Devicing Future Populations:
Problematizing the relationship between quantity and quality of life

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Abstract

Taking as point of departure the claim that, in late modern societies, there has been shift from a focus on producing measures of life and death towards metrics of health and disability, this paper investigates how, through what means and processes was this transition achieved. It proposes that such questions can be addressed by analysing the transcripts and sociotechnical network of one single meeting held at the United States Senate on July 15th 1983 to assess the validity and sensitivity of life expectancy forecasts. The paper analyses how members of the Hearing transformed a weakly articulated set of differing life expectancy projections into a controversy about the issue of vitality and health in populations. Analysis of the Hearing proceedings suggests that 'calculative devices' played a generative role in problematizing the relationship between forms of expertise, calculative procedures, data infrastructures and specific expectations of the effect of technology on health and longevity. The paper details empirically that this re-composition was possible through a collective investigation – an opening up - of key instruments in the management of populations in 'insurance societies'.

Keywords: life expectancy; quality of life; calculative devices; insurance society.

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Introduction

A key issue within population science and epidemiology has been the longstanding disagreement about forecasts of mortality, life expectancy and health in contemporary societies (e.g. Siegel, 2016). This controversy is usually characterized as a divergence in the way the relationship between the 'quantity' (survival, life expectancy) and 'quality' (health, disability) of life is conceptualized and/or modelled. In the conventional version of the debate (Jagger and Robine, 2011), three positions, originally articulated in the 1970s and early 1980s, are typically identified. The first theory proposes that medical research and technology, while extending human life span, has also 'prolong[ed] diseased, diminishe[d] lives and so increase[d] the proportion of people who have a disabling or chronic disease' (Gruenberg, 1977: 5; cf. Brody, 1985; Kramer, 1980). The second theory, mostly associated with the work of James Fries (1980, 1983) suggests that, given a biological limit to human life span, preventive medicine and health maintenance programmes could delay the onset of disease and disability so as to minimize the gap between morbidity and mortality, leading to a 'compression of morbidity' or 'rectangularization of longevity'. A third proposal argues that while medical technology might increase the proportion of people living with disability, its severity on average would be reduced, extending life expectancy in future populations (Manton, 1982).

While this version of the debate emphasizes its academic character, hinging on esoteric issues such as the methodology for the measurement of health, its endurance cannot be dissociated from the significance projections of mortality, life expectancy and population health have for the institutional apparatus of contemporary societies. As the authors of a recent *Lancet* article – which claimed that by 2030 female life expectancy at birth would be higher than 90 years – put it, mortality and life expectancy forecasts are 'needed to plan for health and social services and pensions' (Kontis et al., 2017: 1). The sustainability of public and private health care systems, social care programmes and the provision of 'old-age' pensions depends on calculations of changing conditions of demand and use, and of the adequate financing needed. This, in other words, means that quantifications of future life

expectancy and states of population health are central to the contemporaneous politics of health care and social security.

This link between knowledge of the health of populations and their management speaks directly to theorizations of governmentality, and in particular Foucault's conceptualization of regimes of power-knowledge and forms of security. In brief, Foucault's argument was that in liberal, governmentalized states, power is reliant on knowledge and management of 'a global mass affected by overall pressures of birth, death, production, illness' (Foucault, 2003: 243). This 'mass' – a population – is understood and deployed through a series of epistemic and political 'apparatuses' focusing on these aspects of the 'mechanics of life', thus giving rise to a particular form of biopolitics (Agamben, 2009). The making of population is thus contingent on the application of methods of data formatting and procedures of statistical analysis that render the 'mechanics of life' visible by 'display[ing] constants that are easy, or at least possible, to establish' at 'the collective level' (Foucault, 2003: 246).

Because the notion of population is founded on the epistemic assumption that it possesses its own regularities, from a Foucauldian perspective, 'insurance or regularizing technology' is therefore central to the apparatus of governmentality (Foucault, 2003: 222). For this reason, risk calculations about the chances of life and death – based on actuarial methods – have become fundamental to the deployment of the liberal Welfare State, an arrangement Ewald (1991) claimed underpinned the 'socio-politics' characterising 'insurance societies'. This conjunction is evident, for example, in the establishment of social security programmes such as the Old Age Pension Reform of 1908 in Britain, informed as it was by actuarial models derived from Gompertz' work on the 'mortality function' (Moreira, 2017: 36-40). As Foucault put it, governmentality was – and indeed is – underpinned by 'the absolutely capital concept … of risk' (Foucault, 2009: 87).

Recently, Wahlberg and Rose (2015) have proposed that in the past four decades it is possible to identify a shift in the forms of knowledge produced about populations. This transition can be described as a shift from a focus on life and death to a situation where the emphasis lies in measuring and calculating aggregate states of disability and health on a global level. In this process, the social conditions and the personal consequences of living

with disease become objects of political concern that are made knowable, quantifiable, and thus targets of intervention. Wahlberg and Rose argue further that this denotes a new epidemiological style of thought in which 'the problem of morbid death gives way to that of morbid living, made calculable through metrics of "severity", "disability" and "impairment"' (Wahlberg and Rose, 2015: 60). The shift Wahlberg and Rose propose is significant, since it opens the possibility that new articulations between populations and politico-epistemic apparatuses have emerged.

This article takes as a point of departure the shift from measures of life and death to metrics of population health. It asks: To what extent was this transition achieved, and negotiated, and how, through what means and processes? I propose that these questions can be addressed by analysing the transcripts and sociotechnical network of one single meeting held at the United States Senate on July 15th 1983. The meeting, a hearing before the Subcommittee on Savings, Pensions and Investment Policy, specifically focused on analysing 'whether [the then] current life expectancy projections [were] accurate' (Chaffee in US Senate, 1983: 1). By publicly recognizing the uncertain character of the main source of information on which – the just reformed – US social security programmes were based, i.e. actuarial projections, the meeting constitutes a unique moment in the collective examination of the forms of expertise, methods, calculation techniques and types of data used in making demographic and epidemiological projections and forecasts.

The justification for focusing on this specific Senate Hearing is threefold. One is that the meeting constitutes a temporary centre of calculation (Latour, 1987) articulating an extended sociotechnical network, making it visible and durable. This capacity to stabilize connections is linked to the second reasons for focusing on it. Like the evidence-appraisal committees analysed by Moreira (2005) and McGoey (2007), the meeting is a deliberate attempt to tame the proliferation of uncertainties in a knowledge domain. Second, by transporting emerging uncertainties about life expectancy projections into a confined space, Hearing members were enabled to 'problematize' (Callon, 1986) population science projections, tracing the links between different approaches to measuring population health, the technological expectations that such measures embody, and contemporaneous health and social security plans. Third, this close scrutiny of the assumptions and corollaries of life expectancy calculations was not without consequences. Through the ceremonial order of

the Hearing, calculations publicly viewed as a consequence of inexorable processes of population change became tractable objects underpinned by data collection conventions, mensuration practices and scenarios of technological expectation. As a result, the Hearing turned a loose, and weakly articulated set of approaches to life expectancy calculations into a controversy: an identifiable and shared uncertainty around a specific issue or 'object', around which gathers a variety of actors, instruments and practices (Callon et al., 2009; Latour, 2005). The meeting thus enables us to understand the uncertainties surrounding the contemporary research and policy agenda on how to combine mortality with morbidity or health outcome measures (Murray et al., 2002; also *Lancet*, 2018).

I suggest that this was possible because the Hearing focused on the role of 'calculative devices' (Callon, 1998; Callon and Muniesa, 2005), such as life tables – tabular descriptions or estimates of the pattern of mortality survival in populations – in producing projections of longevity and health. By opening up the uncertainties underpinning what Lakoff (2015) has termed actuarial devices – in rendering their contingent character public – members of the Hearing were able to propose alternative arrangements that could make visible and knowable the complex relationship between health and longevity.

Through this close analysis of the Hearing, the paper provides insight into the contemporary politics of population health. Two clearly delineated standpoints emerged in the meeting. One entwines optimistic expectations of the impact of preventive or therapeutic technologies on health and longevity with fiscally conservative policies; the other enacts a conjunction between modest technological expectations and fiscally 'liberal' programmes to support health and social care programmes. The relationship between these positions is redolent of the tension between 'hope' and 'truth' that pervade the contemporary domain of health (Clarke, 2016; Moreira and Palladino, 2005;).

Staging the vitality controversy

On the morning of July 15th 1983, in Washington DC, the Subcommittee on Savings, Pensions and Investment Policy of the Committee on Finance of the United States Senate held a hearing on 'Trends in US life Expectancy' in room SD-213 of the Senate Dirksen Building. The Hearing had been instigated by the Chairman of the Subcommittee, Senator

John Chafee (Rep., Rhode Island), with support from Senator Bob Dole (Rep., Kansas), due to 'a nagging suspicion that we are not taking into account adequately the increased life expectancy of Americans in our projections of the costs of social security' (Chafee in US Senate, 1983: 6).

Although noting, in the meeting, that this 'suspicion' was mainly based on personal experience and anecdote, Chafee was drawing on a growing concern, amongst population science experts and policy makers, that life expectancy forecasts produced by the Office of the Actuary (OoA) were no longer reliable. Between 1977 and 1981, the OoA had considerably revised its mortality projections in response to changing demographic and epistemic conditions. This was due to two main reasons. On the one hand, while between the mid-1950s and the 1960s there had been relative stability in mortality rates in the US population, these had been significantly reduced in the first years of the 1970s. On the other, while the earlier stability in mortality fit within the expectations of population scientists and actuaries about the 'natural' limits of human life expectancy, the new emerging pattern of mortality was at odds with dominant demographic models about the role of mortality, and gains in longevity in older age groups in the dynamics of populations (Manton, 1991). As a result, Social Security Administration projections of mortality for the year 2000 were higher than mortality rates already observed in 1975 (Myers, 1981; also Rice, 1978).

The uncertainty of mortality and life expectancy projections was not a purely academic issue, but a matter of public concern. In particular, these calculations not only fed directly into taxation and spending plans for social security and health care programmes such as Medicare, but also informed occupational retirement and health care insurance policies across the country. Indeed, just a few months before, the Federal Government had completed a fundamental reform of social security in the US, the Social Security Amendments of 1983. This policy was itself derived from the sparking of a political 'crisis' about the financial sustainability of the social security system around 1982, when policy makers and commentators denounced the fact that the 'old-age and survivors insurance trust fund' had reached its lowest ever balance. Facing resistance to his original proposals to solve the 'crisis', President Reagan formed a Bipartisan Commission – known subsequently

as the Greenspan Commission – tasking it with developing a plan that would save $40 billion in the 'unified budget'.

The Greenspan Commission proposed to meet that challenge in four interlinked ways: a) extend the coverage of the system, by mandatory enrolment of Federal and other local government workers; b) tighten the efficiency of the program, c) increase the tax revenue coming into the system, and d) ration the entitlement conditions of the system, particularly by increasing the retirement age. The last proposal is of significant interest to this analysis: firstly, because it was both the most contentious – with the American Association for Retired Persons (AARP) leading the critique (US Senate, 1983: 153-5); and, secondly, because it explicitly linked the sustainability of the system to changes in life expectancy calculations. Indeed, for this purpose, Alan Greenspan specifically asked Myers, a fiscally conservative Republican and former Chief Actuary for the Social Security Administration (SSA), to provide a possible retirement age that would, in 1980, be 'equivalent' to the one established in 1940 (Bayo and Farber, 1981; Tynes, 1988: 30). The request laid open the link between social security institutional arrangements and calculations of life expectancy.

This connection had already become publicly unstable through the publication of alternative projections of life expectancy based on different 'mortality assumptions' (Crimmins, 1983; also Manton 1982). 'Mortality assumptions' are conceived as 'judgements' made by actuaries and populations scientists on how and at what rate mortality rates will evolve in the years ahead and beyond (e.g. ONS, 2016). In the event, Crimmins' view that, contrary to the reversal proposed by the OoA, 'mortality changes observed [from] 1968 to 1977 [were to] continue unaltered to 2000' (Manton in US Senate, 1983: 59), further questioned the assumptions held by the actuarial status quo. Drawing on these uncertainties, Chafee argued at the beginning of the Hearing that policy makers and the public 'cannot afford to blind [themselves] foolishly to the fiscal and societal effects of *leaps in scientific knowledge*' (Chafee in US Senate, 1983: 4; emphasis added).

To illustrate his argument, Chafee drew on a figure and table provided by the National Centre for Health Statistics (Figure 1), which he structured as a narrative of continuous gains in longevity through human history. The figure deserves special attention because it inscribes – or inscripts (Latour and Woolgar, 1979) – in its differently shaped curves the

relationship between ‘quantity’ and ‘quality’ of life referred to above. ‘Survivorship curves’, widely used in actuarial science, demography and population ecology, depict how mortality varies with age of individuals in one particular population. Derived either from past/current life table data – or from forecasted/conjectural survival probabilities based on mortality assumptions – they are understood as statistical abstractions. Within them, survival probabilities obtained cross-sectionally for different age groups at one given historical time are converted into a graphical inscription of a single cohort’s mortality function. The figure provides thus what can be thought of as ideal types of mortality function.

The curve attributed in the figure to ‘Ancient Rome’ populations – often known in population ecology as a Type III curve – describes a cohort with a high death rate following birth, tapering after that. The ‘USA 1900’ curve is characterized by a more constant mortality rate throughout lifespan. The curve for ‘USA 1960’ is one seen to be approaching the ‘rectangularization of longevity’ – the title which heads the figure. This is a scenario in which high survivorship rate throughout the lifespan sees mortality accumulate at the end of life. The last curve, rectangular – dotted in the picture – exhibited a ‘theoretical possibility’ of ‘ideal senescence’ proposed by Raymond Pearl in 1940 (Pearl, 1940; see Comfort, 1964: 24; Ramsden, 2002).

[INSERT FIGURE 1 APPROXIMATELY HERE]

As already mentioned, the prospect of bringing to bear such ‘rectangularization of longevity’ in human populations had been given public airing by James Fries just a couple of years before. Supported by Kaiser Permanente – a California-based non-profit integrated health care system, often seen as the model for the health maintenance organization system adopted in the US – Fries proposed that ‘if all premature death were eliminated … statistics suggest that … under ideal societal conditions mean age at death is not far from 85 years’ (Fries, 1980: 131). His argument hinged on a particular, and *much contested*, interpretation of life tables and mortality rates during the 1970s that linked increases in life expectancy to changes in lifestyle, better preventative medicine and ‘growth in personal autonomy and personal responsibility for health’ (Fries, 1980: 133). He thus suggested that pursuing these ‘ideal societal conditions’ would result in a ‘compression of morbidity’, a shorter average

period between the onset of disability and what he, drawing on Hayflick (1965), saw as the 'biological limit to lifespan'.

The fact that the Hearing's proceedings were framed by these proposals is significant because they both challenged directly the OoA's mortality assumptions and more established views on the effects of life expectancy changes on disability on older populations. Indeed, one can argue, following Manton (1991; also Jacobzone et al., 1999;; OTA, 1985; Pugh, 1987; Preston, 1993) that the Hearing was one of the key events in the crystallization of the content and format of the controversy on the relationship between the 'quantity' (survival, life expectancy) and 'quality' (health, disability) of life that still pervades population science. The power of meetings such as Senate hearings to transform issues is linked to the way in which they enable the public, ceremonial performance of expertise (Hilgartner, 2000). This meant that the usual interactional structure of questioning of expert in public hearings – namely, 'you say this but someone else says another thing' – facilitated the creation of a recognizable map of relative positions within a controversy (Lezaun, 2010).

In this, a key role was played by calculative devices. This is because the controversy was not only about 'vitality' per se, but most importantly about how vitality should be measured and its temporal variations monitored. Could the health of populations be measured and supervised by life tables alone, as actuaries and populations scientists had done for more than a century, and as the representatives of the OoA argued in the meeting? Alternatively, as proposed by Manton, should other forms of data about health and disability – and related techniques of calculation – be taken into account and combined with mortality data? Far from straightforward, technical questions, these interrogations problematized the very character of the relationship between data, calculative techniques, expert practice, policy makers and the public. These were thorny questions, of substantial consequence for health and retirement systems.

Life tables constitute one of the most stable calculative devices in population science, from which survivorship curves and computations of life expectancy derive. By contrast, there was no accepted, 'universal' way of measuring population health – the quality of life lived by the surviving population. Just a few years before the Hearing analysed here, Sullivan (1971) had published what is considered a seminal contribution to the measurement of health: an

index of 'health expectancy'. Designed to assist decision-making when 'public health programmes compete with each other and with other government activities for budget allocations' (Sullivan, 1966: 1), the proposed device was explicitly justified by the need to formulate new approaches to population health measurement in a context where*, despite developments in health technology,* there was, as referred above, an observed stabilization of mortality levels in the population. New forms of measurement were necessary, it was argued, not because of technologically driven improvements in life expectancy, but because it was believed that technological advances in chronic disease management would only affect the 'quality' of life, *not* its quantity (Moryama, 1964).

However, at the time, as the joint WHO/International Epidemiological Association Study Group on Measurement of Levels of Health put it, it was 'generally thought impossible to arrive at a composite health scale to suit all comparative situations' (Ipsen, 1979: 16). One of the main challenges of implementing this approach was the lack of suitable, available data to measure morbidity in a sustainable way (Sullivan, 1971). This problem continued to be evident both to Fries (1980: 133) and to Manton (1982) a decade later. This was because there was uncertainty about which data should be collected and for what purposes. Was it necessary to obtain data on illness as well as the impact illness had on function and activities, as suggested by Sullivan (1971)? Or was the data collected by the National Centre on Health Statistics on illness-linked mortality enough to forecast future trends in life expectancy? How were these different sets of data to be combined and composed? Calculative devices had thus an intervening capacity in shaping the controversy on the relationship between the vitality of populations and health technology because, as the meeting made clear, they carried complex assumptions about what population health outcome was politically relevant to measure.

Devicing technological expectations I

The 1983 Senate Hearing on Trends in US Life Expectancy was, as we saw above, set up as an exercise in plotting different projections of life expectancy and how they relate to specific methods of estimation and forms of data. This was explicitly justified by emerging, 'nagging' uncertainties about the robustness of forecasts provided by the OoA. It was the need to 'take into account', as Sen Chafee put it, the place of those forecasts within a wider space of scientific debate and controversy that made the meeting necessary, even if it

meant revisiting policy decisions that were 'supposed to take care of the problem to the year 2000' (Chafee in US Senate, 1983: 6).

Unsurprisingly, given this context, the first witness of the Hearing was a representative of the OoA, Francisco Bayo. Recognizing the weight of public and private accountability bearing upon official mortality forecasts, Bayo's starting point was the intrinsic nature of 'uncertainty about the future' (Bayo in US Senate, 1983: 6). Explaining how the OoA established its 'mortality assumptions' underpinning forecasts, Bayo provided a historical periodization of 'mortality decline'. In the years 1952 to 1968, a stabilization of mortality rates had led to the belief that,

> further declines in mortality would be difficult to achieve because most of the controllable diseases were already controlled and the remaining … degenerative diseases were very difficult to control (Bayo in US Senate, 1983: 8)

Although this belief had been challenged by Crimmins and others (see above), Bayo, drawing on calculations of possible cause of death, was still reluctant to accept that future declines in mortality would be similar to those experienced in the first half of the twentieth century. Past experience was not enough to forecast future mortality: It was also necessary 'to use our imagination' to factor the effect of technological developments and changes in lifestyle (Bayo in Use Senate, 1983: 8 and 22). As a result, the OoA produced a set of three forecasts, presented in detail in life expectancy tables from 1900 to 2080 (Idem: 37-8): one where mortality rates stabilized, another where mortality declines continued (as per the Crimmins calculations), and a moderate scenario where improvements in life expectancy would continue for another two decades and then taper off from 2007 onwards.

Chafee, however, was doubtful whether the moderate forecast was sufficiently robust:

> Sen. Chafee: [T]o a layman, your current intermediate projections seem awfully unrealistic just in terms of historical record. … Why, for example, would you estimate such a drop of mortality improvement at about the turn of century, just as one might expect we could be making major breakthroughs against disease?
>
> Mr. Bayo: A good projection cannot just extrapolate historical trends [and] consideration must be given for the reasons for past declines and the likelihood

> of future declines. … It must be remembered that a projection of continuously declining death rates implicitly assumes a continuous stream of breakthroughs in the control of disease and the ageing process. … A continuation of this recent trend [in mortality reduction] for the next 100 years seems highly unlikely. (US Senate, 1983: 41-42)

In this exchange, Chafee questioned the quality of Bayo's forecasts by making reference to the inaccuracy of previous, recent calculations of future life expectancy provided by the OoA. These errors were produced, he suggested, because of the way in which those forecasts focused on past mortality trends, and failed to take account of 'major breakthrough against disease' in the future. Bayo's reply to the Senator makes clear that government actuaries did, in fact, take in consideration expectations of the effect of technoscientific innovation on life expectancy. Nevertheless, they were less 'optimistic' about the probability of 'breakthroughs' of the kind Chafee imagined.

This contrast between an 'optimist' and a 'modest' or conservative position in relation to the future of biomedical innovation is key to understanding the unfolding of the meeting. Again, these two positions were not de-contextualized divergent 'expert opinions'; rather, they had direct impact on the design and management of public institutions across the US:

> Sen Chafee: … I wonder Mr Bayo how closely you followed this Committee's two year struggle to reach agreement on the Social Security salvation package? Significant changes – such changes in retirement age are very difficult … Wouldn't it be better to represent conservative estimates of mortality that would if wrong provide a happy margin for the safety for these programmes?
>
> Mr. Bayo: … If specifically requested I would be glad to provide Congress with conservative estimates. In the meantime I interpret my principal responsibility as providing my best estimate. (US Senate, 1983: 42)

As is made clear, an 'optimist' position on the effects of technology on human longevity would result in a fiscally 'conservative' arrangement, providing a 'happy margin' of available funds and ensuring the 'safety of these programmes' (see also Manton in US Senate, 1983: 71). The charge appeared to be that by offering a 'moderate' assessment of the effects of

technology on life expectancy, the OoA was endangering the sustainability of the social security system. Lack of enthusiasm for the technoscientific promises of biomedicine and public health could result in the failure of the institutions protecting older and vulnerable citizens in the future. For Mr. Bayo, however, this charge was misplaced because it was the government that specified which type of forecast it required. This stance, in turn, enabled those questioning the panel to explore the basis of upon which this 'best estimate' rested.

Wasn't the problem that the OoA's forecasts relied only on life table data and ignored 'improving techniques of data gathering and analysis' relating to health and disease (Chafee in US Senate, 1983: 42)? Invited to represent the proposed melding of actuarial and epidemiological techniques in life expectancy forecasting were Jacob Brody, of the National Institute of Aging (NIA), and Kenneth Manton, of the Center for Demographic Studies at Duke University.

Brody explicitly aligned his presentation with the Committee's aim to bring a 'new humility' to life expectancy forecasts provided by actuaries. Such need for humility was encapsulated in two graphs he presented to the Hearing: one charting mortality from all causes between 1900 and 1979, and another for the same period but focusing on people aged 65 and over. The charts showed, according to Brody, that while mortality decline for the overall population had occurred most rapidly between 1900 and 1920, shifts in mortality in the older population had occurred mainly after WWII, '*for reasons we just do not understand*' (Brody in US Senate, 1983: 45; my emphasis). This was because, in his view, those decreases in mortality occurred before post-war biomedical breakthroughs or changes in lifestyle took effect. There was hence a deeper uncertainty about the relationship between technology and life expectancy which required 'iterative approaches' between methods of forecasting, and the use of techniques for monitoring rapid shifts in mortality – such as that then observed with AIDS – to enrich mortality assumptions in life expectancy calculations.

Manton, for his part, argued that assessing the 'reasonableness' of life expectancy forecasts was a difficult business, because the assessment had to rely in part on the data on which the forecast themselves were based. Comparing the OoA and Crimmins life expectancy projections, Manton favoured the fiscally prudent/biomedically enthusiastic position. It was not only that the more 'optimistic' forecasts were aligned with the estimated changes in life

expectancy provided by authorities based on 'elimination of cause' method – by Bernard Strehler (1975) and Leonard Hayflick – or extrapolations from current trends (Fries, 1980), but also that 'we may be entering a period of major medical advances' which 'may be traced to the increased funding after WWII of biomedical research on the mechanisms of chronic disease' as well as the more recent investment in research in 'basic aging processes' (Manton in US Senate, 1983: 75).

This assessment, Manton further suggested, justified changes in the infrastructure of data collection and analysis of trends in mortality and morbidity in the population. Manton argued that a series of questions emerged, though, regarding what direction this change should take. Should mortality at later ages be linked to one specific aetiology, and thus entangled with expectations from extant biomedical programmes related to that illness? Or, should they reflect multiple morbidities, and their underpinning by the 'aging processes' and loss of vitality? Was it, indeed, necessary to rethink the 'basic conceptual' relationship between mortality and morbidity so as to formulate 'alternate modes of forecasting'? And what would those 'alternate modes' be?

Both Brody and Manton agreed that it was necessary to monitor not only how changes in disability and 'quality of life' affected life expectancy forecasts but also how it could affect patterns of service use or retirement age. Yet their views of such trends were significantly different. Their presentations to the Committee questioned the narrative of 'rectulangurization of longevity' with which Senator Chafee had opened the meeting (Figure 1). As noted above, Manton (1982) had published an assessment of the shifting relation between 'quantity and quality of life' a year before the meeting. The article suggested that increases in life expectancy would be complemented by an amelioration of the impact of disability on human populations. This, in turn, implied that, at older ages (i.e. 85 years and over), populations might be experiencing some degree of 'horizontalization of longevity'. Brody, on the other hand, was of the view that gains in life expectancy would be significantly offset by such 'de-rectangularizing' trends, resulting in an increase in the quantity of disability in the population. Leveraging his argument against Fries 'compression of morbidity' hypothesis, Brody proposed, just a few months later, that

> Fries' prediction … is based on the assumption … that there will be a postponement of the onset of chronic diseases. Fries suggests this can be achieved by preventive approaches such as stopping smoking … However, this optimistic view must be tempered by two realities: the absence of evidence of declining morbidity and disability in any age group, particularly those age 45 to 64, and the increasing number of people who are reaching advanced age. If current trends continue, the fastest growing segment of the population will be those must vulnerable to chronic disease, the group aged over 85 [and this will entail that] more people will spend longer proportions of their lives afflicted with chronic diseases. Unless preventative measures are extraordinarily fruitful, or successful methods of threating or minimizing the impact of chronic diseases of aging are developed, we will be faced with a burgeoning number of patients in need of long term care (Schneider and Brody, 1983: 855; also Brody, 1985)

By highlighting their different assessments of the future relationship between mortality and morbidity, Manton and Brody effectively made the case for a different system of health surveillance. In a significant way, from their point of view, the Hearing was not the place to discuss whether the 'rectangularization of longevity' was occurring, but to shape the devices, procedures and institutions that would support the collective production of knowledge on population health. Indeed, the ceremonial enactment of disagreement justified the argument for the creation of a new health data management infrastructure supported by, for example, 'modern computer technology [and] new tools such as the National Death Index' (Brody in US Senate, 1983: 45).

The need for new calculative devices, and new forms of data collection, resulted from a critical appraisal of the life table as a technology of insurance. The life table, it was argued, was limited in its capacity to monitor and forecast changes in populations where life expectancy responded to shifts in patterns of mortality across the life course. These patterns where themselves sensitive to complex causality processes in the production of health, some of which, as Brody put it, 'we just do not understand'. The new devices – and the infrastructure that they embedded – aimed at melding actuarial and epidemiological procedures and ways of reasoning, promising to make the monitoring of population health more sensitive to change, so as to avoid another 'social security crisis'. Political and

institutional stability could only be guaranteed, Manton and Brody seemed to be arguing, if the calculative infrastructure of population health took seriously the question of the relationship between quantity and quality of life. New devices were needed to mediate between a new dynamics of population health and a new politics of social security and health care.

Devicing technological expectations II

In the previous section, I explored how the Senate Hearing on Trends in Life Expectancy was able to open up uncertainties about the robustness of existing methods of calculation of probability of death for different age groups. In particular, I described how the OoA's 'best estimate' on future life expectancy was weakened by a close scrutiny of its methodological procedures and a critique of its technological conservative assumptions about the pace and effect of biomedical innovation on health and mortality in future populations. New devices and data systems were proposed that could enact the complex, indeterminate and multifarious nature of population health.

Questions remained, relating to whether the magnitude of uncertainty and disagreement about the shape of future populations health clearly justified such an overhaul of the systems of data management and expertise on which social security and health care systems relied. What would be the difference between 'technologically conservative/fiscally liberal' and 'technologically optimistic/fiscally conservative' approaches on the future budgetary structure of social security and linked health care systems? As Bayo clarified in both his written submission and his witness statement,

> The cost of the program under the intermediate [mortality] assumption is now estimated at 12.84 % of taxable payroll. If we use the [most technologically conservative] assumption, that is people dying sooner, the cost will decrease by about 2/3 of 1% of taxable payroll. If we use the [most technologically optimistic] assumptions, that is of people living longer, then the cost will go up by about 1% of payroll. … What I wanted to emphasize is that the increase or decrease in cost is not as large as we would imagine at first sight. (Bayo in US Senate, 1983: 9-10)

With this statement, Bayo wanted to re-assure the Committee that if projections based on mortality assumptions differing from those underpinning the 1983 Social Security

Amendments were to come to pass, the budgetary consequences would not be unsurmountable. Such reassurance was, as Chafee's subsequent questioning makes clear, itself underpinned by an assumption about future Congresses' willingness to raise taxes, or re-design the system so as to ensure the sustainability of social security and related health care programmes. For the public, 1% meant 'a very, very large sum of money, and indeed could significantly affect the viability of the system' (Chafee in US Senate, 1983: 40). By stressing the uncertainty infusing the political ability or willingness to raise taxes to this effect, Senator Chafee was marking a key boundary between Bayo, who, if only for representing 'the accuracy of the cost estimate', was prepared to assume a fiscally liberal position, and himself who – along with Senators Dole, Myers and others – had represented the fiscally conservative stance in the social security crisis of 1982-83.

This meant, in effect, that a fiscally conservative position entailed exploring possible states of population health that went beyond the different mortality assumptions of the OoA, or the prospects offered by the melding of actuarial and epidemiological techniques. Rhetorically, the argument worked as follows: while fiscally liberal policymakers might be satisfied with underwriting cost estimates based on unreliable life expectancy forecasts, fiscally conservative ones would want to embed safety in the system by considering 'the ramifications of [experts] being wrong' (Chafee in US Senate, 1983: 44). Crucially, this also meant going beyond the 'rectangularization of longevity' expert narrative which had initially framed the meeting (see above).

In venturing in this direction, the Committee was not charting previously unknown politico-epistemic territory. Five years earlier, the Select Committee on Aging of the House of Representatives had held a hearing on 'Life Extension and Tomorrow's Elderly', which aimed to assess the imaginable effects of technological innovation on life span. One of the witnesses to that 1978 Hearing was Alex Comfort, a leading gerontologist of the time (Comfort, 1976). He argued that the current innovation system, focused as it was on components of age related morbidity (illnesses), would enable the 'rectangularization of longevity'. However, a new emerging technological approach to vitality explored 'the possibility of resetting the clock' that controlled the onset of age-associated morbidity (Comfort in House of Representatives, 1978: 17; also Comfort, 1968, Moreira, 2017). Comfort's suggestion was that 'any intervention which alters the basic datum of the lifespan

even by 0.25% is going to *knock the floor out of all actuarial forecasting*' (Comfort in House of Representatives, 1978: 18; my emphasis).

Supporting Comfort's claims was his friend Leonard Hayflick. Hayflick was, by then, famous for the discovery of the celullar replicative limit (cellular senescence), which overturned previous theories about the potential immortality of cultured cells, and the related hypothesis that ageing related illnesses were 'whole organism' phenomena (see above; also Landecker, 2009). Hayflick presented himself as 'more negative than Dr. Comfort' on the possibility of fundamentally modifying the conjectural 'biological clock' that regulates human longevity (Hayflick in House of Representatives, 1978: 29). His more unassertive account of the promises of 'fundamental research on the biological causes of ageing' came from his view that not only research on this domain was still incipient but also because there was a lack of reflection about the 'complex problems' that life extension could bring in future, particularly how to balance the trade-offs between quantity and quality of life (Hayflick in House of Representatives, 1978: 29-31).

Emulating the pairing of experts in the Hearing on Life Extension, the Senate Hearing on Life Expectancy invited Roy Walford from UCLA, who had been a witness on the Greenspan Commission, and, again, Hayflick, by then President of the Gerontological Society of America. Their role, as suggested above, was to shore up the fiscally conservative stance by providing a bolder horizon of technological promise on life expectancy, and in so doing, to re-shape the techniques and procedures used to quantify population health. However, re-imagining the future of population health from the perspective of ageing research had consequences for how the success of the innovation system was evaluated and made accountable. In particular, it raised questions about what type of 'health' innovation systems were strategically pursuing, and how it could be measured; that is to say, questions about the very ability of different calculative devices in bringing to bear the states of health that would be publicly desirable.

Focusing on the strategic aims of the innovation system, Walford distinguished between 'curve squaring technologies' and those aiming to modify the ageing process, which he termed 'span extending technologies' (Walford in US Senate, 1983: 117). In this sense, he was echoing fellow gerontologists Comfort and Strehler (1975; Figure 2), by arguing that

biomedical research – with its focus on disease specific programmes – could only extend life expectancy to the limits calculated by Fries and others. Although such a 'rectangularization of longevity' scenario had significant implications for public and private retirement and health care programmes, as the Hearing had made clear, it was based on the expectation that gains in health and life expectancy were most likely to occur at older ages. This reduced the range of socio-economic consequences arising from that scenario, mostly concerned with shifting age-dependency ratios and retirement age. Consequently, he argued that focusing on 'curing diseases had bad economic potential for the population' (Walford in US Senate, 1983: 119).

[INSERT FIGURE 2 APPROXIMATELY HERE]

Conversely, life extending technologies would work by stretching the period of 'adult vigour', leading, in the long run, to a 'biological and social revolution' (Walford in US Senate, 1983). Again, life tables and survival curves as calculative devices were key to the articulation of this technoscientific promise. As can be seen from Figure 2, extracted from Strehler's (1975) key paper on the 'implications of aging research for society', curves A, B and C represent the *calculable space of longevity* within the technological frame proposed by biomedicine and public health. This is one where, by elimination of causes of death, a more square survivorship curve would be obtained (also US Senate, 1983: 141). Curves D, E and F inscribe, on the other hand, an alternative calculable space, where through the application of technologies that fundamentally alter human genomic and homeostatic processes, the 'whole [curve] would move to the right' (Comfort, 1968: 100). This new biopolitical order would be underpinned by a re-structured life-course, with five generation families, multiple successive careers, and lead to a new intergenerational economic contract (also Walford, 1983).

Hayflick again played the role of the more 'realistic' forecaster, mediating between the actuarial, the epidemiological and the gerontological positions as they were enacted in the Hearing. He agreed with Walford – and Brody – that the current technoscientific horizon of 'rectangularization of longevity' inevitably 'would increase the proportion of older people' and therefore of frailty and disability in the population (Hayflick in US Senate, 1983: 199). Yet, he was unsure whether it would be possible to create the new biopolitical order

promised by Comfort and Walford. Hayflick identified two significant barriers to the fulfilment of this promise. One, as suggested above, was that policymakers and researchers were ensnared in the technological pursuit of the 'postponement of death'. This normative, strategic goal was reinforced by how the success of technological innovation in health was measured, which constituted the second obstacle. Measuring improvement in population health through increases in life expectancy, Hayflick seemed to argue, entangled population health in a narrow and limited quest. What was instead required was the creation of a new system of measurement that detected and monitored the maintenance of 'adult vigour', and substituted calculations indexed to chronological age with 'biological age' (Moreira, 2017).

Gerontologists thus presented a challenge to the actuarial status quo that was substantially different from that posed by epidemiologists. While the latter proposed that new calculative procedures and data systems were necessary to monitor the complex, indeterminate and multifarious nature of population health, gerontologists highlighted the close interconnection between the systems used to measure population health and the expectations put on the biomedical innovation system. They questioned whether 'rectangularizing longevity' should be the consensual promissory horizon of technomedicine and public health; in so doing, they identified the limits of the biomedical imagination. To the committees' question about the reasonableness of their own, alternative technoscientific promise, Hayflick argued that since 'predicting the course of scientific progress [was] inherently unscientific' (Hayflick in US Senate, 1983: 199), actuarial, epidemiological and gerontological forecasts should be seen in same light. However, while actuarial and epidemiological techniques locked scientific, public health and health care institutions in the management of age-related diseases (and in the question of the trade-off between quantity and quality of life), gerontological research and techniques of measurement could unravel a new form of population management.

Rather than focusing on the likelihood and desirability of such promises (e.g. Anton, 2013), crucially, from the point of view of this article, Hayflick and Walford uncovered how the limits of the biomedical imagination were maintained by calculations of life expectancy. In this regard, they questioned whether the melding of mortality and morbidity could actually break the bounds between what Foucault labelled 'insurance or regularizing technology'

(Foucault, 2003: 222) such as life tables, survival curves, and mortality assumptions, and a society that 'regards the increasing number of older people as a burden which must be endured' (Hayflick in US Senate, 1983: 203), the 'ageing society'. To create the 'Long Living Society' (Walford, 1983: 176-202), it was necessary to re-arrange the pairing of technological expectations and the system of monitoring population health, it was necessary to device population health differently.

Conclusion

In this paper, I have addressed the questions of whether, to what extent and through what means was a shift from mortality to morbidity achieved in the knowledge and management of contemporary populations. The analysis presented here suggests that there has been a re-composition of the problematic of population health. Specifically, population health sciences are now primarily concerned with investigating the relationship between mortality *and* morbidity or health. I have done this by analysing the proceedings and sociotechnical network of one particular Hearing in the US Senate in 1983. This meeting, I argued, publicly stabilized the relative position of diverse expert views on the techniques and procedures of calculating forecasts of population health, and brought those to bear on the policies and budgets of social security and health care programmes.

The Hearing analysed in the paper did this by focusing on two questions: Were life expectancy calculations based on life tables alone an adequate technique to monitor and forecast populations? What could alternative calculative devices do to population health? The statements and proceedings of the meeting provided two answers to this question, which were the focus of the two previous sections of the paper. One the one hand, devices inscribe what factors are taken into account in the production of population health. They make available the list of relevant entities – and related data – from which health is calculated. They also determine how 'health' is enacted in its measurement. On the other, devices themselves frame the making of technological expectations on human health and longevity. They constrain the possibilities of conceivable, imaginable future populations. But, conversely, these 'inherently unscientific' estimations also limit the scope, aim and structure of calculative devices, dictating what measurement of population health should be pursued and calculated.

My argument was not that there was a causal relationship between the meeting and contemporary population health science by establishing a foundational ground for a field of research. Instead, my argument was that the Hearing clearly articulated what have become contemporary concerns about the measurement of health. It did so by defining - in a public forum - the relative positions in a continuing controversy about the future of population health. Contrary to versions of this controversy that emplaced it solely in the technical domain and extrapolate consequences for health care and retirement budgets, the analysis of the meeting presented above showed how it laid bare the intricate relationship between the technical and the political. I suggested that this was because the meeting made explicit how devices used to measure population health are entangled with differing expectations about the effects of health technology on human health and illness, and corresponding divergent visions of future human societies. As the Hearing proceedings make clear, calculative devices are key instruments in making those futures possible, in bringing them to bear. To put in another way, the analysis of the meeting enables us to understand why the problematic of population health measurement is central to the governance of contemporary societies.

In the Hearing, two standpoints on this problematic are easily identifiable, one that binds optimist technological expectations to fiscally conservative policies, and another whereby modest expectations justify strong health and social care programmes in later life. As I suggested at the beginning of this article, the tension between these two positions might be usefully understood as part of the dynamic between the regimes of 'hope' and 'truth' in contemporary biomedicine (Moreira and Palladino, 2005). In this dynamic, hope is concerned with the fabrication of expectations and future possibilities. Action is typically oriented towards the potential that knowledge-making embodies, valuing, for example, measurement techniques by the future they might be able to bring about. Truth, by contrast, is concerned with the fabrication of proofs and testing knowledge claims. Practice is thus oriented towards using measurement as a form of 'reality test'. In the Hearing, these two positions became ensnared in a relationship of mutual interdependence, promissory technological scenarios hinging on the analysis of what the current situation *is*, and calls for accurate measurement of mortality and morbidity being justified by what a future, technologically-enhanced population health *could be*. Viewed through this lens, political

positions on population health that are generally seen as separate would be best analysed as entwined parts of the same assemblage, an assemblage that exactly relies on the iterative mutual criticism between these two politico-epistemic stances on population health. STS critiques of the making of technoscientific expectations in health and ageing might be merely reinforcing this dynamic rather questioning it.

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