evidence could ever convince someone who holds it. While it is true that this prior will always say that light drinking is bad in expectation, high quality evidence could hypothetically reduce the plausible effect size to very close to zero and make the probability that the effect size is exactly zero arbitrarily high. If the evidence suggested that there is a 99% chance that the effect is exactly zero and that—if it is non-zero—there is a 99% chance that the effect has a smaller magnitude than 0.2 IQ points, few people would think it was worth advising against light drinking.

My read of Oster is that she is implicitly interpreting all the studies using a symmetric prior (e.g. the one below) around zero.[4] This is a very standard assumption in social science studies, as we rarely have strong enough theories to convincingly rule out effects in a particular direction. There are good arguments for minimum wages increasing employment or for decreasing it. If you ran a minimum wage study with a

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[3]If you want to add on a small tail of positive outcomes to the prior that's fine too (perhaps the asteroid hits Vladmir Putin and ends the invasion of Ukraine), but for the levels of evidence we're talking about it's not going to matter.

[4]It's worth noting that the actual studies under discussion all use frequentist methods. The Bayesian language here is a way of conceptualizing how a reader could reasonably update their views based on reading the studies. You certainly could formalize this into a Bayesian meta-analysis, but the concepts from Bayesian statistics are helpful even when doing this informally. Note that if you were to do this formally, you would want to include latent estimates of measurement error at the study level as part of the estimation.

heavily asymmetric prior, you would rightly be called out for stacking the deck.
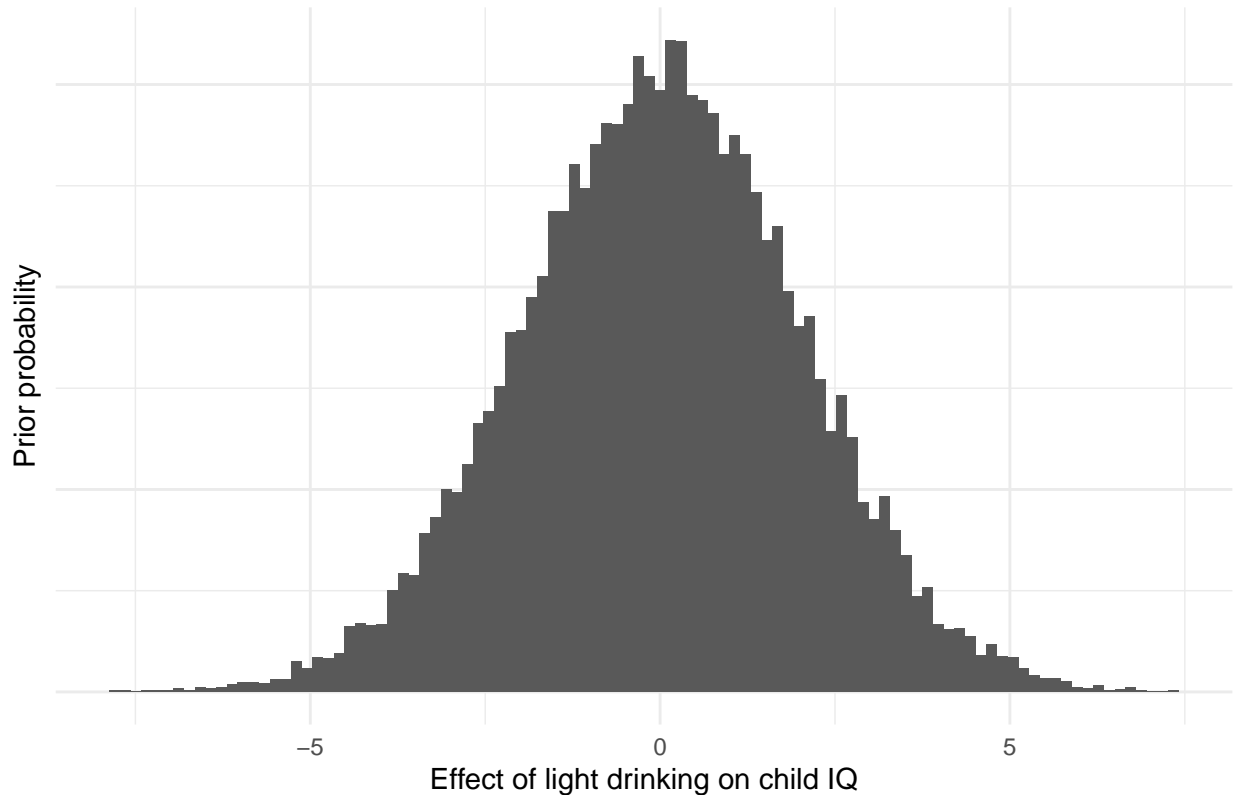
So which prior should we be using when assessing the alcohol and pregnancy literature. I'm not a biologist, but the asteroid prior seems to fit quite well with Oster's own account of the mechanisms:

> When you drink... Your liver processes the alcohol into a chemical called acetaldehyde and then into acetate. The acetaldehyde is toxic to other cells, and depending on how quickly you drink, it can remain in your bloodstream. You share your blood with your baby through the placenta; acetaldehyde, which remains in your bloodstream, is therefore shared with the fetus...**If too much acetaldehyde is passed to the baby, it can get into his tissues and impact development. When you drink slowly, you metabolize much of the alcohol before it would get to the fetus. If you drink quickly, your liver cannot keep up and toxins are passed to the fetus.**

The story here is that alcohol is bad, but the mother's body is probably capable of dealing with the negative effects of it before it reaches the fetus. Notably, there's no counterbalancing story here about perhaps acetaldehyde having some positive effects in the right dose. The story also doesn't a priori rule out an effect of light drinking. Instead, the effect is dependent on the empirical facts about how fast and effectively the liver can remove the toxins, the concentration of acetaldehyde required to cause tissue damage etc. The story also doesn't rule out the possibility that some subset of women's bodies will fail to remove the toxins fast enough to avoid damage (maybe depending on ethnicity or body mass?).

So what does the evidence Oster cites say? Is it strong enough to at least shift the asteroid posterior to a large point mass at zero and a small effect otherwise? I'm not aiming to do a literature review of the pregnancy and alcohol literature here, but having read the studies Oster approvingly cites, I'm not convinced that the evidence is strong enough to make us strongly update our posterior.

There are some studies showing negative effects of light alcohol consumption on development, but Oster is skeptical about the quality of these studies. I generally agree with her assessment and agree that the studies