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The Concept of Generation in Biology and Medicine

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The term *generation* originally stood for *procreation*: the (momentous) act of creating a new being out of paternal and maternal contribution under the influence of the procreative environment (Hopwood, 2009). Prior to the 18th century, wrote the French biologist François Jacob, living organisms did not *reproduce* – they were *engendered* in the act of *generation*, always a unique, isolated event (Hopwood, 2018, p 288). In the context of genealogy, *generation* also carried a metaphorical meaning: it described the number of successive procreative acts in a line of descent (Parnes, Vedder and Willer, 2008). But with the emergence of the novel concept of *heredity*, as a material entity that determined the characteristics of the organism and that was passed across generations akin to legal inheritance, the term *generation* was increasingly replaced with the term *reproduction* (López-Beltran, 1994). The new term highlighted *re-production*, or copying, of the ancestral traits, in contrast to the unpredictable, unique, and divine nature of procreation.

Yet the term *generation* did not disappear. Rather, it launched a new career, as it began to stand for a collective (of humans, or other organisms) born around the same time (Parnes et al, 2008). Generations could denote groups within families but more often they referred to individuals born around the same time. Indeed, the notion of *generation* incorporated 'historical time', a novel concept around 1800, which stood at the centre of new ways to understand the world (Wülfingen et al, 2015). The older, static approach, concerned with collecting, describing and classifying the objects of natural history created by God, did not see nature in terms of temporal change; but from around 1800 a series of methodological approaches that then became new disciplines concerned with change across

time emerged: history, geology, embryology and evolutionary science, to name just some.

This temporal view of the world extended to the explanations of contemporary society through the 19th century. With an increased social mobility in the age of revolutions and rapid technological change loosening the ties with parents, the communities of contemporaries came together on the basis of shared experiences and outlooks. The capacious definition of *generation* allowed different disciplines to appropriate the concept in various ways. At the same time as biologists (Carl Nägeli, Gregor Mendel) articulated a new idea of biological reproduction through generations, political philosophers such as Auguste Comte and Karl Marx envisaged human society as a succession of generations and writers (e.g. Ivan Turgenev in his *Fathers and Sons*) described the growing political and cultural schisms through accounts of generational conflicts (Parnes et al, 2008, pp 203–17).

The career of the term *generation* in social sciences of the early-to-mid 20th century is well described. In the 1920s, the sociologist Karl Mannheim published his now-famous essay 'The problem of generations', a systematic consideration of the issue of generations in the human society (Mannheim, 1952 [1928]). Mannheim argued that people in the formative age of youth and adolescence are significantly influenced by the socio-historical environment. This strong and lasting influence, based on the shared experience, produced the social phenomena of generations.

Karl Mannheim's work had enormous influence on thinking about societies, including the work of scholars across many disciplines (White, 2013). Many chapters in this volume demonstrate the continued strength of generational thinking across humanities and social sciences as well as broader culture. In this chapter I focus on a less examined aspect of 'generational thinking': the ways in which human biological and medical sciences, as well as social sciences that heavily drew on medical concepts – such as the fields of social work and social psychology – used the term *generation*. While there is excellent historical scholarship examining the turn from generation to reproduction and the career of *generation* in the 19th century (for example, Hopwood, 2018; Parnes et al, 2008), there is far less on the concept of generation in sciences over the past hundred years. This chapter is an attempt to write this history: a selection of cases and stories that captures, in my view, the most significant developments and transformations. I pay particular attention to the adjectives *intergenerational* and *transgenerational*, which, I argue, allowed scholars, physicians, social workers and other interested people to describe the recurrence of phenomena that could not be explained using the concepts and methods of the dominant science of heredity, genetics. By using these terms, these 20th-century scholars, social workers, clinicians and activists brought together the new, horizontal

meaning with the older one, which united procreation, procreative environment and lineage.

The chapter consists of three main sections, alongside the introduction and conclusion. In the first, I will briefly examine the terminology that scientists and social workers used to describe the recurrence of phenomena such as addiction or mental health problems in families through the first half of the 20th century, at the time when heredity became synonymous with genetics. Developed during the heyday of eugenics, a broad set of ideas proposing the use of science to improve the 'quality' of human population, the terms *social problem group* and *problem families* captured these non-genetic yet recurrent issues of medical and social importance. In the aftermath of the Second World War, as I show in the second section, the public support for eugenics weakened. The increasingly popular language of *generations* was used both for what used to be termed *problem families* but also to describe the lasting trauma of the Second World War, especially the second generation of the Holocaust survivors.

Psychoanalytic psychiatrists and psychoanalytically trained social workers played a key role in the development and propagation of these concepts. Descendants of ethnic and other groups, and especially Indigenous peoples in former settler colonies, who had suffered colonization, genocide and violence, picked up on the language of intergenerational trauma to make sense of the burden of trauma they had experienced growing up in families oppressed by painful memories and stories, and strengthen political arguments for recognition, reparations and sovereignty. In this work the procreative link was weakened to make room for the shared 'cohort' experiences. But by the 1980s, biological psychiatry, which sought to explain mental illness as a consequence of the disruption of the biological functions in the brain, began to replace psychoanalysis as the dominant intellectual trend. The third section investigates how the question of the cause and mechanism of the intergenerational trauma became part of a broader reconsideration of the nature of heredity that reintroduced environmental influence back into the picture. Heredity could now be not just genetic but also intergenerational and transgenerational heredity, persisting for two, three or more generations. Under the guise of the new science of epigenetics, the 'old' meaning of *generation-as-procreation* was revived again.

'Social problem group' and 'problem families' in the era of eugenics, c. 1900 to 1940s

While the notion of material heredity was introduced in the early 19th century, its nature, susceptibility to environmental change, as well as the laws and mechanisms of its transmission, remained open for debate for decades (López-Beltran, 1994; Müller-Wille and Rheinberger, 2007). In the early 1900s a new discipline with a mission of explaining the distribution of

hereditary material across generations was named *genetics*, but the extent to which hereditary material – the nature of which was unknown – was susceptible to environmental modifications remained open for a few more decades (Sapp, 1987; Burian et al, 1988; Graham, 2016; Buklijas, 2018). Yet by around the 1930s the consensus was created that the stability of the hereditary material transmitted across the generations was the key criterion for true biological inheritance. In short, only genes counted.

The relationship between this new, experimental science of genetics, and the (older) social programme of eugenics has been extensively examined (Kevles, 1985; Roll-Hansen, 2010). The late 19th-century anxieties over the challenges to the social order, political upheavals, the falling birth-rate in educated and wealthy classes, the perceived decline in the biological 'fitness' of young generations, all supported interest in the biological basis of these changes, and genetics provided a scientific method and language to study the problem (Bland and Hall, 2010). Both geneticists and eugenicists subscribed to the idea of stable heredity; many geneticists agreed with eugenic social goals; eugenicists by and large copied the genetic methodology. They collected human pedigrees and mapped loosely defined traits such as 'alcoholism' or 'insanity' onto human genealogy charts similarly to the geneticists' mapping of the fruit fly eye colour or plant height (Bland and Hall, 2010).

But observations collected on humans did not always lend themselves easily to the geneticists' methods. Most traits that were distributed according to Mendelian ratios – albinism, polydactyly, haemophilia – were comparatively rare and so, while often clinically severe, not significant at the population level. Yet those recurring traits that appeared frequently and were of high social concern were hard to fit into the neat Mendelian categories. Geneticists and other biological and medical scientists were increasingly critical of the 'reckless statements' of eugenicists (Roll-Hansen, 2010, p 85). Instead, they supported medical research that would look beyond pedigrees to understand the reasons for recurrence of mental disorders in families.

A new language to describe these recurring yet 'non-genetic' phenomena was needed. Geneticists' criticisms of eugenics did not mean that eugenics was no longer popular. Even left-wing scientists still subscribed to it, though they argued that eugenic methods can only be applied in a socially and economically equal society. In an equal society, they suggested, differences caused by socioeconomic inequality would disappear; and then we could claim that the remaining pathologies are truly heritable (Kevles, 1985).

Moving away from pedigrees yet staying with the idea that it is possible to find a scientific solution to the population-level problem of aggregation of people with mental illness, addiction or intellectual disability in certain families, in 1929, the Wood Report on Mental Deficiency claimed that mental defectives and their families were concentrated in the *social problem group*, making up the bottom 10 per cent of the society – 'habitual slum

dwellers', paupers, prostitutes, homeless, unemployed (Welshman, 1999, p 459; Welshman, 2013, p 68). The Eugenics Society tried to capitalize on this concept and entice the interest of the broader public; intellectuals across the political spectrum were attracted to this idea, including Richard Titmuss as well as Julian Huxley, British geneticist, evolutionary scientist and science popularizer known for his left-wing politics. In 1937, Huxley presented the Eugenics Society film *From Generation to Generation*, which advocated eugenics as a social science that could solve the social problem group (Bland and Hall, 2010, p 219; Weindling, 2012). Yet the research commissioned to find the evidence, and hence strengthen the argument for the use of eugenic policies on this group, failed to support these claims. The economic crisis, the Second World War, the emerging consensus on the future welfare state, all contributed towards both weakening of the interest in this concept and the support for eugenics overall (Welshman, 1999).

In the course of the Second World War the notion of the *social problem group* was, importantly, replaced by the notion of *problem families*. The former concept was a sociological, collective term created out of population studies. It implied a solution at population level: through the access to birth control, sterilization (voluntary but within a society alert to and compliant with eugenic goals), segregation and immigration restriction (Bland and Hall, 2010, p 219). The latter, by contrast, was created by social workers in Pacifist Service Units (PSUs), whose pacifism was expressed in explicit commitment to 'relief and other social work … for the benefit of the community at large' (Starkey, 2000, p 8). And while the PSU cared for people affected by the bombing of the British towns and mass evacuation of children, from the start they had (implicit) ambition to continue their work after the war is over. Their work was institutionally supported by the development of new publicly funded welfare services and underpinned by an increasing concern over the welfare of the child.

This shift from *social problem group* to *problem families*, however, did not mean that the concerns over the hereditary, 'fixed' basis for the recurrence of undesirable traits and behaviours disappeared. Eugenically inspired explanations persisted decades after the war; the Eugenics Society formed its Problem Families Committee in 1947 (Welshman, 1999). Problem families were understood as those who, for various reasons, required additional help from social services. But, once the post-war welfare state provided a safety net against the worst poverty, and to some extent remedied some of the factors arguably causing 'problems' in *problem families*, the arguments for their 'innate unfitness' ostensibly gained strength. Indeed, the discourse of *problem families* reached its peak as eugenics as an idea and the field weakened; however, from the late 1950s onwards the looseness of the concept, lacking evidence, unexamined biological assumptions and implied class connotations, all led the growing field of social work to abandon it.

Intergenerational cycles of disadvantage and the generations of trauma, c. 1950s to 1990s

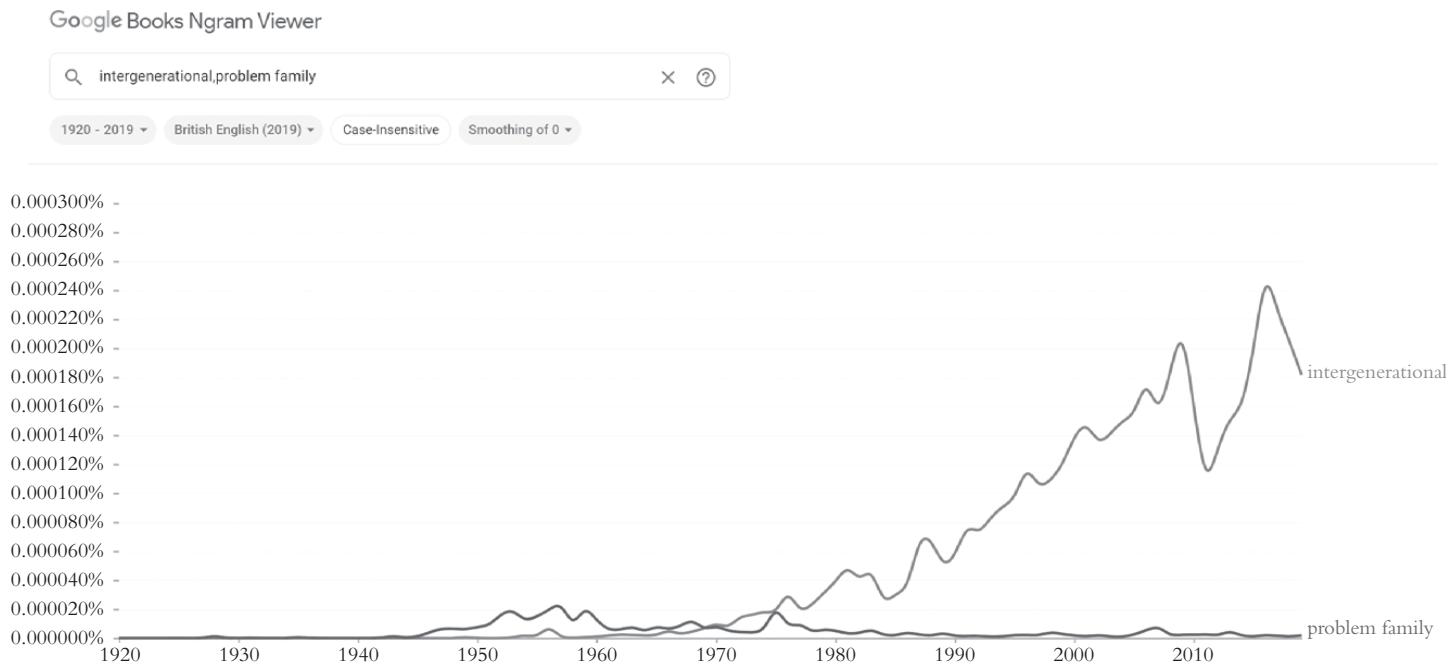
The notion of *intergenerational cycles* (of poverty, deprivation, violence, addiction) emerged in literature – especially in social work, social psychology and education – just as the notion of *problem families* began to fade. In the US medical database PubMed the earliest articles with the adjective 'intergenerational' in the title date from 1954 (Kantner and Kiser, 1954). This finding corresponds with the frequency of both terms in the British English corpus searched using the Google search engine and presented in Google Ngram Viewer (see Figure 4.1). Figure 4.1 shows how neither the term 'problem family' nor 'intergenerational' was in use before the 1940s; but while 'problem family' reached its peak in the late 1950s and then started to decline, the popularity of 'intergenerational' has been increasing overall, despite peaks and troughs.

There is, undoubtedly, a link between these two terms. They both referred to the repeated occurrence of poor health, low educational attainment, addiction and criminal activity, within families and across generations. Yet where *problem families* pointed directly to the family as the locus and cause of the observed behaviour or phenomenon, the concept of *intergenerational cycles* had a more neutral undertone. It called the attention to the repetition of the observed phenomenon across generations ('cycles') but without a judgement placed on the family – a word replete with emotions. The new concept may have been introduced to distance social work and public health from increasingly unpopular eugenics. But *intergenerational* also contained the term *generation*, which was becoming increasingly popular as an explanatory tool in post-war social science (Brumberg, 2015; Bouk, 2018; this volume). It connected the (newer) understanding of generation as a horizontal grouping (cohort) with the vertical transmission, which in turn incorporated both cultural transmission and a biological link, the older meaning of 'generation', yet without explicit reference to a direct biological connection.

Indeed, this lack of explicit reference to the mechanism of transmission in the early papers was probably intentional. The search for a cause of a material, biological nature – genetic or otherwise – could have been interpreted as a revival of eugenic practices. But also, social workers used this term as a diagnostic category to which they applied social welfare tools. A loose definition and a broad scope of their work allowed them to capture, and act on, a wide variety of behaviours and phenomena – from poverty and parenting to alcoholism and drug addiction (Wolin et al, 1980; Ijzendoorn, 1992; Rodgers, 1995).

A distinct generation that came to occupy a prominent place in the changing understanding intergenerational transmission of trauma and, hence, in the conceptualization of 'generations' in medicine and related fields, were

Figure 4.1: The frequency of the term 'intergenerational' compared to the term 'problem family' in Google's text corpora in British English, dated between 1920 and 2019



Source: Google Ngram Viewer

the children of the Holocaust survivors. Post-1945, hundreds of thousands of people emerged out of the concentration camps and ghettos into the world they no longer recognized (Cohen, 2006; Zahra 2011a; Zahra 2011b, pp 3–6; Cohen, 2006). Rebuilding lives back at home was the obvious route to health and normality for all victims of the war, but most Holocaust survivors had no family and no home to return to, through destruction, political change or the hostility of the remaining population in their home countries who might have profited from their disappearance.

Many emigrated to the newly founded state of Israel, to North America or even Australia and Latin America, where they encountered psychoanalytically trained social workers and psychiatrists, many Central European Jewish émigrés themselves (Quen and Carlson, 1978; Cohen, 2006, p 135). These experts interpreted the survivors' trauma using the existing psychodynamic, primarily psychoanalytical, frameworks, in which early childhood experiences and especially family relationships are the key forces shaping personality including their response to trauma (Cohen, 2006, pp 135–6; Zahra, 2011a). The earliest publications that explained the human response to trauma using the psychodynamic framework came out even before the end of the war though these studies were not on Holocaust survivors. A study of the response of London's children to evacuation at the time of Blitz by Freud's own daughter, Anna, and Dorothy Burlingham, argued that the separation from families was a greater source of trauma than the German bombing campaign itself (Freud and Burlingham, 1943; Zahra 2011b, p 89).

But following a period of intense concern with the survivors' trauma immediately after the war, the public interest in the survivors' suffering and help offered subsided (Friedman, 1949; Cohen, 2006, pp 141–2). Historians offer two explanations for this shift. First, psychological help was not part of the help package either in displaced person camps or in the countries in which the survivors returned or newly settled (Cohen, 2006, pp 137–9). Second, in the Freudian psychoanalytic framework the core trauma was caused in the childhood; the concentration camp could only aggravate a trauma that had already existed. Rather than seeing the Holocaust as an exceptional event that fell well beyond the normal human range of experience and response, the unimaginable crime was shorn of its political, ethnic, collective context and 'universalized', by forcing it into existing psychoanalytic categories (Cohen, 2006, pp 139–40). Several decades later, psychiatrists suggested that universalization belied something deeper, the inability of psychiatrists themselves to confront the enormity of the Holocaust (Bergmann and Jucovy, 1982, pp 3–7).

Yet just as the initial interest began to fade, around 1950, a formal structure to support the new and sustained wave of the Holocaust research began to develop. The German Federal Indemnification Law (*Bundesentschädigungsgesetz*, BEG), encompassing three separate laws adopted

in 1952, 1953 and 1956, was introduced to recompense the victims (Federal Ministry of Finance, 2011). Medical and psychiatric assessment was required to establish a link between the abuse sustained during the war and physical and medical disabilities suffered at present (Bergmann and Jucovy 1982, pp 7–8). Many pressed claims and underwent required psychiatric examination (Bergmann and Jucovy, 1982, pp 62–79). Clinical data began to accumulate at the same time as the memoirs and research of psychiatrists-survivors of the Holocaust were published (for example, Viktor Frankl (1959) and Bruno Bettelheim (1943)). From the initial universalist position the pendulum swung towards particularism that recognized the unique trauma that was the Holocaust. At the same time, the idea of the Holocaust as the source of Jewish identity developed partly through conscious efforts by Jewish leaders and through media, for example, through the televised trial of the 'Final Solution' architect Adolf Eichmann or through documentaries and films (Grimwood, 2007, p 40).

Initially the medical attention focused on the survivors themselves rather than their families. Right after the Allied victory, Jewish children represented one of the smallest ethnic groups among the displaced people of Europe, largely because Nazis and their collaborators murdered those too young to work (Zahra, 2011b, p 96). But as early as 1946, that changed dramatically: the birth rate among Jewish survivors was exceptionally high, even in the context of the fertility increase across the Western world, which would become known as the 'baby boom' (Grossman, 2007, pp 184–236). For many, having children was a way not only to restore their family trees reduced to stumps by the war and genocide, their own lives and hopes for future, a life-affirming act amidst chaos and pain, but also to show themselves and the world that the physical and psychological trauma did not render them incapable of childbearing (Grossman, 2007, p 187).

By the 1960s and 1970s an entire new generation born in the late 1940s and early 1950s, whose parents had survived the Holocaust, was coming of age. Though some received psychiatric help throughout their childhoods, it was only in the late 1960s that psychiatrists began to connect their mental health symptoms with the parental Holocaust experiences (Bergmann and Jucovy, 1982, pp 33–8). Study groups of psychoanalytic psychiatrists working in places such as New York and Tel Aviv created frameworks for the diagnosis, specifying who counts as the 'Holocaust survivor', and developed treatments. Through their work, the *second generation* trauma became a recognized clinical phenomenon (Kestenberg, 1972; Bergmann and Jucovy, 1982; Solkoff, 1992). Psychiatrists and their patients wrestled with the difficult question: if the family was the solution to the trauma of the war, what to do when family itself becomes the source of trauma?

From clinical medical journals and books, the *second-generation* voices came into the public realm. Perhaps the best-known writer was Helen Epstein,

born in 1947 in Prague to the newly forged family of two Holocaust survivors who then moved to New York. Her childhood took place in the shadow of the enormous loss that her parents had to live through as they built a new life in an environment so unlike the Central Europe of their youth. Her *Children of Holocaust* interwove a personal memoir, interviews with other second-generation children with a history of post-war reckoning with the trauma of the Holocaust in politics and in medicine. The book was hugely successful, but perhaps more importantly it became a model for the *second generation* writing (Epstein, 1979). This new *second generation* genre combined creative components – memoirs, biographies, novels, even visual arts, such as Art Spiegelman's famous graphic novel *Maus* – with an abundant use of psychoanalytic concepts to explain and situate personal emotions and experiences into longer family histories, sometimes even including essays by psychiatrists alongside creative writings (Steinitz and Szonyi, 1976; Berger, 1997; Sicher, 1997; Berger and Berger, 2001; Spiegelman, 2003 [1986–1991]).

These books presented a more intimate, individualized way of centring the Holocaust alongside public and mass manifestations of cultural memory. They provided a way for this distinct group within the *baby boom* generation to formulate its unique identity. The *second generation* had many shared characteristics with their larger *baby boom* peer group but also its exceptional features: extraordinary parental experiences, separated or destroyed families, and connections to places that no longer existed or could not be visited any more, in the divided post-war Europe.

It is through this lens of belonging to the larger *baby boom* generation, while also being uniquely and profoundly marked by the Second World War, that we can understand how the offspring of the other side – 'Nazi children' as the authors of *Generations of the Holocaust* would put it – came to be studied alongside the survivors' children almost as soon as the concept of the *second generation* was created (Bergmann and Jucovy, 1982, pp 161–227). A specific element in the development of their trauma, it was argued, was the silence that descended upon their early years after the end of the war (Bar-On, 1989). Originally focused on the perpetrators' children only, by the late 1980s German psychiatrists and writers proposed a much broader notion of *Kriegskinder* ('children of the war'). This concept was created to encompass a broader category of (non-Jewish) children born between 1930, or sometimes 1939, and 1945, in Germany, and who were too young to serve in the military yet old enough to remember hunger, destruction and violence (Bode, 2004; Lohre, 2016). Not only were all of them profoundly marked by this trauma, but moreover, it was argued, they transmitted it to the next generation, to the 'grandchildren' (*Kriegsenkel*) born decades after the war.

This literature then helped communicate the idea of the *second generation* to other groups whose parents or ancestors had suffered from mass violence.

A 1998 volume on transgenerational trauma included chapters on the multigenerational impact of the Turkish genocide of the Armenians, Japanese Second World War occupation of Indonesia upon the Dutch settlers; Stalin's persecutions in Russia; ethnic conflicts in Nigeria, to name just some of them (Danieli, 1998). The concept was embraced perhaps the most wholeheartedly by Indigenous activists and scholars in the former settler colonies of the British Empire: Canada, United States, New Zealand and Australia. In these countries where many Holocaust survivors and their families settled after the Second World War, public commemorations of the Holocaust and writings of the *second generation* made its memory a paradigm for a mass trauma. In the United States an entire new generation affected by the war, the young men returning from the Vietnam war – whose mental health and self-destructive behaviours spurred the new diagnostic category of post-traumatic stress disorder (PTSD) – helped the institutional medical recognition of collective trauma that extended well beyond the US borders (Young, 1995, p 108).

The medical recognition ensured the communication of knowledge of collective trauma through education and professional training. Indigenous people trained as social workers and clinical psychologists became acquainted with the concept of intergenerational and transgenerational trauma through their education. Perhaps the most influential were the social worker Maria Yellow Horse Brave Heart; Eduardo Duran, psychologist and Vietnam war veteran, and, public health researcher Bonnie Duran, working with the First Nations of the Pacific West Coast (Duran, 1995; Brave Heart, 1998). These scholars generalized the 'children of the Holocaust' or *second generation* notion into a concept of broader geographical, temporal and clinical scope (Mohatt et al, 2014).

Researchers and activists worldwide embraced this expanded concept, under the names *intergenerational*, *transgenerational*, *multigenerational* or *cross-generational trauma*. It was capacious enough to include experiences of torture, internment, colonization, slavery, political persecution, war, genocide, colonization, land dispossession, loss of language and culture. The reference to multi- or transgenerational transmission allowed for the inclusion of trauma experienced by ancestors many generations earlier. Some argued that while *intergenerational trauma* should be reserved for the inheritance of trauma within families, we should also recognize a related yet distinct type of shared and heritable group experience, termed *historical trauma*. For the latter the link with parental or grandparental suffering was presumed rather than diagnostically established (Mohatt et al, 2014, p 2).

The concept of *transgenerational trauma* had many uses, especially as the vertical generational link was loosened, allowing 'generations' in medicine too to stand for groups with shared cultural and political experiences rather than successive lines of descent. It could explain the persistence of poor health

outcomes – high levels of addiction, mental health disorders, chronic illness and short life expectancy – among the Indigenous people around the world (Brave Heart, 1998; Brave Heart, 1999; Mohatt, 2014). But perhaps more importantly also worked well with the Indigenous relational worldview, now experiencing a cultural revival.

The case of the New Zealand Māori provides an illustration of the ways in which the 'Western' concept of historical trauma was connected to an Indigenous worldview. A key concept in the Māori worldview is *whakapapa*, which can be understood as a genealogy, or a framework, that links animate and inanimate, maps the terrestrial and spiritual relationships, forms the basis of spiritual relationships: between humans and the landscape, flora and fauna of their place of origin and extends into the past but also into the future (Roberts, 2013). Humans whakapapa not only to their human ancestors but also to rivers and mountains: in modern Aotearoa New Zealand this system of knowledge provided the legal basis for granting the status of personhood to a river and to a (former) national park (Geddis and Ruru, 2019). Within whakapapa, where land is not only ancestral but ancestor itself, the trauma of land dispossession is akin to the bodily injury or death of human ancestors. So, while the concept of historical trauma was first adapted by the North American First Nations scholars, and brought to Aotearoa New Zealand through networks of Indigenous knowledge-sharing in the early twenty-first century, we can understand why it was immediately accepted as a way of explaining the long and complex impact of the multi-layered trauma of colonization (Walters et al, 2011; Pihama et al, 2014).

But this expansion, indeed explosion, of the concept initially created to explain the transgenerational impact of the Holocaust trauma also received criticisms. Some argued that the social, political, psychological context of the Holocaust was different from post-colonial Indigenous suffering in important ways (Kirmayer et al, 2014). The persistence of poor health and social outcomes among the Indigenous peoples in former settler colonies, they argued, is better explained as a result of ongoing structural violence, than a past trauma. Others worried that the high popularity of *intergenerational trauma* as an explanatory tool presents a 'global shift in the moral economy by which victimhood status, acquired through individual experiences of physical and especially sexual abuse, has come to wield greater currency than collective struggles against colonialism' (Maxwell, 2014).

A question that began to crop up more regularly from the 1990s onwards, across all the literature on the intergenerational and multigenerational transmission – of historical trauma but also the intergenerational cycles of addiction – was its biological causation and mechanism of the transmission. These questions in the previous decades were either avoided, for fear of sounding eugenicist, or explained using the conceptual framework and

language of psychodynamic (including psychoanalytic) psychiatry. The next section interrogates how and why the framework of *generations* and *intergenerational inheritance* remained strong in spite of these challenges.

Looking for causes of intergenerational trauma, c. 1990s to the present

The 1996 paper 'Breaking intergenerational cycles: Theoretical tools for social workers' by a collaborative pair, a social work academic and professional social worker, provides an insight into how social workers, who had been operating with the concept of *intergenerational cycles* for decades, attempted to take stock of their work so far (McMillen and Rideout, 1996). 'Patterns of intergenerational dysfunction often dominate our clients' genograms and social histories,' wrote the authors. 'Social workers are often asked to intervene in these families in an effort to stop the cycle. When the problems repeat themselves in subsequent generations despite our interventions, social critics cite our work as exemplars of failed social programs' (McMillen and Rideout 1996, pp 378–79). Experiences of adverse events appeared to increase the risk of recurrence in the next generation; yet 'most abused children do not abuse their children'. Furthermore, the persistence of the problem may or may not be type specific: some alcoholic parents raised alcoholic children yet others, in what they called 'cross-typal transmission', had non-alcoholic children who suffered from other problems. Finally, intergenerational theories were, ostensibly, descriptive rather than analytical: they said little about the substrate and the mechanism of the recurrent phenomena ('what is transmitted and how').

Figure 4.2 summarizes the key theories of intergenerational transmission discussed in social work literature in the late 20th century, including ideas about the substrate and mode of transmission and possible intervention targets. As the post-war welfare state gave way to a neoliberal, market-based solutions to social and health problems, social services found themselves in danger of cuts. The new economic philosophy required specific targets for intervention grounded in cost-benefit analysis: which interventions provide the highest return; how to achieve the best health outcome for the lowest expenditure. The review argued that while none of the fields and theories that contributed to the intergenerational theory had provided a satisfactory explanation of either the mechanisms of transmission or of the ways to stop these intergenerational cycles of deprivation and trauma, the answer did not lie in abandoning the concept altogether. Rather, the way forward lay in the integration of different theoretical perspectives, which would then in turn open up new intervention methodologies and new conceptualizations of the transmission pathways.

One of the key elements in this integrated theory of intergenerational cycles was the role of genetics and heredity. 'Slowly, scientists are discovering

Figure 4.2: Theories of intergenerational transmission in social work literature

Theory	What is transmitted	How it is transmitted	Intervention targets
Genetics	Not yet determined	Heredity – specific mechanisms to be determined	Coping strategies for dealing with inherited predispositions
Social learning theory	Learned behavior	Observational learning, reinforcement	Dose of exposure; reinforcers of prolem behavior; function and forethought
Bowen's family theory	Symbiotic parent-child relationships; inability to cope rationally and objectively	Parent-child relationships. triangle relationships, mate selection	Coping strategies; individuation; parent-child interaction
Attachment theory	Internal working models of self and others; patterns of relating	Parental interactions guided by views of self and others	Views of self and others; patterns of relating views of adverse experiences
Self psychology	Unmet needs for admiration, calmness and twinship	Unmet needs create parents who use children to meet their own needs, creating more unmet needs in the offspring	Parental and child needs for affirmation and merging with calmness of idealized others
Rutter's model of risk and protection	Because the model was built deductively, it is not clear what is transmitted. May include poor views of self, decreased opportunities	Unclear, but one potential mechanism is negative events that predispose to other negative events	Dose of exposure, negative chain reactions; self-esteem and self-efficacy increased support; opportunities

Source: Redrawn from J.C. McMillen and G.B. Rideout (1996) 'Breaking intergenerational cycles: Theoretical tools for social workers', *Social Service Review*, 70(3), 378–99, p 393 (Appendix A), courtesy of the University of Chicago Press.

genetic markers for behaviors once thought to be socially determined' (McMillen and Rideout, 1996, p 380) Decades after social workers had excluded genes from their considerations of the causes of *problem families*, biological heredity was making a comeback. This 'return of the gene' can be explained by the growing influence of the science of genetics, which reached its pinnacle in the 1990s, the decade of high financial and emotional investment in the Human Genome Project (Kevles and Hood, 1992). Yet, while the primacy of the gene was unchallenged, the science of heredity was nevertheless changing. Where once research into environmental influences upon genes was largely sidelined, gene-environment interaction was now a recognized part of orthodox genetics.

Indeed, the new field of epigenetics was beginning to provide some plausible hypotheses – and early evidence – of *how* environmental impact could have a lasting, hereditary impact (Jablonka and Lamb, 1995; Buklijas, 2018). The gene itself remains unchanged, the argument went, but the gene *expression* – meaning, whether the gene was 'switched' on or off – could change (Gluckman et al, 2011a). This change took place through the attachment of a small chemical group to DNA upstream of the gene (promoter region), or through a change in the structure of small proteins in the nucleus (histones); or through some other chemical mechanisms. Importantly, studies on organisms as different as plants, insects and mammals, showed that such environmentally induced modifications could not only last through the lifetime of the examined organism but also be inherited by subsequent generations (Jablonka and Raz, 2009; Heard and Martienssen, 2014).

Epigenetics opened up debates in the science of heredity that had been largely closed for decades, ever since the transcription of DNA had been acknowledged as *the* hereditary mechanism (Jablonka and Lamb, 1995). A major question was how significant – how stable, and how widespread in the living world – epigenetic inheritance truly was (Grossniklauss et al, 2013; Heard and Martienssen, 2014). Were the patterns of gene expression directly copied, akin to the genetic inheritance? Were they simply a result of the simultaneous exposure of the mother, the embryo/fetus she carried in the womb and its own early sex cells – hence, three generations under exposure, all at once? Or, were these patterns re-established in each successive generation, under the influence of the stable, or recurring, environment?

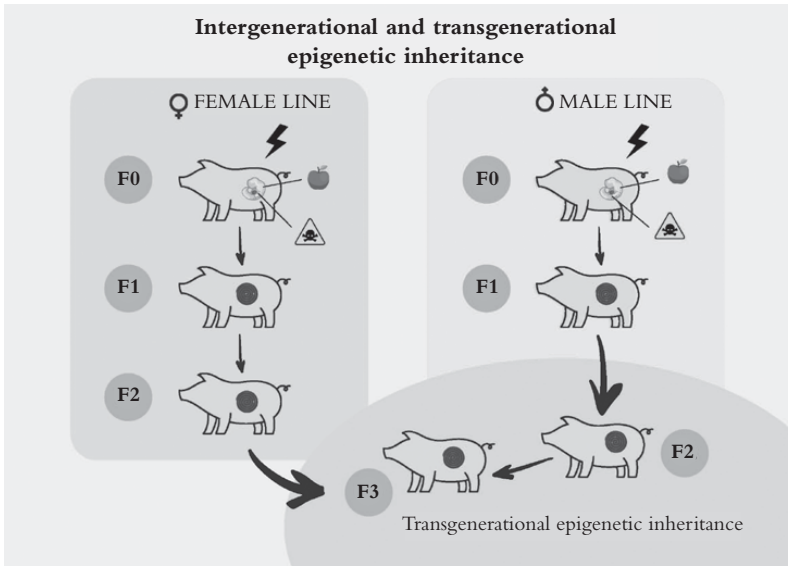
To deal with these complexities, new terminology was introduced. In other disciplines, such as psychology, *intergenerational inheritance* tended to refer to transfers from one generation to the next, and *transgenerational* across multiple generations (see Williams in this volume). Here, *intergenerational inheritance* extends from two to three generations: the parent (F0), the embryo/fetus or the future child (F1), and (if the parent is the mother) the grandchild (F2), as the influence would likely affect the very early predecessors of sperm or

egg cells in the embryo/fetus (Gluckman et al., 2011b). *Transgenerational inheritance* by contrast implies the inheritance independent of the direct exposure, similar to the inheritance of DNA itself (see Figure 4.3). Figure 4.3 illustrates the concept of epigenetic inheritance in mammalian organisms, including humans. F0 stands for the parental generation, F1 for the child, F2 for the grandchild and so on. When a female animal (F0) is exposed to an environmental factor (food, toxin, or a stress-inducing event) during pregnancy, this exposure affects the fetus (F1) too, including its early germ cells. These early germ cells develop into either egg or sperm cell lines, depending on the sex of the fetus, and these sex cells then later give rise to the next generation, F2. If there is evidence for epigenetic inheritance in F1 and F2, but not in F3 (or later generations), this type of inheritance is understood as a result of the direct exposure on the fetal body or early germ cells during the F0 event and it is termed *intergenerational*. However, if there is evidence of epigenetic change in F3 or even further down the line, then this finding is interpreted as a result of copying of epigenetic marks across generations and termed *transgenerational*.

In the male line, the individual (F0) and their early germ cells (F1) are simultaneously exposed; so the finding of epigenetic change in F2 (rather than F3) is considered evidence of *transgenerational* inheritance.

Generations in this context stand for the vertical link, the line of descent: inheritance could happen 'between' generations, with grandparents and parents passing short-lived formation about a presumably transitory – but

Figure 4.3: Intergenerational and transgenerational epigenetic inheritance



significant – change of the environment; or it could be passed on for multiple generations, unchanged, akin to inheriting genetic sequences. Yet, where many scientists understood this vertical link as having an exclusively biological, reproductive nature, others argued for a much more expansive redefinition of heredity across generations. In this view, genes and epigenetic alterations are considered the deepest layers in a rich tapestry that includes behavioural and cultural components (such as learning, family and social traditions) of the familial environments (Jablonka and Lamb, 2005).

Although the science of epigenetic inheritance was – and remains – by no means settled, media became its enthusiastic promoters. Titles such as 'You are what your grandmother ate', 'Grandma's experiences leave mark on your genes' and 'Pregnant 9/11 survivors transmitted trauma to their children,' spread across the pages of widely read newspapers and news outlets such as *The Guardian* or BBC (Richardson et al, 2014). Social scientists criticized these reports, arguing that they oversimplified and exaggerated the findings and, by doing so, reinforced the traditional responsibility of the mother for the child (Richardson, 2021). The new element was that this responsibility now started not only well before the birth – indeed, before the pregnancy – but it also extended well beyond the child's lifetime, onto future generations (Meloni and Pentecost, 2020).

But the genealogical way of thinking struck a chord with many different audiences. Perhaps the most striking example of how the communication of the new science of heredity was linked with the familiar – and familial – narratives of the generational histories was the 2005 documentary *The Ghost in Our Genes*. This film was part of the longstanding BBC Horizon TV series that had been launched in 1964 with the intention 'to present science as essential part of our twentieth century culture'. In this film several of the most prominent scientists in the field of epigenetics (for example, Marcus Pembrey, Wolf Reik, Jonathan Seckl) discussed some of the best-known studies of the transgenerational impact of environmental changes (BBC, 2005). Most of them were studied by epidemiologists and clinicians long before any epigenetic molecular techniques were available, combining medical data – general and specific mortality, infant weight, disease frequency – with historical records such as the size of the harvest or food prices. Epigenetics was now supposed to provide a mechanistic explanation of relationships between these seemingly disparate variables.

Perhaps the most famous of all was the Dutch Winter Famine study. Launched immediately after the end of the Second World War, it examined the human reproductive impact of the intense but time-limited restriction in food supply, during the German blockade of Western Holland from September 1944 to May 1945 (Smith, 1947). Thanks to the meticulous records of the women's food rations, infant birthweight, rates of stillbirth, record of infant malformations and other health data, this so-called 'natural

experiment' became the start of a multigenerational study that tracked not only the long-term impact of starvation at different trimesters of pregnancy upon the child as it grew, developed and then aged but also on the second, and then third generation. While initially this study was conducted using clinical and epidemiological methodologies – recording the health data, fertility and intelligence test results of the offspring, to name just some variables – by the early 2000s the study team began to apply epigenetic methods. The famine that these children experienced while still in the womb, the argument went, left a signature in the form of an epigenetic mark, still visible some 60 years later (Heijmans et al, 2008).

The popular fascination with the scientists' effort to illuminate our past and bring us closer to the future generations was, of course, not new. Much of the cultural 'mystique' that has surrounded the DNA and the gene has been about the promise of explaining who we are and where we came from (Nelkin and Lindee, 1995). The distinction of epigenetic studies was in that they went beyond the crude outlines of reproductive histories, recorded in genetic pedigrees, and migrations, which constrained or enlarged genetic diversity. Building on the longstanding historical epidemiological research, these studies made a (biological) sense of the rich stories of people's lives, especially their suffering: of wars, violence, bad crop years, poverty and famines.

The narrative structure and the visuals of the film *The Ghost in Our Genes* both reflect and reinforce this message. The film opened with the narrator's statement that: 'We are on the brink of uncovering a hidden world. The world that connects past and future generations in ways we never imagined possible.' This opening was followed by the statements by scientists: '[It] makes me feel closer to my children. What I experience, in terms of environment, will have some type of a legacy in my children, and my grandchildren,' said the Cambridge epigeneticist Wolf Reik. The message was further emphasized by the imagery, showing modern-day families (including the families of scientists) interspersed with the sepia photographs of the ancestors: as orderly aligned family portraits, or as 'ghosts' of difficult historical times: wars, prisons and barren fields.

Perhaps the best example of how the new science of epigenetics provided not so much new evidence, but new and more authoritative, molecular language of *intergenerational inheritance* including intergenerational trauma, is the history of disciplinary transformations of the studies of the *second generation* of the Holocaust. By the 1980s psychodynamic studies of the offspring of Holocaust survivors were increasingly criticized, by opponents who sought a better understanding of the wide range of symptoms that the *second generation* exhibited. These critical voices were part and parcel of the broader shift in psychiatry, in the US but also internationally, away from psychoanalysis and psychodynamic approaches and towards a 'biological' approach that more

closely aligned with the rest of medicine: using randomized clinical studies with control groups, biostatistics and clinical psychology (psychometrics) (Shorter, 1997). The aim of this turn was to locate the causes and mechanisms of mental illness in biological processes of the brain, in order then to develop treatment that can be delivered more easily – and much more cheaply – than psychoanalytic sessions.

The entrance of biological psychiatry was the first step towards the molecularization of intergenerational trauma, and in this transformation an important role was played by researchers who merged their professional background in biological psychiatry with their own *second generation* histories. The best example is that of Rachel Yehuda, born in 1959 in Israel to an observant Jewish family, with a rabbi as her father. She then moved to Cleveland and a neighbourhood populated by the Holocaust survivors (Tippett, 2017). In graduate school, she researched the role of stress hormones, which are produced by adrenal glands, upon the brain development in rat pups: it appeared that pups whose adrenal glands were removed – and hence, did not produce stress hormones at all – had larger brains that those with adrenals intact. Looking for a human project that could use her skills, she took up a clinical research position for the Veterans' Administration, just after the moment when 'post-traumatic' stress disorder was first recognized as a psychiatric diagnosis (Young, 1995). The aim of her research was to explain the finding of low cortisol in Vietnam veterans. This observation confounded the researchers: as a hormone that is released by the adrenal glands in high-stress situations, it was expected that soldiers would have high levels. Unable to explain the clinical finding of low cortisol in combat Vietnam veterans, Yehuda's team decided to test another group that had undergone profound trauma: Holocaust survivors. They too appeared to experience symptoms crucial to the diagnosis of PTSD (dreams/nightmares, flashbacks), and their results confirmed the finding in Vietnam veterans: they had low cortisol too, and this biological indicator was strongly associated with PTSD symptoms (Yehuda et al, 1995).

Through the late 1990s and early 2000s this research project took up the question of the *second generation*. The survivors' offspring, Yehuda and her collaborators found, had the same biological association between low cortisol and PTSD symptoms as their parents (Yehuda et al, 2000). But rather than explaining the recurrence of PTSD symptoms as a result of the disrupted psychological development in the early childhood, as psychodynamic psychiatrists did in the 1970s, with low cortisol a secondary outcome of the mental illness, Yehuda reached for the emerging epigenetic toolbox of explanations (Yehuda and Bierer, 2008). Epigeneticists used animal models and human participants to propose that the levels of stress hormones in pregnant mothers – and, possibly, epigenetic 'stress' markers in fathers – could 'programme' the stress hormone receptors of the offspring. In turn,

these could up- or down-regulate the fetal stress hormone production – and perhaps be transmitted, further down the line and in the form of epigenetic marks, to future generations (Weaver et al, 2004; Yehuda and Bierer, 2008).

Yehuda's own study of epigenetic markers in the offspring of the Holocaust survivors resulted in findings that were conflicting and difficult to interpret (Yehuda et al, 2014). Where only the father was a Holocaust survivor with diagnosed PTSD, the child's epigenetic changes corresponded with those found in the animals with 'uncaring' mothers, understood to have experienced a high-stress, traumatic early childhood: they had low numbers of glucocorticoid ('stress hormone') receptors, which corresponded with the higher levels of stress hormone. Yet where both parents were Holocaust survivors with PTSD, epigenetic changes were in the exactly opposite direction, closer to those found in animals whose mothers were 'caring'. Yehuda attempted to explain her findings by suggesting that the 'overattached' mother somehow overcompensated for the influence of the withdrawn father. But these explanations only confirmed to the critical scientists that the study was rife with methodological problems: small differences in epigenetic markers, which could have arisen randomly; inadequate presentation of raw data in the paper; and, finally, the fact that stress hormone receptors were regulated from multiple points (promotors) and that the study focused on 'one of the weakest' (meaning, those regulatory sequences that had the least impact on the stress hormone production).

Yet at the same time, for those who had come to epigenetics hoping to find a way to capture the elusive effects of family environments, Yehuda's complicated results only confirmed that the finding was always going to be nuanced: epigenetic markings were, after all, fine-tuning of the stress system in response to the close familial environment.

Furthermore, the public interest in this research was huge. 'Epigenetic inheritance' became almost synonymous with intergenerational and also historical and collective trauma (Dubois and Gaspare, 2020). Yet in contrast to the early definitions of epigenetics, where it was imagined as an important, but by no means the dominant, component of inheritance that was passed across generations, it was now presented as equal to genetics. The 'non-biological' transmission modes, namely cultural inheritance and behavioural learning, were again fading into the background.

This popularity of the epigenetic model can be seen as one outcome of the considerable and expanding authority of molecular science. But another important aspect is the growing awareness of, and concern with, the rapidly and radically changing human environments and their impacts on human reproduction (Lappé, Hein and Landecker, 2019; Baedke and Buklijas, 2022). From the rapidly changing diets to new environmental toxins – endocrine disruptors, radiation, air pollution; to social stressors and to the yet to be fully understood exposures created through the climate changes, it is clear

that the environments of our ancestors were different from our own, and that the environments of future generations are difficult to even imagine. Even if it could not provide a way to control and slow down the change, epigenetics at least offered a translation tool, a mode of communication between generations.

Conclusion

The term *generation* is used today usually in the horizontal sense, describing a social cohort, yet in medicine and human biology its older vertical meaning derived from the Latin *generatio* has remained strong. Through the 20th century both *generation* and its derived concepts – the adjectives *intergenerational*, *transgenerational* and *multigenerational* – have been defined in relation, and sometimes in opposition, to the prevalent trends in thinking about heredity. *Intergenerational* came into use in the mid-20th century to capture the recurrence of certain (pathological) phenomena in successive generations. It implied a vertical, procreative link, while staying clear of the suggestion of heredity; a deft move at the time when many scholars and professionals were trying to distance themselves from the increasingly problematic legacy of eugenics.

The notion of the *second generation* – the 'baby boom' children of the Holocaust survivors – combined the suggestion of the procreative link with the increasingly widespread social cohort concept. Through popular culture that made Holocaust the symbol of the human trauma, and thanks to the success of 'generational' thinking, the notion of the *second generation* trauma was adopted by many around the world. They saw themselves as descendants of generation(s) indelibly marked by the profound trauma, of war, famine, political violence or genocide. The capaciousness of the term, where the vertical link meant both a form of biological – but definitely non-genetic – transmission, and a shared cultural experience, combining both meanings of the generation, allowed the idea of second (and then *inter-*, *multi-* and *transgenerational trauma*) to be filled with multiple meanings, leading to new concepts of *historical* and *collective trauma*.

Reconsiderations of the nature of biological inheritance from the 1990s onwards, with the new science of epigenetics 'capturing' the early developmental environment in the form of biochemical marks, could be seen as a boost for the vertical understanding of generation. The terms *intergenerational* and *transgenerational inheritance* were imbued with new, precise meanings: *intergenerational* to stand for a short-term heredity, across no more of three generations, simultaneously exposed to the same environmental factor; *transgenerational* for a long-term, multigenerational impact that cannot be explained by the exposure directly affecting the developing organism. But it could also be understood as the integration of the horizontal

understanding of generations into medical and biological thinking. In the fast-changing world, experiences of past generations still had the power to shape us – even if our culture, our way of life, had so little in common with our ancestors. As the epigeneticist Michael Skinner said in the introduction to the BBC documentary *The Ghost in Our Genes*: 'What this means is, that environmental exposure that your grandmother had, could cause disease in you, even though you'd never been exposed to the toxin. And you will pass it on to your grandkids.'

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