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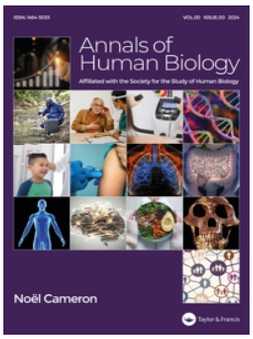

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COMMENTARY

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Commentary on: "age period cohort analysis – a review of what we should and shouldn't do"

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I would like to thank the editors of *Annals of Human Biology* for inviting me to write this commentary, and for picking my paper (Bell 2020) as one that was worthy of such comment. In many ways it's an odd choice of article to pick: I am not a human biologist, and the paper has an interdisciplinary reach. It is also a review article and does not have an original research contribution in the way that many of the other articles highlighted do.

Having said that, many of those characteristics – interdisciplinarity, robust methods, etc. – fit very well within the broad church of Human Biology. More personally, the paper was an important piece of work for me as the culmination of a body of work that started during my PhD, critiquing an age-period-cohort (APC) method that I originally intended to use. That method, the Hierarchical APC model (Yang and Land 2006), was a natural fit to my methodological interests, having been inspired by a multilevel modelling course on my undergraduate Geography programme at Bristol University. However, it soon became clear that that method, at least, needed testing carefully, and it was that which led to a series of simulation studies showing the situations in which that method does and doesn't work (Bell and Jones 2014a, 2014b, 2015a, 2015b, 2018). That opened me up to a broader literature, critiquing other APC methods (e.g. Luo 2013; Te Grotenhuis et al. 2016), and highlighting the challenges that using age, year or birth year expose for researchers more generally.

It is a literature that goes back at least 50-years, and the further I delved into it, the more surprising it was to me that the issues at hand were so misunderstood and under-appreciated given their longevity. For the most part, the APC identification problem is something that, if taught at all in (say) masters-level programmes, will be reserved for an "advanced" module – signalling it as a statistical quirk that only the most committed quantitative researchers need worry about. And yet, the implications of the identification problem are big. We are not talking about small biases, of the sort that occupy many advanced statisticians. We are talking about regularly finding large effects on one direction when the truth is a large effect in the opposite direction. And this is for variables like age which are fundamental to human biology, social epidemiology, and social sciences more broadly.

It is understandable why APC issues have been relatively neglected. Thinking about age-period-cohort for more than a few minutes frequently makes one's head hurt (I know – I've been thinking about it for over a decade!). They are variables that at first seem simple, but that have an interlocking complexity that should be ignored at your peril. Many of the texts that exist on APC also use relatively technical language and statistical notation. That is also perhaps why so many APC methods that try (unsuccessfully) to solve the identification problem have popped up: because the literature has often presented it as a problem that is statistical (and so fixable) rather than conceptual and innate to the three APC variables.

It is perhaps understandable, then, that this isn't something that you would want to teach on an "Intro Quants" class. And yet the consequences of not understanding the dangers of the identification problem are great, and easily succumbed to. In fact, any study that includes age, year, or birth year in some kind of a regression model will be making some kind of strong assumption about at least one of age, year, or birth year, and that assumption will need to be understood and acknowledged for the interpretation of those models to be meaningful. That is the case regardless of whether the researcher is interested in all of APC or just one of the three. In other words, it matters if you are interested in people, and you are interested in change in those people or society.

The review paper in question, then, was an opportunity to explain these broader issues at a conceptual level, without advanced statistical notation. It was great to see the paper being useful to other researchers in this, and in helping them understand the assumptions inherent in the models that they are fitting. It has been used widely across the health and social sciences. A quick scan of the paper's citations (on google scholar) shows it has been used across a wide range of disciplines – health fields, but also criminology, tourism, sociology, political science, geography, and more. This is a testament to the interdisciplinarity of age-period-cohort

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analysis, but also Human Biology more broadly, which covers a lot of different fields and influences even more.

Since the paper was published, more recent contributions have furthered the literature in very positive ways. I have edited a book of contributions (Bell 2021) in which authors make positive suggestions for how researchers could manage the APC identification problem and the assumptions that are needed to be made about APC. Other scholars have also moved beyond the identification problem, for instance considering the concept of "cohort careers" to understand social change in a way that is meaningful but doesn't force researchers to assign effects specifically to APC (Fosse and Winship 2023). It is also notable how the issues around APC have appeared in other methodological work I have been involved in: for instance longitudinal analysis of intersectional inequalities (Bell et al. 2024), where age and generation are important axes of social inequalities for a number of outcome variables, in health and beyond.

I'd like to thank Will Johnson for the invitation to write the article as part of a special issue (and to present it at the SSHB Symposium), and, again, for the invite to comment on it 5 years later. I hope the article continues to be useful to researchers, in human biology and beyond, looking to understand how people change over time.

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