Tesis Doctoral

IS AGING A DISEASE?

The Philosophical Debate between Bioconservatives and Transhumanists on Life Extension

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Autorizamos a D. PABLO GARCIA BARRANQUERO, estudiante del programa de doctorado de Estudios Avanzados en Humanidades, a la defensa de la tesis doctoral titulada "IS AGING A DISEASE? THE PHILOSOPHICAL DEBATE BETWEEN BIOCONSERVATIVES AND TRANSHUMANISTS ON LIFE EXTENSION".

EXPONEMOS:

Que la tesis doctoral citada cuenta con el visto bueno de la Comisión Académica y de los evaluadores externos.

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What I'm after is not living to 1,000. I'm after letting people avoid death for as long as they want to.

Aubrey de Grey

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Acknowledgment

Philosophy is commonly viewed as a lonely, extremely complex discipline, only accessible to those who are already initiated in it. To many, doing philosophy is a matter of being alone with your ideas, listening to calming music or, in the best-case scenario, meditating on a beach by the Mediterranean Sea. The only thing that I must admit is that I have heard many waterfalls and little birds chirping while I was immersed in my own thoughts.

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General Abstract

A profound revolution is afoot in the biomedical sciences. Aging is typically understood as a biological process of growing older with deleterious effects on our cognitive and physical capacities—a natural, normal, and universal phenomenon that everyone must undergo with the passage of time, without exception. In the previous decades, there was no possibility of scientifically intervening in aging, either to control it or decelerate it. Our ancestors simply had to accept it and only looked for the best way of successfully aging, regardless of how much pain or suffering it could cause in for them and those in their lives.

Traditionally, medicine has tried to manage and treat many age-related diseases (ARDs), such as Alzheimer's or various cancer types. In contrast, biogerontology has made huge advances over the past decade hoping to improve people's health, such as the discovery of the hallmarks of aging—for instance, cellular damage, which leads to an increased risk of the appearance of these ARDs. From this new perspective, aging could be considered a syndrome, as a special type of disease inherent in all humans, and the underlying cause common to all ARDs. Now, the scientific community already has enough knowledge to start developing anti-aging treatments (AATs) in humans, similar to those currently being studied in other model organisms. The research line will focus on the intervention in the aging process itself, regardless of a favorable outcome in its first phases, since what really matters is to intervene now. These AATs are still hypothetical, but they provide a plausible picture of a scientific approach to addressing aging. This profound revolution is based on a substantial change in medicine: the shift away from a restorative approach to ARDs and towards a preventive alternative starting around the first moments in which we age.

According to the above, the real goal is not to search for a method of life extension related to longevity—that is, the years of life lived. Exceeding 122 years and 164 days as the longest recorded life span of a human should not be the goal of the scientific community. The end of life is currently characterized by dependency, disability, and weakness, and for many of us it is not desirable to

live under those circumstances. The change must be more radical: maintaining a high level of functioning of our cognitive and physical capacities for long as we live, and controlling the decrease in quality of life that has traditionally accompanied old age. This approach does not necessarily imply living much longer, at least in the first instance. The possibility of living a healthier life with a biological condition similar to our 20s may be more desirable than becoming a centenarian. And perhaps most importantly: this would impact most of the population—something similar to the increase in life expectancy in developed countries in the twentieth century. Therefore, I advocate "adding life to the years of life of those persons".

Finally, the treatment of aging should not be related to the alleged dream of immortality. The goals of biogerontology differ from the attempt to live forever. The research lines are so far apart from each other that any supposed connection simply undermines the daily work of the scientific community. The premature success of aging interventions should not generate excessive expectations, since the "death of death" will not be achieved in the coming decades. One of the great philosophical and social challenges is to lower the expectations connected to promises coming from a world of science fiction rather than real science. Furthermore, the fact that many humans may not want to die today does not necessarily imply a desire to live forever. Some people would embrace the unknown, only because of their strong fear of death; for instance, our mind being uploaded into a computer and its possible existence in a digital reality. Immortality is not only technologically unfeasible, but it also compromises our meaning of what it is to be human, its relationship with the world, and with life.

To preserve and promote what we value in what it currently means to be human, we should strive to decelerate the onset of cognitive and physical decline rather than attempting to overcome death itself. In an ideal scenario, we may want to live longer without suffering the ravages of aging. The defense of AATs must be based on a real and rigorous science, which can be distinguished from approaches to and conceptualizations of immortality.

Resumen de la tesis doctoral en español

El avance de la ciencia y la tecnología está abriendo un horizonte sin precedentes. El mundo se está transformando, todo está cambiando, no solo en la forma en que vivimos nuestra vida, sino también en cuánto tiempo. Con la biogerontología empujando fuertemente en la lucha contra el envejecimiento, hay cada vez más voces que proclaman su intervención. Ante las promesas de algunos y los temores de otros, he considerado conveniente escribir esta tesis doctoral sobre cuál debería ser el objetivo de esta comunidad científica y las razones para apoyar el desarrollo de cierto tipo de tratamientos contra el envejecimiento. Mi reflexión se adentra en uno de los debates más recientes sobre la posibilidad de extender nuestra vida, es decir, la tensión entre bioconservadores y transhumanistas.

Los primeros tienden a interpretar el envejecimiento como un proceso "irreversible", "natural" y "universal". Argumentan que cualquier esfuerzo por modificar y superar el ciclo vital es, en última instancia, deshumanizante. Para ellos, la mortalidad es esencial para dotar de sentido a nuestras vidas (Fukuyama 2002; Kass 2003).

El punto de vista opuesto, el que sostienen los transhumanistas, tiende a interpretar el envejecimiento como una enfermedad, es decir, es un proceso patológico potencialmente curable. Argumentan que los esfuerzos por detener el envejecimiento no solo son moralmente permisibles, sino que se les debe dar una alta prioridad dentro de la investigación biomédica. Para ellos, vivir más tiempo, o incluso vivir para siempre, sería el mejor de los escenarios posibles (Cordeiro & Wood 2018; Kurzweil 2005).

Para la exposición de las ideas principales de esta tesis doctoral seguiré el orden de los capítulos, resumiendo las ideas y nociones principales que aparecen en cada uno de ellos. Finalmente, en las conclusiones generales, clarifico cuál es mi propuesta.

Capítulo 2. Uno de los grandes debates teóricos en la biogerontología es la posible conceptualización del envejecimiento como una enfermedad. En términos generales, se puede decir que existen dos posiciones principales.

En primer lugar, aquellos autores que sostienen que el envejecimiento no puede definirse como una enfermedad (Hayflick 2007). El envejecimiento no puede ser una enfermedad porque no es una falla en el funcionamiento de los organismos, sino una propiedad definitoria de su diseño. En este sentido, hay dos justificaciones para defender su "naturalidad". Por un lado, se ha argumentado que el envejecimiento es un producto de nuestra historia evolutiva—influencia de la teoría de acumulación de mutaciones (Medawar 1952), la teoría de la pleiotropía antagonista (Williams 1957) y la teoría del soma desechable (Kirkwood & Holliday 1979). Por otro lado, independientemente de si el envejecimiento es o no un producto de la evolución biológica, numerosos autores han defendido que es natural porque es un fenómeno irreversible, progresivo y universal. En consecuencia, es un rasgo inevitable de los seres vivos.

En segundo lugar, la definición del envejecimiento como algo natural, y en consecuencia como un proceso que no puede interpretarse como una enfermedad, es precisamente la suposición cuestionada por quienes sostienen que sí lo es. Arthur L. Caplan (2005) defiende que la noción de "naturalidad" en términos de inevitabilidad y universalidad no demuestra que el envejecimiento no sea una enfermedad. Incluso si pudiera admitirse que este puede ser natural en el sentido en el que es algo que afecta a todos los seres vivos, tampoco sería un criterio suficiente para decir que no es una enfermedad. Por el contrario, argumenta que el envejecimiento es una enfermedad porque es claramente disfuncional para el organismo. El envejecimiento no cumple ninguna función biológica porque es un subproducto de la selección natural el cual se centra en el éxito reproductivo a expensas de las capacidades cognitivas y físicas a largo de la vida de los organismos. El envejecimiento debe tratarse como una condición análoga a otras patologías, principalmente, porque conlleva el deterioro de las capacidades funcionales clave. Por lo tanto, no parece haber ninguna razón para

no incluir al envejecimiento como otra enfermedad "familiar" en las clasificaciones médicas.

Un tercer enfoque, muy prometedor y sustancialmente diferente a los previos, es el propuesto por Daniel Callahan y Eva Topinkova (1998). Consideran que la mejor estrategia posible para resolver este debate es tratar al envejecimiento como si fuese una enfermedad. Afirman que la medicina debe incluirlo dentro de las condiciones que debemos combatir por razones puramente pragmáticas. Por ello, proponen evitar la cuestión de la conceptualización ontológica del envejecimiento porque lo realmente importante es la evaluación de los beneficios de categorizarlo como una condición médicamente tratable. En muchos aspectos, argumentan, las consecuencias biológicas del envejecimiento son similares a los síntomas de otras enfermedades bien conocidas. Conceptualizar al envejecimiento como una enfermedad ayudaría en la tarea de controlar los procesos subyacentes una vez descubiertos y/o de reducir sus graves efectos. Además, creen que este enfoque pragmático encaja bien con la forma en la que los investigadores entienden la noción de envejecimiento en la práctica médica.

Una respuesta obvia a este enfoque pragmático podría ser que no es necesario considerar al envejecimiento como una enfermedad para que sea tratado médicamente. La medicina aborda muchas afecciones que no se consideran enfermedades. Sin embargo, la motivación para considerar al envejecimiento como una enfermedad es clara: esto situaría al envejecimiento directamente en la agenda médica. No todo lo que trata la medicina es una enfermedad, pero todas las enfermedades son tratadas por la medicina.

No obstante, si el envejecimiento se considerase como una enfermedad en toda regla, entonces este giro pragmático no sería necesario. Parece bastante obvio que la definición del envejecimiento como enfermedad depende no solo de lo que entendemos por envejecimiento, sino también de nuestra definición previa de enfermedad. En términos generales, se puede decir que hay dos posiciones principales.

Por un lado, hay un enfoque que argumenta que es posible caracterizar objetivamente las propiedades biológicas que determinan ciertos estados como sanos o enfermos. Según este enfoque, denominado "naturalismo", los organismos biológicos pueden presentar ciertas condiciones que pueden calificarse como sanas o patológicas en sí mismas independientemente de nuestros criterios culturales o personales. Para Christopher Boorse (1977) la salud es el comportamiento funcional estadísticamente normal y la enfermedad es una disfunción orgánica que hace que un individuo se comporte con un nivel de eficiencia más bajo que el resto de los miembros de su clase de referencia (es decir, seres de la misma especie, edad y sexo). Desde este punto de vista, las consideraciones evaluativas que los observadores externos pueden tener con respecto a estos comportamientos aparecen como irrelevantes.

Por otro lado, otro enfoque, denominado "normativismo", argumenta que no es posible definir objetivamente la salud y la enfermedad. Para Lennart Nordenfelt (1997) estas nociones están tan plagadas de valores culturales que es imposible disociar las categorías médicas de su contexto social. Por lo tanto, "salud" sería la condición que deseamos mantener mientras que "enfermedad" sería la condición que queremos evitar. Los normativistas a menudo recuerdan ejemplos de afecciones que se consideraban enfermedades en ciertos contextos históricos y culturales y actualmente no lo son—como la homosexualidad. Sin embargo, el principal problema con este enfoque es que cae en un relativismo radical según el cual el concepto de enfermedad no tiene sentido. No todos los estados indeseables son una enfermedad.

Sin embargo, hay autores que han argumentado que la definición de enfermedad no debe considerarse tan crucial. Germund Hesslow (1993) argumenta que el pensamiento clínico y la toma de decisiones en medicina no necesitan la noción de enfermedad. La idea de Hesslow es que los médicos pueden identificar y tratar a los pacientes sin la necesidad de un concepto refinado. Esto puede ser cierto, pero no parece restarle importancia a la tarea filosófica de definir la enfermedad. En cualquier caso, Hesslow señala algo que vale la pena enfatizar: el concepto de enfermedad es una noción técnica y debe

evaluarse con respecto a la forma en que esta noción adquiere significado solo dentro de un marco teórico. Esta es la base de algunas propuestas en filosofía de la medicina que definen la enfermedad desde una perspectiva que considero alineada con un enfoque "pragmático" (Hofmann 2001). La tecnología "inventa" enfermedades, en el sentido de que nos ofrece las herramientas para abordarlas, el conocimiento y los conceptos para clasificarlas e identificarlas, y los protocolos para enfrentarlas. Por lo tanto, la noción de enfermedad que los médicos asumen está determinada por las preguntas que hacen y la forma en que intentan responderlas en la práctica.

Ahora bien, considero que esta propuesta puede alinearse con una perspectiva "pragmatista" desde la filosofía de la ciencia. La idea principal se basa en la defensa de que nuestros conceptos científicos no responden a preguntas metafísicas sino a preocupaciones epistemológicas—el hecho de que la ciencia es una empresa en la que los valores e intereses de los individuos están involucrados en el cumplimiento de objetivos científicos.

Por lo tanto, propongo utilizar las ideas de Ingo Brigandt (2009) para responder a la cuestión de si el envejecimiento es una enfermedad. Desde su posición, el contenido de los conceptos científicos se puede dividir en tres componentes: (1) la referencia del concepto; (2) su papel inferencial; (3) el objetivo epistémico perseguido por el uso del concepto. Dice Brigandt que el cambio semántico de conceptos se debe a cambios en alguno de estos tres componentes. Muchos conceptos teóricos relacionados con la historia de la ciencia han cambiado por completo su referencia o incluso la han perdido—como el flogisto. La pregunta filosófica en este punto se refiere a explicar cómo este cambio en la referencia de un concepto puede tener lugar de manera racional y justificada. Para Brigandt, un concepto puede cambiar legítimamente su referencia si el papel inferencial de ese concepto también cambia. Además, añade que: (1) el objetivo de un concepto científico es inferible del papel de ese concepto en la práctica científica; (2) el objetivo epistémico está relacionado con los deseos, intereses y valores de una comunidad científica determinada. A medida que el conocimiento científico cambia el uso de conceptos por parte de los científicos, esto conduce a

diferentes resultados epistémicos y, por ende, contribuye al propio conocimiento de diferentes maneras.

Por lo tanto, la propuesta de Bjørn Hofmann (2001) encaja muy bien en este enfoque pragmatista. Reconoce explícitamente que las prácticas médicas determinan el significado del concepto de enfermedad. La enfermedad es todo lo que la medicina trata como tal para responder a ciertas preguntas epistémicas de esta disciplina: cómo funcionan nuestros cuerpos o qué nos causa sufrimiento. En este sentido, la medicina "inventa" enfermedades. No es simplemente que la medicina trate estados que son enfermedades, sino que estos estados se convierten en enfermedades porque son tratados como tales por la medicina. Mi defensa no se basa en que todo lo que la medicina trata es una enfermedad, sino que todo lo que la medicina conceptualiza como una enfermedad, es una enfermedad. Desde un punto de vista pragmatista, un cambio conceptual en la noción de enfermedad estaría justificado en aquellos casos en que el estado del conocimiento médico nos permita pensar que un cambio en cualquiera de estas dimensiones nos ayudaría a alcanzar sus objetivos prácticos. Por ende, hay casos en los que los cambios en el conocimiento médico y ciertas condiciones dejan de considerarse enfermedades porque esta categorización resulta inútil para lograr propósitos de investigación, hacer inferencias científicas o ayudar en el descubrimiento de nuevas técnicas. Por ejemplo, la drapetomanía o la homosexualidad no se consideran enfermedades actualmente. La noción de enfermedad que se ha usado en medicina durante siglos cubrió estos casos, pero dados los cambios médicos en las últimas décadas, la noción de enfermedad ha adquirido un significado que no permite que estas afecciones se consideren patológicas. Las razones por la cuales ciertas afecciones dejan de considerarse enfermedades pueden ser muy diversas y deben examinarse caso por caso, pero es innegable que este tipo de cambio conceptual ha ocurrido con mucha frecuencia en la historia de la medicina.

El enfoque pragmático en la filosofía de la medicina está muy cerca de la propuesta de Callahan y Topinkova en el debate sobre la definición teórica del envejecimiento. Ellos proponen que el envejecimiento debe tratarse como una

enfermedad de acuerdo a aquellos beneficios potenciales que podrían producirse en la salud de las personas. Sin embargo, al mismo tiempo sostienen que el envejecimiento no es una enfermedad—ontológicamente hablando. Desde mi punto de vista, este conservadurismo conceptual subyace a una visión objetivista que no está justificada y se basa en una comprensión errónea de cómo se forman los conceptos en la ciencia. Propongo dar un paso más allá de estos autores y asumir un giro pragmatista. Mi máxima es que la práctica médica determina qué es una enfermedad. Obviamente, la medicina trata muchas afecciones sin considerarlas enfermedades—como los problemas estéticos o de rendimiento deportivo. No todo lo que es objeto de práctica médica es una enfermedad, pero todo lo que la práctica médica trata como si fuera una enfermedad es una enfermedad porque la práctica determina el significado de un concepto, así como sus posibles cambios.

En conclusión, el envejecimiento es un concepto técnico que está en el centro de ciertas prácticas médicas. Esto significa que los objetivos epistémicos de dicho concepto también han cambiado: el envejecimiento ya no es solo un concepto que sirve para comprender lo que les sucede a los organismos después de cierta edad, sino que también es clave para la investigación y el desarrollo de tratamientos que buscan mejorar la calidad de la vida de las personas.

Capítulo 3. En la última década la investigación sobre el envejecimiento ha experimentado un avance sin precedentes, particularmente notable con el descubrimiento de las nueve causas que lo regulan (López-Otín et al. 2013). Por este motivo, la posibilidad de tratar el envejecimiento ya no es una historia sobrenatural, sino que ha encontrado cierto apoyo empírico en experimentos realizados con otros organismos en el laboratorio—teniendo como objetivo fundamental la mejora en la salud.

Sorprendentemente, la postura bioconservadora se caracteriza por el fuerte rechazo a cualquier avance biotecnológico, especialmente a aquel que busque transgredir la condición humana. Para examinar más a fondo esta perspectiva me centro en los argumentos de Leon Kass (2003). Su perspectiva

comienza al reconocer que el mayor sueño de la Humanidad ha sido encontrar la cura contra el envejecimiento y, por ende, la posibilidad de vivir mucho más tiempo—incluso para siempre. Si el envejecimiento fuese una enfermedad que pudiera ser corregida, Kass propone que muchos verían que nuestra mortalidad, la condición que nos hace humanos, sería algo que también debería superarse. Por lo tanto, la posibilidad de conseguir "cuerpos sin edad" nos invita a reconsiderar el significado de nuestra existencia. Los seres humanos nacen, crecen, se desarrollan, envejecen y mueren; difícilmente podría entenderse nuestra existencia más allá de este ciclo vital. Kass afirma que la vejez no es una etapa de la vida que deberíamos eliminar, sino más bien es la última parada del viaje. Por ello, estas biotecnologías producirían una serie de consecuencias catastróficas para nosotros.

Más allá de las preocupaciones bioconservadoras y su crítica a la consecución de "cuerpos sin edad", existe una posición caracterizada por el intento de tratar el proceso de envejecimiento en sí mismo. Para analizar esto, me baso en el enfoque de David Gems (2014) por tres razones principales: (1) definir el envejecimiento desde una posición pragmática; (2) priorizar la intervención en seres humanos; (3) rechazar el enfoque tradicional de la medicina. Después de responder si el envejecimiento es una enfermedad, uno se pregunta si la biogerontología puede hacer algo para retrasar este proceso. Con el objetivo de ahondar en esto, divido su enfoque en tres puntos clave:

1. Argumenta que el envejecimiento da lugar a un amplio espectro de enfermedades ligadas a la edad que conducen inevitablemente a la muerte. Dado que el envejecimiento se acompaña de un número considerable de patologías severas, como el Alzheimer o el cáncer, uno esperaría que, cualquiera que sea la causa subyacente, esté acompañada por un aumento en el daño celular (2014: 14).

2. Defiende que existe un fuerte deseo de pasar de la biología del envejecimiento a una nueva práctica médica (2014: 14).

3. Expone lo que son los tratamientos anti-envejecimiento (preventivos) en base a dos objetivos: (a) controlar y proteger principalmente contra el amplio espectro de enfermedades ligadas a la edad; (b) en el mejor de los casos, mejorar el mantenimiento somático (2014: 16).

Gems realmente quiere desarrollar una línea de investigación que intervenga en la causa subyacente para disminuir todos los graves efectos del envejecimiento. Para él, el tratamiento por separado y sin interrelación de las enfermedades ligadas a la edad, típico de la medicina tradicional, no tiene sentido ya que simplemente prolongaría la vida de la persona por un breve período de tiempo—y no conllevaría una mejora sustancial en su salud. El giro en la biogerontología sería intervenir directamente en el envejecimiento en sí mismo. En otras palabras, ir al daño celular subyacente como base común de todas las enfermedades ligadas a la edad.

Ahora bien, es importante tomar cierta perspectiva con respecto a estos tratamientos y sopesar sus posibles limitaciones: esto puede no implicar el fin de todas las enfermedades ligadas a la edad, ni tampoco excluye la posibilidad de que alguna de ellas pueda escapar del alcance del tratamiento. Considero que una buena estrategia para comprender su naturaleza es la consecución de alguna de las siguientes metas: (1) manifestación posterior de esas enfermedades o al menos de un número considerable de ellas; (2) duración de tiempo más breve de esas enfermedades o al menos de un número considerable de ellas; (3) efectos menos graves de esas enfermedades o al menos de un número considerable de ellas.

Además, añado dos puntualizaciones a este enfoque. Primero, si bien el objetivo final de los tratamientos anti-envejecimiento sería el control y la protección contra el amplio espectro de las enfermedades ligadas a la edad, no hay nada en la biogerontología que garantice el cumplimiento completo de este objetivo, al menos de acuerdo al estado actual de la ciencia. Si bien el envejecimiento es la causa común, los tratamientos anti-envejecimiento pueden no cubrir con éxito el rango completo de todas las posibles patologías. Segundo,

considero que los tratamientos anti-envejecimiento se entienden como una imagen hipotética en el sentido en el que es una línea de investigación prometedora en biogerontología, pero aún incipiente para lograr resultados altamente exitosos.

Tras estas dos puntualizaciones, distingo entre un tratamiento anti-envejecimiento y una posible cura, idea sobre la cual los bioconservadores pueden estar pensando la consecución de los "cuerpos sin edad". Una cura es un subconjunto de procedimientos para tratar enfermedades o síntomas hacia un "resultado favorable" con un 100% de éxito. Esto implica que existe la certeza de que una enfermedad o síntoma no estará presente después de una intervención médica. Tras la cura no quedará ninguna de patología sin tratar.

Partiendo de esta definición de cura, señalo tres diferencias fundamentales en relación a los tratamientos anti-envejecimiento: (1) nada garantiza que habrá un "resultado favorable"; (2) el éxito puede ser mínimo o parcial en las primeras fases del desarrollo del tratamiento; (3) el envejecimiento no se elimina. La idea aquí es que los objetivos de estas comunidades científicas son diferentes. Esas líneas de investigación son independientes y podrían superponerse en algún momento. El desafío real es conseguir que estos tratamientos sean cada vez más efectivos.

En respuesta a Kass, sostengo que su visión es extremadamente reduccionista porque no todas las líneas de investigación en biogerontología se centran en la búsqueda de "cuerpos sin edad". Si bien sus preocupaciones no solo son comprensibles, sino también válidas, se centran en enfoques muy radicales. Pero aquellos que defienden el tratamiento del proceso de envejecimiento no tienen por qué estar sugiriendo el final de dicho proceso. La postura bioconservadora se preocupa por la alteración o modificación de la esencia humana más íntima. Pero como he mostrado anteriormente, la biogerontología simplemente busca desarrollar tratamientos anti-envejecimiento con el objetivo de mejorar la salud de las personas a lo largo de sus vidas.

De hecho, muchos argumentos en contra de tratar el envejecimiento son realmente un rechazo contra la extensión de la longevidad (Schramme 2013). Como Gems defiende, hay dos objetivos cuya consecución no es y no debe considerarse como equivalente: (1) reducir las enfermedades ligadas a la edad a gran escala; (2) en el mejor de los casos, lograr vivir más (2011a: 280). Hay una relación, pero esta no ha de ser necesaria.

Capítulo 4. La posibilidad de extender la esperanza de vida y la vida máxima ha sido un tema muy debatido por científicos y filósofos (de Grey & Rae 2007; Overall 2003). Nuestro conocimiento sobre el envejecimiento está aumentando exponencialmente y se están comenzando a plantear muchas preguntas al respecto. Conceptual y normativamente, los enfoques bioconservador y transhumanista son claramente incompatibles. Si estas fueran las únicas posiciones posibles, el debate se estancaría. Por esta razón, algunos autores tratan de facilitar el progreso en biogerontología más allá de estos dos puntos de vista. Ellos generalmente distinguen dos formas de extensión de la vida: (1) los esfuerzos "débiles" de la biomedicina actual para mantener una buena calidad de vida en la vejez; (2) los esfuerzos "fuertes" de alguna biotecnología futura que permitirá vivir vidas saludables, superando el límite de la longevidad humana (Lucke & Hall 2006; Moody 2001). A la luz de esta división, ellos describen cada uno estos escenarios para evaluar cuánto de deseables son para nosotros.

Resumiendo, argumentan que existe un escenario "débil" caracterizado por tratar de extender la esperanza de vida hasta el límite de la vida máxima, es decir, la edad Jeanne Calment (122 años y 164 días). Para hacerlo, abogan por mantener la condición biológica adulta el mayor tiempo posible a la vez que desean eliminar la decrepitud asociada a la vejez. Postulan que este objetivo se podría conseguir alrededor del año 2050 utilizando tratamientos concretos extraídos de la biomedicina actual. Contrastan esta visión con un escenario "fuerte" caracterizado por tratar de extender la esperanza de vida más allá del récord de Jeanne Calment. Por lo general, esta ganancia la sitúan alrededor de los 200-250 años y argumentan a favor de mantener la condición biológica adulta

indefinidamente, o lo que es lo mismo, una eliminación del proceso de envejecimiento en sí mismo. Por lo tanto, postulan que este objetivo se podría conseguir alrededor del 2070-2080 utilizando una biotecnología futura.

Mi crítica principal contra esta división se basa en considerar la diferencia entre las formas débiles y fuertes en términos cuantitativos. La existencia de un límite en la longevidad humana sigue siendo un enigma en la biología del envejecimiento. Por ello, propongo la idea de Potencial de Vida Adicional para esclarecer este problema—siendo este el período de tiempo que transcurre entre la vida máxima documentada y la vida máxima teórica. Ambos conceptos se pueden definir de la siguiente manera:

1. La vida máxima documentada se refiere al desempeño único de un individuo en términos de cuánto tiempo vive con respecto a la cuota más alta observada.

2. La vida máxima teórica se refiere a cuánto tiempo un individuo de una determinada especie podría vivir teóricamente en circunstancias ideales (Weon & Je 2009).

La vida máxima documentada es 122 años y 164 días, aunque esta se deba reajustar si una persona vive al menos un día más que Jeanne Calment. Desde esta perspectiva, no hay una razón obvia para pensar que algo (es decir, un límite biológico intrínseco) provocó su muerte. Ella podría haber vivido más tiempo, tal vez no mucho más, pero su muerte aún pudo ser producto de algún factor fortuito. Por lo tanto, la vida máxima teórica no es un valor fijo y solo tiene sentido en un espacio-tiempo determinado. Pero incluso si la vida máxima no estuviera fijada, es concebible que exista un límite biológico para la longevidad que todavía no se conoce. Para entender esto, ilustro un paralelismo entre la longevidad humana y los límites de velocidad en la prueba de los 100 metros lisos. Las actuaciones recientes de Usain Bolt han desencadenado una ola de interés sobre este tipo de carrera. Nadie puede decir que su récord nunca se

superará, pero eso es completamente diferente de sugerir que tendremos velocistas como *The Flash* en un futuro—quien alcanza los 37 metros por segundo.

Parece irracional pensar que una persona pueda correr a esa velocidad, simplemente por lo que sabemos sobre la estructura del cuerpo humano y la física del movimiento, lo que podría equipararse a pensar en un Nuevo Matusalén viviendo 969 años. Este ejemplo ayuda a aclarar por qué esta división no puede enfocarse en el límite de la longevidad humana, y menos aún en un número fijo de años, sea cual sea este.

Aquí propongo que lo que realmente importa es ampliar el período de salud y disminuir el período de decrepitud en términos poblaciones. En otras palabras, centrarse en la calidad de vida durante toda nuestra existencia y no simplemente en los últimos años de debilidad y discapacidad. Mi propuesta se clarifica a través de un experimento mental que denomino como "la Píldora de Peter Pan". Con ello, muestro el giro que la biogerontología debe tomar para enfatizar el control y el retraso del envejecimiento en lugar de enfocarse en la extensión de la vida como se hace actualmente, es decir, prolongando el número de años en el que nuestras capacidades cognitivas y físicas están rozando un nivel de funcionamiento mínimo. Para los defensores de esta división, si una persona vive 123 años, pero sin ninguna mejora especial en su calidad de vida, estaría ubicada en un escenario "fuerte". Si bien el caso de Jeanne Calment fue excepcional, ella sufrió un deterioro similar al de sus contemporáneos. Mi giro es, por lo tanto, sustancialmente diferente: una población que vive alrededor de 120 años, pero cuya salud se ha maximizado. Sus últimos años están llenos de actividad y esto sería mucho más "fuerte", utilizando la expresión de estos autores, que si su vida se extendiera algo más.

Por supuesto, si una persona vive más tiempo que Jeanne Calment, será una noticia socialmente relevante. Pero hay que ser cautelosos porque esto no implica que los tratamientos contra el envejecimiento sean mejores. Simplemente pudo tener algo más de suerte que otras personas. Defiendo que no debemos agregar años a la vida si no podemos agregar vida a esos años. Nuestros instantes

finales se caracterizan por un período de decrepitud, el cual es popularmente muy indeseable. La esperanza de vida debe continuar aumentando si y solo si nuestro período de salud es mayor, independientemente de si la vida máxima documentada continúa siendo 122 años y 164 días o más. Muchos se negarían a vivir sus últimos días bajo las condiciones actuales, ya que esto les impediría desarrollar el tipo de vida que desean. El período de decrepitud tiene que disminuir incluso si esto conlleva cierto estancamiento en las expectativas de extender la vida. Por lo tanto, el objetivo de la biogerontología debería ser aumentar nuestra calidad de vida sin que esto implique que vivamos más que ahora.

Capítulo 5. En un artículo reciente sobre la extensión de la vida, Larry Temkin (2008) se pregunta si vivir más es inherentemente vivir mejor. Llegados a este punto, reflexiono sobre una pregunta filosófica complementariamente diferente a lo investigado en los capítulos anteriores: "¿querer vivir más tiempo implica querer vivir para siempre?". Desde la perspectiva del transhumanismo, este objetivo sería el primer paso hacia la conquista de la muerte—para ello, volcaríamos nuestras mentes en un ordenador. Los transhumanistas argumentan que cualquier extensión significativa de la vida nos convertiría en mejores humanos ya que disfrutaríamos de una existencia más digna y plena. Ellos asumen que apreciamos estar vivos y que no queremos morir. Nick Bostrom lo argumenta de la siguiente manera: (1) las personas "normalmente" aprecian estar vivas; (2) en consecuencia, "normalmente" desean no morir; (3) también tienen un deseo (implícito) de que su vida se extienda indefinidamente; (4) por lo tanto, "normalmente" desean vivir (potencialmente) para siempre (2008: 113-118).

Para rechazar este supuesto deseo de inmortalidad sigo el enfoque de Michael Hauskeller (2013). Él afirma que Bostrom cae en la denominada "falacia inmortalista". Según su criterio, no hay una implicación lógica entre la afirmación "la gente (normalmente) no quiere morir" y la afirmación "la gente (normalmente) quiere vivir para siempre". A diferencia de Hauskeller—aunque enlazado a sus ideas—muestro que la clave para desmantelar el argumento de Bostrom es el calificador de la premisa: "normalmente". Que una persona no

quiera morir "normalmente" no implica que la misma persona nunca quiera morir. Propongo un cambio filosófico de "normalmente" a "en estas circunstancias". ¿Qué significa "normal" o "normalmente"? No aclara si es "en general", "la mayor parte del tiempo" o "la mayoría de las personas", entre otras opciones. Entiendo "en estas circunstancias" como el contexto antropológico, histórico, psicológico, político y social según el cual cada individuo responde a la falacia inmortalista. Por lo tanto, mi deseo implícito de vivir para siempre está condicionado por dos razones: (1) quiero estar vivo hoy; (2) no quiero morir hoy. Respondo desde mi presente. Todos estamos viviendo una vida similar y proyectamos un mundo futuro que se extiende más allá de nuestros límites. La diferencia sustancial entre nosotros es el nuevo mundo que queremos que suceda.

Al igual que Hauskeller, sostengo firmemente que el deseo de vivir para siempre no implica el deseo de no morir. El giro filosófico de "normalmente" a "en estas circunstancias" también muestra cómo la muerte podría ser buena o mala dependiendo del contexto de cada individuo. Para muchas personas, el caso de un estado vegetativo persistente es un ejemplo de una situación en la que la muerte podría considerarse una "salvación" en lugar de un "destino inevitable".

Tras ello, considero útil revisar las críticas sobre el sueño de la inmortalidad que se plantean en la literatura académica. Los transhumanistas ya han mostrado todos los beneficios (posibles) que el volcado de la mente tendría y cómo mejoraría la vida de las personas en todos sus aspectos. Sin embargo, señalo diferentes problemas que este tipo de "vida" podría plantearnos en un futuro lejano. Todo es especulativo, pero también creo que este escenario no sería tan deseable como el propuesto por los transhumanistas. Desde esta perspectiva, no se trata solo del deseo individual de querer vivir para siempre, sino también de si este deseo puede realizarse correctamente en términos tecnológicos.

Mi rechazo a la inmortalidad está relacionado con estas dos preguntas: (1) "¿una versión volcada de mí será consciente?"; (2) "¿al volcarme, seguiré siendo yo?" (Chalmers 2010). El concepto de mente que Bostrom o Raymond Kurzweil

defienden es muy discutible para muchos filósofos y neurocientíficos. Los transhumanistas la consideran análoga al software, a un patrón de información que puede transferirse a diferentes hardware y funcionar correctamente. Pese a ello, algunos autores muestran que esta es una versión reducida de quiénes somos y que nuestro conocimiento sobre la conciencia es mínimo; además, no estamos seguros de que sea todo lo que nos hace humanos. Incluso suponiendo que la conciencia no fuera un problema, el dilema de identidad personal aún estaría presente. Por ejemplo, si pudiera hacer una copia de mi mente y la transfiriese a un dispositivo de silicio, nada me garantizaría que "él", "ella", o "eso", fuese yo mismo (Agar 2010; Pigliucci 2014). Intentaríamos evitar la muerte volcando nuestras mentes en un ordenador, pero podríamos morir en el proceso. Si este es el caso, estaríamos simplemente ante una forma sofisticada de terminar con nuestras vidas. Yo doy un paso más sugiriendo un tercer escenario en el que hemos sobrevivido, pero ni nosotros ni el mundo que nos rodea es lo que realmente queríamos.

Hauskeller piensa que muchas personas quieren vivir para siempre simplemente porque imaginan un futuro radicalmente diferente al actual (2013: 100). Esto da por hecho que en el futuro viviremos mejor que ahora. Sin embargo, ¿qué tipo de vida viviríamos sin la muerte? Una de las preguntas que inició mi argumentación fue: "¿quieres vivir para siempre?". En la literatura académica esta pregunta también ha aparecido de la siguiente manera: "¿más vida es siempre mejor?" (Gems 2003).

Siguiendo mi argumento de que el deseo de una vida extendida depende del contexto, la mayoría de las personas querrían seguir viviendo si el conjunto de sus circunstancias fuese ideal; por ejemplo, si pudiesen continuar viviendo con sus seres queridos y en buenas condiciones cognitivas y físicas. No obstante, estoy seguro de que podría haber un momento en el que mis circunstancias cambien tanto que no quisiera seguir viviendo. Si una existencia inmortal fuera en última instancia aburrida u opresiva, desearía terminarla en lugar de soportarla para siempre. No todos quieren lo mismo, ni una persona quiere lo mismo día tras día. Y es difícil, si no imposible, que la persona que quiere seguir

vivir comprenda la perspectiva de una persona para quien la muerte es deseable. Por lo tanto, la única pregunta que se puede responder es si preferiría seguir viviendo antes que morir en las circunstancias actuales.

Esta pregunta no es solo sobre el concepto de "muerte" sino también implica una reflexión sobre el concepto de "vida". Este concepto depende de quiénes somos. Dicho de otro modo, si no fuéramos *Homo sapiens*, o incluso algo similar a este, es completamente posible que dicho concepto no existiera, o al menos, no en su forma actual. Disfrutar de ciertas actividades o soñar con un futuro mejor es algo específicamente humano.

Por esta razón, defiendo un cambio en los conceptos de "muerte" y "vida" de la siguiente manera: si X es muerte e Y es vida, los humanos solo se preocupan por X sin pensar que Y cambia cuando X desaparece. La interdependencia entre X e Y es tan fuerte que no podemos imaginar un mundo sin X en el que Y siga siendo Y. Un mundo sin X en el que Y sigue siendo Y es imposible porque X ya no existe. Por lo tanto, un mundo sin X nos obliga a pensar en un mundo donde Y se convierte en Y'. Los transhumanistas nos prometen un mundo sin X en el que Y' será radicalmente diferente de Y. Sin embargo, si Y' no se parece prácticamente a Y, ¿vale la pena vencer a X? La mayoría de la sociedad podría querer Y sin X. Uno se pregunta si es posible imaginar una vida sin muerte.

Dando un paso más continúo mi reflexión: temo a X, pero soy consciente de que sin X no podría mantener Y, al menos como la conozco hoy. No defiendo una Y estática porque mis circunstancias cambian día tras día. Es una Y reconocida por mí y por quienes me rodean. No acepto una Y' sólo por evitar X. Además, no renuncio a X para tener una Y' eterna. Por lo tanto, no acepto lo que los transhumanistas defienden: la conveniencia de volcar nuestras mentes en un ordenador y vivir para siempre sin morir nunca. Lo que parece realmente deseable es tener la capacidad de decidir cuándo será nuestro final.

Capítulo 6. Finalmente, a modo de conclusión general, defiendo que la biogerontología se ha de centrar en desarrollar tratamientos anti-envejecimiento

efectivos los cuales nos permitan disfrutar de una vida lo más saludable posible sin que esto implique la consecución de la inmortalidad—aunque tampoco deba conllevar que la vida se extienda sustancialmente. Lo que tengo claro hoy es que quiero seguir viviendo y que no me gustaría, en absoluto, morir ahora. Sin embargo, una vida como la que plantean los transhumanistas, quizás no es tan deseable como pueda parecer a simple vista.

List of Abbreviations

ARDs: Age-Related Diseases

AATs: Anti-Aging Treatments

IF: Immortalist Fallacy

MDLS: Maximum Documented Life Span

MTLS: Maximum Theoretical Life Span

PAL: Potential Additional Life

PPD: Peter Pan Drug

TH: Transhumanism

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Chapter 1: Introduction[1]

§1.1. My Grandma and Me

In my view, philosophers cannot afford to neglect the world around them. I have never valued making a contribution to a specific debate that it only matters to a few specialists.[2] Why would I devote my time to something that is so far removed from the most human concerns? Thus, I have chosen a problem that unites us during our lives and make us equal in a certain way: aging. It does not matter if you are poor or rich, if you have had fame, or if fortune has smiled on you—you will not be able to avoid the serious effects of aging, accentuated at the end of your life. Because of that, I could to talk with my grandmother about my philosophical contribution, as it is a topic that she experiences in first person.[3] This problem concerns us both regardless of our age—I am reaching thirty and she is already beyond eighty. Here is a short story with which I would like start my dissertation:

—What have you been working on for such a long time, Pablo? Tell me about it.

—I am writing an essay about what aging is and about the possibility of living longer. This biological phenomenon by which humans decline in their cognitive and physical

[1] I am aware that this introduction is quite unusual in a classic dissertation. I will not review the state of the art in a specific chapter. Rather, I will introduce some philosophical debates throughout these pages. I owe this clarification to Antonio Diéguez and I appreciate his support in my idea of starting my work in a more heterodox way. We have always discussed that there are already exhaustive literature reviews and that it is more worth trying to contribute to the field with some original idea.

[2] I fully respect the dedication and effort of my colleagues in the philosophy of science field who work on topics with less impact on our daily lives.

[3] However, that does not imply that this concern is not important for me. As I will defend later, I really wish that aging could be controlled before I die. I relate very much with some authors who fear death, but I am much more realistic in knowing that that day will come (and that I will want it to come).

capacities over time, that is, we lose flexibility, immune response, or memory until we finally die.[4] *The last years of life can be very hard. You know that better than me.*

—So basically, you are studying "old people", just like me. My knee does not work too well anymore, and your mother has told me that it is "normal".[5] *Growing old is a sad experience.*

—It's that exactly, grandma. What if your knee could work as before? What if you could be almost as healthy as me? Imagine a world in which all of us were younger. What do you think about this proposal?

—The truth is that I don´t like being old, Pablo.

—I understand, grandma. I do not want to be old either.

I think that a good strategy to organize any doctoral project is to explain what you do to a person who knows little or nothing about your research—as it can be deduced, this was the case with my grandmother. A proposal becomes clearer when even some of its points are evident to anyone, even those without any specialist knowledge. In my story, I have really shown different ideas throughout the conversation with my grandmother, despite the absence of technical language. Broadly speaking, my intention was to easily expose something that becomes much more complicated when working on it philosophically.

This was one of the main pitfalls at the beginning of my work and it has taken me a long time to overcome it during my PhD studies. I wondered whether I could approach this typically scientific topic adequately, always keeping in mind that I am a philosopher. I had doubts and asked myself something like: am I generating a different type of knowledge from what biogerontologists would

[4] In the same sense but with more technical words: "Aging is characterized by a progressive loss of physiological integrity, leading to impaired function and increased vulnerability to death. This deterioration is the primary risk factor for major human pathologies including cancer, diabetes, cardiovascular disorders, and neurodegenerative diseases" (López-Otín et al. 2013: 1194).

[5] My mother is a physician.

generate if they cared about this type of question? Not surprisingly, the answer was "yes". I simply had to take some distance from the more technical papers to try to see something "deeper" about aging. In order to do so, I will resume the conversation with my grandmother:

—I have been thinking about explaining my essay on aging in a simpler way. Do you remember the talk that we had the other day?

—Yes. About "old people". Have you already found a cure?

—No, unfortunately not. But I do not doubt that many would take it.

—If it is to live better, absolutely.

—Of course. I fully agree with you, grandma. Look, I have organized my essay as follows: (1) What is aging?; (2) How can we control it or decelerate it?; (3) How do we want to live longer?; and (4) Do we really want to live forever? These four questions are what I constantly have in mind. Thinking about this is my job after all.

—Living forever? But that would be such a bore!

—Are you a philosopher, grandma?

After briefly clarifying what the main questions of this project are, I will now show the starting point to develop my ideas. This dissertation is meant to be a philosophical continuation of the work by Aubrey de Grey, notably in his well-known book *Ending Aging: The Rejuvenation Breakthroughs that Could Reverse Human Aging in Our Lifetime* (with Rae, 2007). He was the first researcher to ask more systematically questions about aging and his work has aroused a massive interest in this biological problem. De Grey defends the possibility of arresting aging and extending life, almost indefinitely: the first person who will live 1000 years is already alive. His defense of this idea is mostly done from the viewpoint of a moral urgency, since the pernicious effects of aging cause us irreparable

harm and suffering. He argues that this is one of the greatest problems that biomedicine has to solve, sooner rather than later. The use of de Grey's ideas has helped me to analyze a framework that I share on many points and to defend my own position, which differs significantly from its approach.[6] I have adopted a different approach in many debates, since my interests and goals as a philosopher are substantially different from his as a scientist.

Conceptually speaking, the main ideas of this project lie at the intersection of two different debates: the great challenge about whether aging is a disease and the discussions about the possibility of living longer, and whether that necessarily means living better, finishing with a critique of the alleged dream of immortality.

I will defend my position in the face of the two antagonistic approaches par excellence: bioconservatives and transhumanists.[7] My goal in this regard is twofold: (1) to argue for a plausible alternative to the two extremes in the debate on aging and life extension ("we must do nothing against this natural process" versus "we will overcome death"), defending a position based on the biology of aging; and (2) to express, philosophically speaking, what a future with an improved experience of aging could be. This is why the theoretical work becomes a social claim, at least in many of the capital issues of this dissertation. I do not only think about the meaning of treating aging—with my arguments, I will advocate that this should really happen.

Before starting the discussion, I would like to make some small points. First, all the chapters begin with a summary in which I synthesize the main ideas and my own contribution. Second, many sections in the project aim to guide the reader towards the predominant approaches in the literature. On many occasions opposing approaches will be very useful to show: (1) the difficulty of some of the

[6] Our discrepancy lies in our optimism about science. In this sense, I am quite moderate as to how long we will live in the future. This will be a recurring theme in the whole project.

[7] I will briefly develop the bioconservative approach in **chapter 3** and the transhumanist approach in **chapter 5**, as these will be essential to understand the rest of my ideas.

issues raised in the dissertation; and (2) the influence of well-established ideas on my contribution. Finally, in the general conclusions, I will reaffirm my own approach, which I will reach after considering all the arguments presented throughout the dissertation.

Moreover, in this project, I follow a very naturalistic approach, which means that I will often refer back to scientific studies to back up my claims. Unfortunately, an important percentage of the experiments in model organisms are in their early stages, but they are increasingly elaborate and promising. According to many biogerontologists, the first human interventions will soon be available. While I will fully discuss this issue in **chapter 3**, the focus of my dissertation as a whole largely prevents me from conceptualizing a post-aging world, as nobody knows whether this will happen or not. However, given that the topics of this dissertation are the theoretical definition of aging and its possible treatments, it is my duty to make clear at this point that my reference to any specific scientific study does not necessarily imply an endorsement of its success in humans, even if that has already happened in other animals. Finally, I want to explicitly state that all this dissertation is strongly influenced by the way I see the world around me (see Dawkins 2006; Dennett 1995).[8] When addressing an issue as intimate to the human experience as aging, it seems extremely complicated to get rid of the beliefs that nourish your existence.

§1.2. Research Methodology of the Dissertation

The present dissertation is an interdisciplinary study which makes use of a mixed methodology, as required by the strong bond between philosophy and science. Before starting to present the different research areas that converge in this dissertation, I will describe what value that a philosopher can bring to this scientific topic.

[8] I cannot deny that my atheism can be "read" at many points in this work. However, I will always show my position regardless of my lack of belief in an afterlife. At the same time, I cannot forget that I see the world with Darwinian eyes.

My work is purely conceptual, and, in that sense, it differs substantially from the typical research of biogerontologists. This is not to say that they do not ask about the nature of aging or about the goal of their own field.[9] Sometimes, it happens. They may have an implicit intuition, but this usually not the primary focus of their daily work, which instead tends to remain in the realm of bench science. However, in this project I will take a further theoretical step in the debate on aging and life extension. In order to do so, I will show the need to provide a different vision from what has already been said about this. From this point of view, my work will adhere to the perspective of Lucie Laplane et al. (2019) about why science needs philosophy:

> Despite the tight historical links between science and philosophy, present-day scientists often perceive philosophy as completely different from, and even antagonistic to, science. We argue here that, to the contrary, *philosophy can have an important and productive impact on science*. (2019: 3948; emphasis mine)

I will follow the perspective of Laplane et al. (2019) in four forms throughout this dissertation: (1) clarification of scientific concepts; (2) critical assessment of scientific assumptions or methods; (3) the formulation of new concepts or theories; and (4) the fostering of dialogue between different sciences, as well as between science and society. This perspective will be developed as follows: (1) theoretical definition of aging in the light of the concept of disease; (2) evaluation of case studies in anti-aging treatments (AATs) such as telomere lengthening; (3) expansion of a hypothetical picture of AATs; and (4) opinion about whether we would never want to die and want to live forever, so that the public can decide their own point of view with strong arguments. Now, I will briefly summarize my way of working.[10]

[9] My work as an intellectual is similar to that of an architect of ideas or a terminology surgeon, always immersed in my own thoughts. I feel like the painter of a picture who wants to outline each color and stroke of my creation once again.

[10] I want to thank Claudia Fernández-Fernández for her advice on evaluating this section.

On the one hand, I will adopt a broad perspective when studying biogerontology by following highly specialized handbooks and papers. To be consistent with my deeply naturalistic approach, I will support my arguments with scientific ideas. Complementarily, I have always linked my ideas with all the empirical data that this science provides, and I must not fail to indicate that this knowledge must be constantly updated by its evident progress.

On the other hand, when it comes to studying the philosophy of science— and more specifically the philosophy of medicine, one of the cornerstones of this dissertation— I will start by reviewing the basic academic literature, which will provide me with sufficient background knowledge. Then, I will venture into some of the most recent debates in this area. Subsequently, I will establish a link between a fairly novel sub-area within the philosophy of science and some of its fundamental works. Finally, the last chapter will deal with issues embedded in the philosophy of technology and even in a more generalist philosophy.

Different collaborations with other research specialists will be necessary for the development of many of the issues that I will work on in this dissertation.[11] In this sense, they have helped me understand many of the technical aspects of the biology of aging and its possible applications in clinical medicine. Much of what has been written has been generated thanks to the altruistic effort of other researchers.

§1.3. Structure of the Dissertation

This dissertation has four original chapters plus some general conclusions.[12] The overall purpose is to pave the way for a healthier life, and the best strategy for this challenge is to treat aging itself. The structure of the dissertation is as follows.

[11] Meetings with scientists will be important to assess the viability of all those promises to treat aging and as a counterpoint to my readings.

[12] In **chapter 6**, I will show a common thread among all these pages. However, at this point I must also indicate the possibility of reading each of them independently.

Chapter 2 discusses the most popular question: is aging a disease? In this chapter, I will analyze this classical question by addressing the concept of disease—other approaches have only referred to it as a somewhat vague idea. From a pragmatist perspective (Brigandt 2009), it can be said that the notion of aging is going through a conceptual change, and aging today can be understood as a process that is not radically different from other diseases which are familiar to us, for several reasons. This chapter plays a double role in my dissertation: on the one hand, it serves as an introduction, in the sense that it makes the reader familiar with this discussion; on the other hand, it directs my position in the following chapters—or, what is the same, my response in other debates would change dramatically if I understood aging in a different way. Concretely, this chapter motivates my claim that aging must be introduced in the medical agenda.

Building upon the previous conclusions, **chapter 3** expands a series of pronouncements made by David Gems (2014), in regard to the possibility of developing AATs. According to Gems, we have to understand this type of intervention in a logical, useful, and realistic sense. In other words, there is some theoretical knowledge, which, despite not being complete, is already sufficient to be transferred to clinical medicine. He argues for a shift in the goals of biogerontology, focusing on the underlying cause of all cellular damage. In this sense, I will defend his approach by pointing out that what really matters at this point is to treat primary damage without necessarily having a great rate of success in its first stages. This chapter is remarkable in that it opens the possibilities of scientific intervention in human aging. Decelerated aging is the way towards a healthier life.

Chapter 4 is strongly influenced by my contribution in **chapter 3** and it rescues the idea of maintaining our cognitive and physical capacities as long as possible. The urgency of treating aging is not to add years to life but rather to add life to our years (complementarily, de Grey 2008). In recent times, human beings are suffering from dependence, disability, and weakness in the years before death, despite our increasing life expectancy through medical and technological developments where the quality of life decreases considerably in terms of health.

For many of us, this means that we cannot develop the type of life that we want, regardless of the type of life that this is. In this sense, I will argue that our priority should not be to exceed the maximum recorded life, but rather to extend the health span at a population level so that the greatest number of people can live in optimal conditions. These first three chapters show the same argument from different perspectives, i.e. what the research lines of biogerontology should be in the current state of science.

Finally, **chapter 5** takes the question of **chapter 4** of whether we want to live longer and radicalizes it into whether we want to live forever, or, what is the same, the alleged dream of immortality. My goal is to evaluate the logic between the following two premises: (1) we normally never want to die; and (2) we normally want to live forever (Hauskeller 2013). In my view, it is possible to contextualize this fallacy by introducing the philosophical turn from "normally" to "under these circumstances". This reflection depends strongly on the context of every individual. This chapter does not only show the difficulties of conquering death, but also that perhaps this possibility is not so desirable. Not everyone would accept a life that is radically different from the one that we have today just to try to continue living.

At this point, I will justify my reasons for including this chapter in a dissertation so strongly influenced by naturalism. Briefly: (1) discussing a very interesting subject from a philosophical point of view, which has in itself a long tradition; and (2) a personal interest in lowering the expectations of these types of promises and asking the public whether they really want this goal. That is why I will use my imagination rather than following what science says, since it is a scenario which exceeds the realm of the possible.

Chapter 6 concludes this dissertation with a common thread among many of the ideas of my whole project thesis and refers back to the four debates that constituted my point of departure, that is, the conversation with my grandmother. Finally, I will conclude my dissertation by linking my contribution

with Antonio Diéguez's thought. While finishing my introduction, at some point I have felt like this famous moment:

> It was 4 A.M. in California but my body insisted on reminding me that it was noon in Cambridge. I was exhausted from the intercontinental flight and by a day spent in biogerontology, at an invitation-only brainstorming workshop on ideas to combat aging (...). But I couldn`t sleep: On the top of the mismatch between biological and geographical clocks, I was frustrated at what I saw as the day's failure to make any real progress toward a concrete, realistic anti-aging plan (...). Now, if only we had solutions like that for all of this other stuff, I mused, we could forget about the "butterfly effect" of interfering with basic metabolic processes, and just take the damage ITSELF out the picture. (de Grey & Rae 2007: 3-4)

Like de Grey, I will provide arguments in my fight against aging, perhaps from another point of view, but complementary to his in many ways. We must get rid of the ravages of this ruthless process which causes us so much pain and suffering throughout our lives, and to those around us. I am not prepared to grow old at a time where "growing old" looks quite grim and is characterized by (potential) decline and disability—in other words, our current understanding and reality of what it means to "grow old". Maybe I will never be.

Chapter 2: Is Aging a Disease? A Theoretical Discussion in the Light of the Pragmatist Approach in the Philosophy of Medicine[13]

Summary

In the philosophical debate on aging it is common to raise the question of the theoretical definition of aging in terms of its possible characterization as a disease. Understanding aging as a disease seems to imply its medicalization, which has important practical consequences. In this chapter, I analyze the question of whether aging is a disease by appealing to the concept of disease in the philosophy of medicine. As a result of this analysis, I argue that a pragmatist approach to the notion of disease is the best strategy to highlight the relevance of the medicalization of aging. From this pragmatist perspective, it can be seen that the notion of aging is going through a conceptual change, and aging can today be understood as a not radically different process from any other condition that is usually considered a disease.

[13] This chapter is based on the paper "Is aging a disease? The theoretical definition of aging in the light of the philosophy of medicine", written jointly with Cristian Saborido during a national research stay at the UNED (Madrid) (accepted in The Journal of Medicine & Philosophy). This chapter, however, is an extended version of the contents we then discussed and provides a more comprehensive survey of the concept of aging in biology and medicine, as well as its normative challenges. I would like to thank to Nicholas Agar, Antonio Diéguez, Javier González de Prados, Gregor Greslehner, Francisco Lara, Maël Lemoine, Andrés Moya, Jon Rueda, and Christopher Wareham, who read earlier versions of this chapter and made useful comments and suggestions. Eric Juengst especially contributed to this final version. Above all, I would like to thank to Cristian Saborido for giving me permission to modify our paper and include it as a chapter of my dissertation. Even more, he has taught me everything I know about the concept of disease. He has encouraged me to relate aging and life extension studies with other topics on the agenda of the philosophy of science. The question of whether aging is a disease is not only an important challenge for biogerontologists and philosophers but the main question for my whole project.

§2.1. Introduction

2.1.1. Aging as a "Mystery" to Biology

Biological organisms have limited life spans, from the extremely short life span of the African turquoise killifish—9 months—, through some species of very long-lived bats and mole-rats, to the 200-years of boreal whales (Brunet-Rossini & Austad 2004; Buffenstein 2005; de Magalhães 2015; Kenae et al. 2013; Valenzano et al. 2015) (**Figure 1**). Over the lifetime from one biological development to the other, their bodies go through a plethora of transformations, often dramatic. In many cases, these changes are due to the effect of their interactions with the environment and with other living beings. Eating, fighting, and mating transform us both behaviorally and morphologically. Surviving and living with others are demanding tasks, and they leave a mark. In other cases, the changes are determined biologically. This happens, for instance, when young organisms grow, develop, and become adults, or when these adults exhibit signs of organic degeneration in their constituent parts as a result of the passing of time (Arking 1998; Bengtson & Settersten Jr. 2016; Finch & Hayflick 1977; Kirkwood 1999; Rose 1994). This last sort of biological transformation is well-known as aging.[14]

[14] It is worth noting that here "aging" is not simply understood as the passage of time, but as the set of decadence processes—normally perceived as something negative—which normally accompanies time passing in organisms. For instance, the decrease of cognitive and physical capacities due to Alzheimer's or various cancer types, among other diseases. In other words, I only take the biological meaning of "aging" for this chapter. In this line, the concept of aging, as used in this chapter, would be synonymous with "senescence". Since it is the most widely used concept in specialized literature, I will exclusively use "aging" in the whole project.

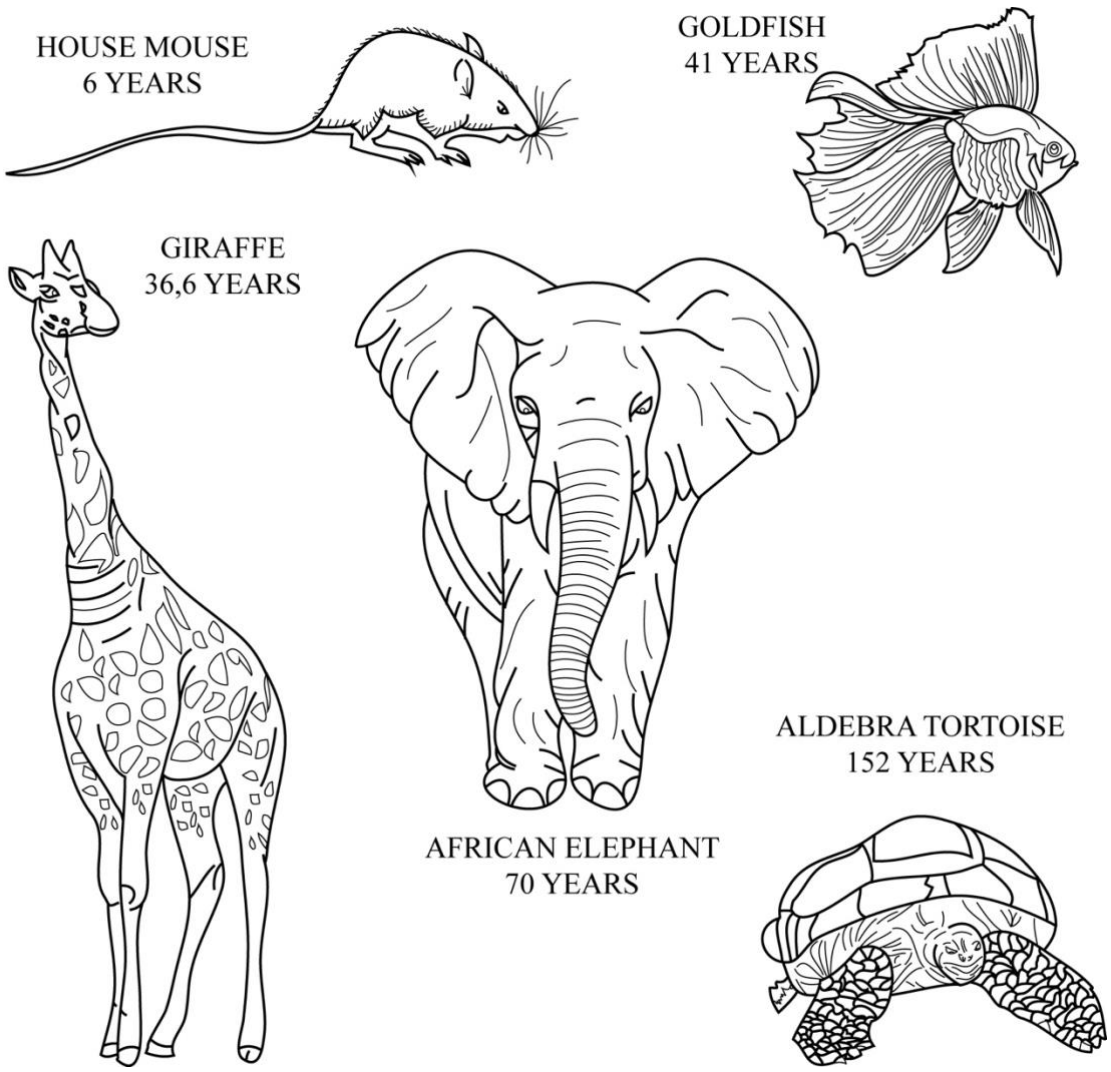

Figure 1. Oldest life span documented for several species. Adapted from: https://www.collective-evolution.com/2016/08/27/we-learned-an-important-secret-to-longevity-slowed-aging-from-studying-elephants-ants/, Accessed 29th August, 2019.

Aging is a biological phenomenon that is widespread in nature and has noticeable signs, such as the appearance of spots and wrinkles on the skin, or hair loss and discoloration.[15] Here comes a most surprising fact: although we assume that it is a very "inevitable", "natural", or even, "normal" fact, biogerontologists have traditionally been unsure about what exactly it was, in scientific terms, to age. Aging has been a "mystery" to biology for decades. In 1951, Sir Peter B. Medawar pointed out this issue in a famous lecture at University College London entitled *An Unsolved Problem in Biology*. Medawar considered that the state of the

[15] I will provide an explanation for age-related diseases (ARDs) in **chapter 2**.

biology of aging at his time (mid-20th century), did not allow one to discern with the desirable clarity what the concrete biological processes behind aging were.[16] Although its effects could be assessed and perceived, there was no precise description of the biological mechanisms underlying aging. As Medawar (1955) said:

> The one master process could be measured, and the rest should follow. But we know of no such master factor; the processes of senescence are in gear, but we do not know which is the *driving wheel*. (1955: 5; emphasis mine)

Biogerontologists throughout the following 40 years considered the *driving wheel* of aging pretty much a "mystery" to biology. However, it would be unfair to say that at that time there were no significant advances in the biological understanding of aging. Medawar himself (1952) and other great contemporary biologists (Hamilton 1966; Maynard Smith 1958; Williams 1957) postulated a series of hypotheses and ideas from an evolutionary perspective with emphasis on natural selection that contributed to the understanding of the origins of aging. Nowadays, biogerontologists seem more optimistic than Medawar and begin to think that aging can be explained. For instance, in 2006 Robin Holliday published *Aging is no longer an unsolved problem in biology,* and the following year Leonard Hayflick wrote another paper with an almost identical title: *Biological aging is no longer an unsolved problem*. It is probable that this optimism is justified. Biogerontologists know more and more about the hallmarks of what we commonly call aging (cf. López-Otín et al. 2013). Of course, there are still open scientific questions without an ultimate answer, those concerning the evolution of aging or the question of why we age (cf. Charlesworth 2000; Kirkwood 1977; Kirkwood & Austad 2000), but, as we know more about the biological processes that lead to aging and new medical technologies allow us to dream of solutions capable of confronting this hitherto unavoidable reality, a multitude of normative concerns arise.

[16] Today, the state of science and technology seems to go hand in hand. In Medawar's time, there were not enough means to intervene in the process. Therefore, the knowledge of the time was practically theoretical.

2.1.2. Normative Challenges of Treating Aging

At present, several normative issues related to the new biology of aging are being addressed by a number of disciplines, from bioethics to the philosophy of medicine. Philosophers have joined biogerontologists in trying to answer questions: such as: (1) "Is there any human traditional limitation to live longer?" (de Grey 2008); (2) "Should we eliminate aging?" (de Magalhães 2014); or (3) "What are the implications of the so-called anti-aging medicine" (Gems 2014). The most pressing issues, both for biogerontologists (de Grey & Rae 2007; Moody 2002;) and philosophers (Agar 2010; Harris 2007), are ethical, political, and scientific concerns derived from the possibility of arresting or even reversing the cellular and molecular damage of our organism. Extending life (perhaps, indefinitely) entails a series of biological and philosophical which we should evaluate.

Some authors are opposed to the view that extending life is something desirable (Fukuyama 2002; Habermas 2003; Kass 2003; Sandel 2007).[17] They believe that including life extension as a goal of the medical agenda would have pernicious effects on our lives. Seeking to live longer can be a bad thing because of socio-economic reasons, as it would involve a waste of resources for therapies and treatments that are not really imperative, or it could encourage inequality between individuals. Furthermore, there are also religious and spiritual restraints about the suppressing of aging, such as the risk of losing the precious fleeting character of life that gives deep meaning to human existence.

However, there seems to be a growing consensus that, if medicine is able to scientifically explain the biologically reasons for the aging process, then it should. At the very best, it is difficult to deny that the fight against the impact of aging is one of the goals of the current medicine. Regardless of whether or not aging will ever be completely arrested, medicine has already made great strides not only to make us live longer, but also to do so with a better quality of life (Vijg & de Grey 2014). Biology holds an increasingly detailed knowledge of the

[17] I will present with more detail the bioconservative approach in **chapter 2**.

mechanisms and processes of aging and, as aging becomes less and less of a "mystery", new advances will surely be able to further improve all stages of the human life-cycle. Is it reasonable to think that, if it can, medicine will not fight aging? Aging is a process that we live in the first person. Like all other living beings, from bats to whales, we humans age. Aging, at least in our case, has enormous personal and social implications. No matter how many self-help books we read and how many motivational slogans we learn by heart, most people have a rather negative attitude towards aging. We do not like to grow old, even if we think it is "inevitable", "natural", or "normal". We may not even take comfort in the positive aspects of the process, such as the acquisition of greater wisdom or temperance in character. We only see aging as a loss of capabilities due to cognitive and physical decline. Also, of course, it is seen as the visible sign of the unstoppable passing of time and as an antechamber to death. In this line, I summarize Aubrey de Grey's thought with the following statement: As far as I am concerned, aging is humanity's worst problem.[18]

The very question of whether or not it is desirable or possible to cure aging implies a strong assumption: aging is a disease or, at least, is a condition susceptible to being treated *as if* it were a disease.

2.1.3. Aging from the Philosophy of Medicine

In the philosophy of medicine, a central debate has developed around the question of whether aging is a disease (see de Winter 2015; Murphy 1986; Schramme 2013).[19] Broadly speaking, it can be said that this debate is marked up of two main opposing positions on whether or not aging is a disease.

[18] This sentence is not a direct quotation from him but simply captures his position on aging. It is not, therefore, literal.

[19] See more specifically the volume 8(2) of *Advances in Gerontology* (2018). This volume contains the papers by Leonid A. Gavrilov & Natalia Gavrilova; Aleksei G. Goluveb; Alexey Moskalev; V. S. Myakotnykh; and Valery M. Novoselov.

On the one hand, there are authors who—without denying the medical relevance of treating aging—reject the condition of aging as a disease on the grounds that it does not meet the definition of disease. From this perspective, the works by Leonard Hayflick (2000, 2007) are particularly noteworthy.[20] On the other hand, other authors argue that aging is a biological condition that shares so many characteristics with diseases that are normally treated medically that there is no reason why it should not be seen as such. What is more, we have good reasons to advocate including the relief of conditions related to aging as a legitimate goal of current medicine. From this perspective, Arthur L. Caplan (2005, 2017) argues that aging should be understood as a disease in order to facilitate public policies that aim to address the pathological processes of old age.

In this chapter, I will attempt to shed light on the philosophical debate about the theoretical definition of aging by looking at the debate on the concept of disease found in the philosophy of medicine. Aging is less a "mystery" to biology today than in Medawar's time. My structure will be as follows: in §2.2, I will analyze the discussion between the two major positions in this debate, and I will introduce the influential approaches of some authors. I will show that in this discussion it is being assumed by some authors that the definition of disease is univocal and corresponds to what they understand as a "non-natural process". My claim is that in order to decide whether aging is a disease it is necessary to look at it from the philosophy of medicine. The motivation for this is straightforward: in order to decide whether aging should be defined as a disease I need to clarify: (1) "What is a disease?"; and (2) "What criteria are used to assess something as such?". In §2.3, I will argue that the disagreement between those who maintain that aging is a disease and those who claim that it is not is ultimately based on the assumption of different notions of disease. Then, I will turn to the debate on disease in the philosophy of medicine to analyze the proposals of Timothy Murphy, and Daniel Callahan and Eva Topinkova. These

[20] Claudius Galen presented one of the most classical arguments considering aging as a natural process. In short: (1) disease is defined as disordered or abnormal function; (2) aging is universal (everyone "catches it"); (3) that which is universal cannot be abnormal; and (4) therefore, aging is not a disease: it is a "natural process" (in Faragher 2015).

authors advocate avoiding the question of whether or not aging is a disease for pragmatic reasons. The issue at hand would not be to define aging as a disease but to medically treat it as such. In this chapter, I will maintain that these proposals have the merit of putting the focus on the practical aspects of the use of concepts in medicine, but they are unsatisfactory because they continue to believe in an objectivist notion of disease that they do not justify. I will propose reformulating this pragmatically motivated proposal to frame it in an approach to the concept of disease that I call "pragmatist", which has been advocated by philosophers of medicine such as Rachel Cooper or Bjørn Hofmann. I will argue that, from this perspective, aging can be seen as not radically different from any other condition that is usually considered a disease. I claim that this pragmatist approach addresses the issue of medical categorization of aging in a more scientifically and philosophically fruitful way.

§2.2. What Is Aging?

2.2.1. Aging as a Natural Process

In the philosophical and scientific literature, several authors argue that aging cannot be defined as a disease (Glannon 2002a; Hayflick 2007; Olshansky et al. 2002; Schramme 2013).[21] The rationale is that aging is a natural process, an unavoidable feature of our nature and not a biological failure. The notion of disease, they argue, alludes to an unnatural state (in the sense that diseases depart from the biological norm). Aging cannot be a disease because it is not a failure in the functioning of organisms, but a defining property of their design. Thus, they distinguish between this biological process and other diseases, such as Alzheimer's or various cancer types.

There are two main justifications for defending the "naturalness" of aging. Firstly, it has been argued that aging is a product of evolutionary history. Many past and present-day biologists, as well as health scientists, medical researchers,

[21] Bioconservatives adhere to this approach as I will show later. However, in this chapter I will cite those authors who, while defending that aging cannot be a disease, provide serious arguments and reasons based on knowledge about the biology of aging.

and philosophers have adopted evolutionary approaches to aging. Medawar (1952) proposed that the force of natural selection decreases once an organism reaches an age at which it has been able to reproduce. Medawar's *mutation accumulation theory of aging* claims that aging is a process resulting from random mutations, and that the benefit or disadvantage of a long-life span is not of great importance in evolutionary terms. Mutations involving changes in biological traits of old organisms do not significantly impact on fitness. In fact, the older an organism is, the less evolutionary significance these mutations have and, consequently, the less influence natural selection plays. Aging is a result of mutations that is not evolutionarily relevant and therefore has not been removed through the action of natural selection. Many wild species do not suffer he severe effects of aging cause they before it occurs.

George C. Williams (1957) proposed the *antagonistic pleiotropy hypothesis*, which claims that a single gene can produce two phenotypic traits, with one being beneficial to the organism and one detrimental. Thus, a trait can be evolutionarily selected for the beneficial effects that it can have on the early life of an organism, even though it may have negative effects on the organism at an old age. That is the key to understanding aging: an organism ages as a result of the combined effect of a number of pleiotropic genes that have beneficial effects in young age but negative side effects when older age is reached. Biological traits are selected for their impact on the reproductive capacity of organisms, which tends to reach its zenith in their youth. If a trait has an impact on increasing the reproductive fitness of an organism, despite having long-term negative effects, then it will probably be evolutionarily selected (i.e. follicular depletion in human females causes more regular menstrual cycles during maturity and a loss of fertility after the reproductive stage).

Thomas Kirkwood and Robin Holliday (1979) presented the *disposable soma theory* according to which organisms have to distribute their limited amount of energy between the activities and processes destined to their reproduction, and those dedicated to the maintenance of the non-reproductive functions (that is, the sustenance of their "soma"). Aging is the natural degradation that an

organism, or soma, could repair only at the expense of reproductive efforts, which, from an evolutionary perspective—that is, a perspective that gives primacy to plant breeding—would not be efficient (in Goldsmith 2006: Ch. 4). In conclusion, according to all these evolutionary interpretations of aging (the mutation accumulation theory, the antagonistic pleiotropy hypothesis, and the disposable soma theory), the signs of aging are the inevitable result of our evolutionary history. Aging would not be an error in our design, but its natural outcome.

Secondly, regardless of whether or not it is a product of biological evolution, many authors have argued that—be it or not a product of biological evolution—aging is natural because it is an irreversible, normal, progressive, and universal phenomenon (Glannon 2002a; Hayflick 2007; Olshansky et al. 2002). Accordingly, aging is an inevitable—an essential hallmark of living beings. If this is so, aging is radically different from the conditions that we usually interpret as diseases since it does not involve any "abnormality" or "dysfunction", but it is only the normal way of functioning in biology from a certain age onwards.[22] Aging is simply an inescapable fact for all organisms that live long enough. Along this line, Hayflick (2007) considers that there are six characteristics to

[22] Of course, the age at which senescence begins is not universal. Here, I consider a vague idea of "a certain age onwards" at which the dysfunction associated with aging could be considered "normal". The age at which senescence begins is different in each species and, within humans, it does not only depend on strictly biological factors, but it also is strongly dependent on social and cultural determinants. people do not start to feel the detrimental effects of old age in Japan at the same age as they do in Sierra Leone - in other words, the health span is different in these contexts, and this has to do with both social and cultural differences between the two countries (one is higher income, greater access to medical care, etc.) But another way this could be interpreted is: People are not seen by others in their community as an 'older person' at the same age in Japan as they are in Sierra Leone (i.e. what we consider an "elder" differs culturally and socially; and indeed, among many First Nations communities in Canada, being conferred the title of "elder" has nothing to do with chronological age, but rather the cultural knowledge that a member of a particular First Nations band member may possess). For the purposes of this chapter, it suffices to point out that aging, despite these differences, is considered by many to be the normal way of functioning from one age onwards, although this age may be different for different groups of people.

justify that aging is a natural process. These six characteristics which justify that aging is a natural process. In his words, age changes:

1. Occur in every multicellular animal that reaches a fixed size at reproductive maturity.

2. Cross virtually all species barriers.

3. Occur in all members of a species only after the age of reproductive maturation.

4. Occur in all animals removed from the wild and protected by humans even when that species probably has not experienced aging for thousands or even millions of years.

5. Occur in virtually all animate and inanimate matter.

6. Have the same universal molecular etiology, that is, thermodynamic instability (2007: 8-9).

In sum, medicine should only address the "unnatural" processes of organisms, and aging is natural, either because it is an evolutionary outcome or because it is universal and inevitable. This position seems to be based on an intuitive idea of a kind of "natural normativity" according to which organisms present an optimal or "healthy" design which is precisely what determines the standard of health. "Natural" would be equivalent to "healthy".

This position has been widely criticized within the philosophy of medicine on the grounds that it shares the same flaw as the famous "naturalistic fallacy" in ethics (Goosens 1980). In fact, many of these authors who endorse the naturalness of aging are in favor of including it in the medical agenda. For instance, Hayflick (2000, 2007) affirms that aging is a natural process but, at the same time, he thinks that it is possible to scientifically explain the biological

resolved problem, and that this is very relevant to understand and treat ARDs such as cardiovascular diseases, strokes, or various cancer types. Aging per se would not be a disease, but it is a natural process underlying many diseases. The goal of biogerontology is not to develop interventions to cure or treat the aging process itself (which is impossible given its universal nature), but rather to develop therapies and treatments that can decelerate, stop, or reverse the serious effects of ARDs in humans in order to help people to have "an active longevity, free from incapacity, and functional dependence". (Hayflick, 2000: 269)

2.2.2. Aging as a Disease

The definition of aging as something natural—and consequently as a process that cannot be interpreted as a disease—is precisely the assumption that is challenged by those who argue that aging is a disease (Caplan 2005, 2017; notably, Gems 2014, 2015).

For Caplan, it is questionable whether aging is a natural process, since aging is not a product of evolution, but rather an "accident of evolution" or a by-product of natural selection, in line with the antagonistic pleiotropy hypothesis (2017: 238). Moreover, he asserts that naturalness is a poor indicator of whether some state is a disease. Caplan holds that the notion of naturalness in terms of universality and inevitability also fails to demonstrate that aging is not a disease. Even if it could be admitted that aging can be something natural in the sense that it is something that affects all living beings, this is not enough. Tooth decay is also universal, and infections are unavoidable, and yet both are still considered diseases. What is relevant for judging whether or not a state is a disease is not its "naturalness", understood either in terms of evolutionary functionality or universality. On the contrary, Caplan argues, aging is a disease because it is clearly dysfunctional for the organism.

Dysfunction, instead of naturalness, is a relevant criterion for determining whether something should be considered a disease. A disease is a dysfunctional biological state. Here, Caplan identifies here the notions of "functional" and

"teleological" with "evolutionarily selected". He argues that those who argue that aging is a natural process are basically assuming that aging has a "natural purpose", i.e. it is a functional biological trait. In this sense, a selected-effect approach to functionality seems to be assumed (Millikan 1989; Neander 1991; Saborido 2014). Insofar as the function of a trait is an evolutionarily selected effect, to say that aging is natural (i.e. functional) is equivalent to saying that aging is a process that has been evolutionarily selected because it represents an evolutionary advantage in terms of its contribution to fitness, which, for Caplan, is not true (2017: 238). Caplan claims that aging does not fulfill any biological function because it is a by-product of natural selection, which is focused on reproductive success at the expense of the long-term cognitive and physical capacities of individual organisms. Consequently, it is wrong to argue that aging is not a disease on the basis that as it is an essential biological characteristic of our organic design, because aging actually has no evolutionary function. For Caplan, aging should be treated as a condition analogous to other pathologies mainly because it entails the cognitive and physical decline of the key functional capacities of organisms.

Arguably, aging as such is not normally treated as a paradigmatic disease—a condition comparable to myopia or tuberculosis—by the medical profession. Aging is not a notable issue either in biology or medicine handbooks or in university degrees, and their own specialties (Janac et al. 2017). Even though —medicine may have led to significant advances in alleviating the consequences of aging, there is not a popular or medical notion of aging as a disease. However, as with other biological conditions in the past, this consideration is subject to change if good reasons are given. As medical knowledge has evolved, medical classifications have been transformed. For Caplan, there does not seem to be any reason not to include aging as another disease in medical classifications. In fact, as many authors argue, it does not seem foolish to think that medical and technological advances could completely arrest or even reverse aging in the future (Bostrom 2005a; de Grey & Rae 2007; Kurzweil 2005; Wood 2016). In that case, aging would clearly be a disease in a very similar sense to that of other

complex multifactorial pathological conditions, such as Alzheimer's or various cancer types.

Thus, Caplan claims that not only are there no sound theoretical arguments for denying the conception of aging as a disease, but there are also good practical reasons for dealing with it *as such*. It is obvious that aging is commonly related to age-related conditions, such as cognitive impairment or bone fragility, which increase in prevalence as people age. Classifying aging as a disease would help us to address ARDs by addressing them at their source. Instead of repairing the damage caused by a flood, a dam could be constructed thus preventing the flood from occurring. If we were able to intervene in aging, humans would suffer fewer age-related symptoms that are usually considered to be pathological.

Finally, like Hayflick, Caplan expresses his negative view of the sequels of aging and in his wish for these processes to be addressed by medicine. However, they disagree on whether aging should be called a disease—not only this, but they also appear to disagree on the point of *intervention*. Caplan bases his argument on a criticism of the reasons offered to claim that aging is not a disease, mainly the argument of naturalness, and asserts that the best way to deal with the negative impact of aging is to consider it a disease. However, medicine addresses many conditions that are not considered to be diseases. Cosmetic surgery is a prime example. If something is sufficiently undesirable and is legally open to medical intervention, it is likely that medical skill and knowledge will be used to address the undesired state, regardless of its status as a disease. What do we gain by categorizing aging as a disease? How is it different from Hayflick's notion of aging as a "medically treatable" condition?

In this chapter, I will argue that in order to answer these questions we need to examine the very definition of the concept of disease. It may be true that advocates of aging as a natural process do not have good reasons to deny the conception of aging as a disease, but Caplan lacks a well-developed definition of

disease itself.[23] In §2.4, I will introduce an approach to the notion of disease that philosophically justifies why some experts, such as Caplan, actually have good reasons for categorizing aging as a disease. However, before explaining this approach, there is one fundamental question that must be answered: Is there a net benefit to medically addressing aging?

2.2.3. Aging from a Pragmatic View

In a classic paper, Callahan and Topinkova (1998) review the debate on the definition of aging as a disease and, in addition to pointing out the two general approaches, they introduced a new one, which they also considered to be the most promising. According to Callahan and Topinkova, the best strategy is *to treat aging as a disease*. Even though, when they believe that aging *is not* a disease, but a natural state, they claim that medicine must include aging within the biological conditions that we can—and should—medically fight, i.e. aging should be interpreted as a disease for pragmatic reasons. Thus, Callahan and Topinkova propose to avoid the question of the ontological categorization of aging and to look instead at the benefits of viewing aging as a medically treatable condition.[24]

Callahan and Topinkova argue that the best strategy to understand the relationship between the concepts of disease and aging is to take a pragmatic view. It does not matter if aging is a disease or not, what matters is what you gain or lose by thinking about it as such. In many aspects, they argue, the biological consequences of aging are similar to the symptoms of diseases, such as Alzheimer's or various cancer types. Viewing aging *as a disease* aids in the task of

[23] There are few proposals in the philosophy of aging that do explicitly endorse a specific definition of disease. One of them is Thomas Schramme's theory (2013), who argues that aging is not a disease because it does not fit the predominant definition of disease (i.e. the bioestatistical approach).

[24] Actually, Callahan and Topinkova explicitly say in their paper that they assume that aging is not really a disease. In this sense, Callahan and Topinkova present an ontological position that interprets diseases as natural states and a pragmatic approach according to which these natural states should be treated as if they were diseases, even if they are not (1998: 93-94).

looking for its causes, controlling the underlying processes once discovered, and reducing or reversing the damage that is currently inevitable and irremediable for humans. Consequently, these authors assume that aging could have a medical treatment analogous to that of any disease, but they do not believe that aging can be defined as a disease. To overcome this tension, they propose to take an "agnostic"[25] stance, which argues that it is best to consider aging *as if* it were a disease, no matter whether or not it (ontologically) is one.

Callahan and Topinkova believe that this pragmatic view fits well with the way in which researchers understand the notion of aging in practice. Biogerontologists, these authors argue, focus on how to address and manipulate the aging processes that we consider undesirable. They do not necessarily need aging to be a disease to medically treat it. Callahan and Topinkova shift the focus from the question of "What is aging?" to "What is the most useful approach to understanding aging?". This shift is supposed to have beneficial repercussions on assessing what the medical and social consideration of aging should be. A similar position is defended by Murphy (1986), who advocates moving from the question "Is aging a disease?" to "Is aging objectionable such that its prevention and cure ought to be sought?". Murphy claims that this would highlight the moral issues behind the problem of the definition of aging. The real challenge, this author argues, is not theoretical, but ethical, and it is in this sphere that the philosophical reflection on aging must be placed.

In fact, several authors have pointed out that there are compelling normative reasons to focus on the benefits and risks of treating aging as a disease. It does not matter what aging ontologically is (whether or not it is a disease), but rather, what theoretical characterization has better implications for our health and welfare. Considering research on aging as a part of the agenda of health programs would help to emphasize its implications for health care. Sven

[25] This word is not in Callahan and Topinkova's paper. Since they are scientists, I think that perhaps they reject a theoretical definition of aging due to the metaphysical character of the question—and because it is almost irrelevant to their work.

Bulterijs. et al (2015) put it this way when referring to the specific case of the US healthcare system:

> Our current healthcare system doesn't recognize the aging process as the underlying cause for the chronic diseases affecting the elderly. As such, the system is setup to be reactionary and therefore about 32% of total Medicare spending in the United States goes to the last 2 years of life of patients with chronic illnesses, without any significant improvement to their quality of life. Our current healthcare system is untenable both from a financial and health and well-being prospective. Even minimal attenuation of the aging process by accelerating research on aging, and development of geroprotective drugs and regenerative medicines, can greatly improve the health and well-being of older individuals, and rescue our failing healthcare system. (2015)

An obvious response to this pragmatic view might be that it is not necessary to consider aging as a disease for it to be medically treated. Medicine addresses many conditions that are not considered diseases (from risk factors to cosmetic surgery). However, the motivation for viewing aging as a disease is very clear: this would put aging directly on the medical agenda. Not everything that medicine treats is a disease (i.e. breast augmentation), but all diseases are treated by medicine (i.e. pancreas cancer). This is something that advocates of the pragmatic view consider imperative. The severity of the consequences of aging not only for individuals, but also in terms of health care, has led authors such as Aubrey de Grey (2003) to assert that just as there has been a "war on cancer" there will most likely be a "crusade against aging" in the next decade.

However, the fact that the social and personal impact of aging is a central (perhaps the most important) issue does not mean that the question of how we theoretically understand aging can be completely ignored. Normative challenges are deeply determined by their theoretical characterization. As Caplan says:

> The debate over what aging is comes prior to a decision to what anyone ought to try and do about it. If we can agree it is disease, then certain barriers to interfering with it, neglecting it, or accepting it fall away. (2017: 236)

I can therefore conclude that we are faced with two well-established presumptions in the debate on the definition of aging: (1) aging is a condition that is correlated with cognitive and physical decline that leads to a deterioration in the quality of life of individuals; and (2) considering it to be a disease would decisively make treatment and prevention of aging legitimate goals of medical research. To alleviate its negative consequences, medicine must treat aging in a similar way to how it treats other conditions usually categorized as diseases. In other words, for practical and moral reasons, aging must be included in the medical agenda as a disease.

On the basis of these presumptions, we find two possible alternatives: either aging is directly considered a disease, which means that it should necessarily be medically treated, or aging is something different from a disease, but it should be seen *as if* it were a disease. The second alternative—epitomized in Callahan and Topinkova's pragmatic view—is presented as a very promising way of avoiding an apparently irrelevant ontological disquisition by shifting the discussion to practical concerns.

However, even though this position is presented as neutral with respect to the characterization of aging as a disease, its rationale ultimately lies in the implicit assumption of a definition of disease that does not apply to aging. Callahan and Topinkova believe that there are compelling reasons to believe that seeing aging as a disease is a positive thing, but we have to be satisfied with making the pragmatic movement to think of aging as if it were a disease because, in real terms, it is not. If aging were seen as a full-fledged disease, as Caplan claims, this pragmatic turn of Callahan and Topinkova would not be necessary. This "agnostic" proposal is mainly motivated by the fact that it is assumed, albeit implicitly, that it is not possible to understand that aging is actually a disease, no matter how convenient this would be.

It seems quite obvious that the definition of aging as a disease depends not only on what we understand by aging, but also on our prior definition of disease. Significantly, in the philosophical debate on aging the definition of disease seems

to be taken for granted or considered as irrelevant (§2.3). At best, the authors distinguish between a disease and a natural process. However, medical theorists are far from seeing the notion of disease in this simplistic way. It should not be uncritically assumed that the notion of disease has a single, uncontroversial definition. In the next section, I will review the debate on the definition of disease as it is addressed in the philosophy of medicine. The concept of disease is no less intricate than that of aging, and its theoretical characterization is at the core of one the most important discussions within the current philosophy of medicine.

§2.3. What Is a Disease?

2.3.1. Naturalists versus Normativists: Classical Approaches[26]

Despite being central to the theory and philosophy of medicine, the notion of disease is particularly elusive. It has two different but intimately intertwined dimensions. As Marc Ereshefsky (2009) argues, to characterize a condition as a disease implies both: (1) making a state description about the characteristics of the individual that we consider sick; and (2) making a normative claim, that is, an evaluation in terms of correct or incorrect, good or bad, of that condition. A diseased individual is someone who has been ascribed a state that has been medically described and evaluated as a bad thing to have. Distinguishing the healthy from the pathological does not only imply an observation but also a value judgment.

It is not surprising that there are theoreticians of aging who have tried to use the notion of disease to justify medical action. The concept of disease, in addition to referring to states whose characteristics we can describe, has a strong normative component, since it its implies a categorization that implies the duty to "try to fix" (i.e. to treat) a negative condition. To assume that aging is a disease is to assume that aging is a localized phenomenon that we can describe and that it is something negative that should be medically addressed.

[26] Complementarily, see Saborido (2020).

However, in order to decide whether aging is a disease, first it must be clarified what a disease is, and the philosophers of medicine have defined "disease" in very different ways. Broadly speaking, it can be said that there are two main approaches in the philosophical debate on health and disease.

First, there is an approach that argues that it is possible to objectively characterize the biological properties that determine certain states as healthy or diseased. According to this approach, known as "naturalism" in this debate, biological organisms may present certain conditions that can be qualified as healthy or pathological in themselves, regardless of our cultural, personal, or social criteria. The most important naturalist theory is Christopher Boorse's Bio-Statistical Theory (1977). For Boorse, health is the statistically normal functional behavior, and disease is an organic dysfunction that makes an individual to behave at a lower level of efficiency than the rest of the members of her reference class (i.e. beings of the same species, age[27] and sex). From this approach, the evaluative considerations that external observers may have with respect to these behaviors are irrelevant: health is simply the normal biological functioning from a frequentist statistical point of view.

This theory advocates an axiologically neutral approach to the notions of health and disease. This does not mean that "disease" is not considered a normative concept, but that this normativity is not based on the values of the observer—rather, it is inferred from the properties observed. This is what James G. Lennox (1995) calls "objective values". On many occasions, this approach is based on the assumption of a sort of "natural normativity" in biological organizations. This natural normativity is sometimes justified by the disposition of the organization of living beings to regulate themselves (Saborido & Moreno 2015; Saborido et al. 2016), or by the action of natural selection to maximize organic designs to improve fitness (Boorse 1976). In any case, the objectivist

[27] It is worth noting that, if age determines the reference class, it would seem that aging couldn't, in any case, be considered a disease from Boorse's perspective. If any disease is an abnormal behavior within the framework of a reference class that is composed of individuals of the same age, then aging is beyond the focus of the biostatistical approach (cf. Schramme 2013, complementarily, de Winter 2015).

approach assumes—in a way reminiscent of Aristotle's biological teleology—that the organic design of living beings allows to infer proper norms for organisms (González de Prados Salas 2018), and that this design can be inferred from the statistical distribution of individuals: the normal in a statistical sense corresponds with the normative.

In contrast to the naturalists, there is an approach that argues it is not possible to objectively define "health" and "disease". According to this approach, known as "normativism", the notions of healthy and diseased are so plagued with cultural values that it is impossible to disassociate the social context from the medical categories from their social context. There is nothing like a "natural normativity" because the distinction between "beneficial" and "detrimental" is something that always depends on us. In the medical and the popular discourse, the difference between "the healthy" and "the diseased" is intimately dependent on our personal point of view. Thus, "the healthy" would mainly be the condition that we desire, whereas "the diseased" would be the condition that we want to avoid. Lennart Nordenfelt (1987) maintained that at the heart of our medical distinctions are our cultural and very non-objectifiable appraisals of what we consider to be beneficial, both in the personal and in the social sphere.

Normativists have been very critical of those who have tried to establish "health" and "disease" as objective scientific categories. The distinction between "healthy" and "diseased", they assert, conceals a political imposition of some people on others, which, on many occasions, has very dishonorable motivations and effects. Normativists often recall examples of conditions that were regarded as diseases in certain historical and cultural contexts and are no longer considered so today, such as homosexuality, hysteria, ideological dissent, or drapetomania (the desire of slaves to escape their masters). In these cases, certain conditions that were socially viewed as undesirable were categorized as diseases and medically treated. Arguably, the field of medicine where the normativist perspective has more radical followers is psychiatry, where there is an influential current called anti-psychiatry which defends that "mental illness is a myth" that

lacks a solid objectivist grounding and is actually a tool for isolating and dominating those who are different or "socially inconvenient" (cf. Szasz 1974).

This approach emphasizes the undeniable fact that medicine is an applied science and medical theory is practical knowledge, and therefore its most basic categories cannot be separated from the moral criteria of those who use them. However, the main problem with this approach is that it falls into a radical relativism according to which the concept of disease is no longer meaningful. In fact, "disease" becomes synonymous with "undesirable state", which does not seem a fair use of this concept. As Ereshefsky points out:

> If there is general agreement that a state is undesirable, then, according to normativism, there should be general agreement that the state in question is a disease. This problem occurs in a number of cases where there is agreement that a state is undesirable but no agreement on whether that state is a disease (…). By tying the term 'disease' to the states we consider undesirable, normativism does a poor job of capturing our use of that term. (2009: 224)

Not every undesirable state is a disease. Unemployment and lack of love are not diseases although they are conditions that we do not want. Only some state descriptions linked to notions such as incapacity, pain, or suffering are qualified as diseases. Therefore, there seem to be objectivist criteria for determining the frame of reference for the concept of disease.

2.3.2. Beyond the Naturalists versus Normativists Debate: Disease as a Conceptual Tool for Medical Practice

I have presented the debate between naturalists and normativists[28] as the core of the philosophy of medicine. However, there are authors who have argued that

[28] In this debate, some hybrid alternatives have also been developed to combine aspects of both strategies in order to come up with a scientifically useful definition of health and disease that is flexible enough to recognize their contextual character (Reznek 1987; Wakefield 1992). In this chapter, I will also present a position which seeks to integrate the more positive aspects of naturalism and normativism, but I will adopt a very different perspective to that of these hybrid approaches. Complementarily, Lemonie (2013).

the definition of disease should not be taken to be so crucial. For instance, Germund Hesslow (1993) argues that clinical thinking and decision-making in medicine do not need the notion of disease. Hesslow's approach is that physicians are able to identify and treat patients without the need for a refined concept of disease. This may be true, but it does not seem to detract from the philosophical task of defining "disease". Physicians may have certain intuitions, more or less precise, about what "disease" is, but assessing whether these are correct or not depends largely on whether we are able to judge the validity of their theoretical assumptions. The very work of the philosophy of medicine is to contribute to the scientific endeavor by rethinking concepts that would otherwise be nothing but the fruits of uncritical intuition or cultural heritage.

In any case, Hesslow points out something worth emphasizing: the concept of "disease" is a technical notion and it must be evaluated with respect to the way in which this notion acquires meaning only within a theoretical framework and in connection with very specific practices, in this case, those of medicine (in my own case, biogerontology). This is the baseline of some proposals in the philosophy of medicine that define "disease" from a perspective that I consider aligned with a "pragmatist" approach. Against the generalized view that our conceptions of "disease" determine medical practice, there are authors who defend that, on the contrary, our conceptions of "disease" is are constructed by what we consider that medicine is able to treat.

In this line, Hofmann argues that it is the technology which somehow determines our medical notions:

> All in all it has been argued that technology is constitutive of the concept of disease. Firstly, technology provides the physiological, biochemical, biomolecular and morphological entities that are applied in defining diseases. Secondly, it constitutes the formation of medical knowledge. Technology constitutes the signs, markers and end points that define disease entities and it strongly influences the explanatory models of disease and medical taxonomy. Thirdly, technology establishes how we act towards disease: through diagnosis and treatment technology establishes the actions that constitute disease.

> Furthermore, the practical capability of technology increases the sensitivity and lowers the treatment threshold, resulting in an increased occurrence of disease. (2001: 18)

Technology "invents" diseases, in the sense that it offers us the tools to address them, the knowledge, the concepts to identify and classify them, and the protocols to face them. "Disease" is a technical term that only acquires meaning within the framework of medicine. If there were no medicine, there would be no diseases as such. Scientific concepts, such as "disease", among others, are formulated to answer certain epistemic goals. Thus, the notion of disease that physicians more or less consciously assume is determined by the questions that they ask and the way in which they attempt to answer them in medical practice.

According to the above, Cooper has developed a definition of disease that attempts to cover the whole complex casuistry in which this term is used. Specifically, she claims that "disease is a condition that it is a bad thing to have, that is such that we consider the afflicted person to have been unlucky, and that can potentially be medically treated". (Cooper 2002: 263). As can be seen:

1. The first of these conditions (disease is a bad thing to have) picks up the constructivist sensitivity according to which a disease is a state viewed negatively by the affected subjects.

2. The second of these conditions (diseased people are unlucky) is linked to the biostatistical objectivist criterion.

3. The third condition introduces the "pragmatic turn". By saying that a disease must be a potentially medically treatable condition, it implies, as Hofmann did, that it is medicine that somehow "invents" diseases.

A disease is something that is susceptible to being treated as such by medicine.[29] In other words:

> For a condition to be disease it must be such that it could potentially be treated by medical science. A cure need not be presently available, but the condition must be such that there is reasonable hope that a medical treatment might become available in the future. This condition is required to distinguish diseases from other types of misfortune—economic problems, social problems and so on. This criterion implies that conditions can come to be thought of as diseases as a result of a treatment for them being discovered. Following the discovery of Paroxetine, social anxiety disorder is a condition that is coming to be thought of as a disease for this reason. Prior to the discovery of the treatment, no-one expected that shyness would prove to be medically treatable, but the discovery of the drug-action proved them wrong. (Cooper 2002: 277)

I think that this proposal by Cooper and Hofmann can be aligned with a "pragmatist perspective", as postulated by authors such as Robert Brandon (1994), Ingo Brigandt (2009, 2010), John Dupré (1993), or Philip Kitcher (1978). Broadly speaking, I can say that this pragmatist approach is based on the defense that our scientific concepts respond primarily not to metaphysical questions but to epistemological concerns. This approach relies on the fact that science is an enterprise in which the values are also involved in setting goals for scientists and clinicians to pursue.

§ 2.4. From the "Pragmatic View" to the "Pragmatist Approach"

2.4.1. Theoretical Terms and Conceptual Change

Scientific communities implicitly establish the epistemic goals of science. Therefore, the terms are re-defined, and uses are changed when science changes.

[29] Cooper's theory is more demanding than Hofmann's because it requires that a condition be an unfortunate and negatively perceived event in order for it to be considered a disease. However, by including the condition of being medically treatable, this definition also includes—but is not limited to—a pragmatic approach.

According to the new developments of the pragmatist approach in the philosophy of science, a philosophical approach to a scientific concept should analyze the fruitfulness of this concept to meet certain scientific goals within the framework of concrete practices.[30]

This approach does not interpret theoretical terms, such as the notion of disease, as natural kinds. Rather they are pragmatically determined. Here, I propose using this pragmatist approach to apply the theoretical concepts developed by Brigandt (2009) to the notion of aging as a disease. According to Brigandt's theory of concepts, the content of scientific concepts can be divided into three different but interrelated components: (1) the concept's reference; (2) its inferential role; and (3) the epistemic goal pursued by the concept's use. The semantic change of concepts, Brigandt says, is due to changes in one or some of these three components.

Thus, scientists can change the intent of a theoretical concept (i.e. its reference). Many theoretical concepts related to the disease have completely changed their reference or even lost it, such as *drapetomania* or *phlogiston*. In fact, core scientific concepts, such as "disease", "matter", or "planet", among others in the history of science, have had different references in different times and cultures. The philosophical question at this point concerns explaining how this change in a concept's reference can take place in a rational and justified way and without disrupting the communication that relies it. For Brigandt, a concept can legitimately change its reference if the inferential role of that concept changes as well.

[30] Pragmatism is a philosophical movement originated in the late 19th century in the United States, mainly from the contributions of philosophers Charles Sanders Peirce, William James, and John Dewey. The pragmatist positions of these authors—as well as those of the many later philosophers influenced by them—differ greatly from each other, but broadly speaking they all shared the view that the world and our conception of it are inseparable from our agency. For a description of the philosophical aspects of pragmatism and its historical evolution, see Godfrey-Smith 2015; Legg & Hookway 2019.

The semantic change that occurs due to changes in the *inferential role* of a concept implies transformations in the beliefs that are meaning-constitutive, and it determines the concept's reference. For example, until the end of the 19th century, when Kitasato Shibasaburō and Alexandre Yersin independently discovered the enterobacterium responsible for plague—which was technically labeled *Yersinia pestis* after the latter—the definition of plague, a term that referred to a disease unfortunately well-known for quite a long time, did not include that bacillus as its cause. Ever since this discovery, the inferential role of "plague" changed. In other words, discovering that plague was caused by a particular bacterium changed what this term meant for scientific theory and practice. Moreover, and as shown in this case, changes in the concept's inferential role can often be due to good epistemic reasons.

What a good epistemic reason is depends on which epistemic goal is attributed to the use of a given concept. Epistemic goals motivate and justify change in the inferential role and reference of scientific concepts. Moreover, the epistemic goal of a scientific concept is a non-truth-conditional aspect of meaning. On the one hand, the goal of a term is an implicit dimension of a concept which is inferable from the use of that concept in scientific practice. On the other hand, the epistemic goal is not to metaphysically account for "the objective reality" of the states of the world, but rather it is related to the desires of the scientific community. Consequently, interests and values determine the framework of concepts of a scientific community. For instance, Brigandt points out that in classical genetics the epistemic goal pursued by the concept of "gene" was the prediction of patterns of inheritance, while the epistemic goal pursued through the use of the molecular concept of gene is to explain how genes bring about their molecular products (Brigandt 2009: 91). As scientific knowledge changes, the use of concepts by scientists leads to different epistemic outcomes and contributes to scientific knowledge in different ways. In other words, the epistemic goals of a concept can change.

2.4.2. Disease as a Technical Concept

Cooper's and Hofmann's proposals fit this pragmatist approach very well. They recognize that medical practices determine the meaning of the concept of disease. Disease is everything that is treated as such by medicine to answer certain epistemic questions: how our bodies function, how we can fix it, what can be done to avoid it in the future, and what makes us suffer, among others.[31]

I argue that changes in the epistemic goals of concepts affect the notions of medicine, such as "disease", in a very determining way. In medicine, the concept of disease, as well as concepts that allude to specific diseases, is used by the medical community to achieve certain epistemic goals. Specifically, the notion of disease is useful for research purposes (i.e. to determine the etiology and mechanisms underlying a given condition), for scientific inferences (i.e. to detect and predict demographic changes in a particular population due to the health problems), and to help develop new technologies (i.e. to design drugs or treatments through experimentation). The conceptual change in medicine is justified by the search for answers to some epistemic questions.

Diseases are not things that objectively exist in the world and that can be grouped into essentialist natural kinds by virtue of their structural properties. Diseases are conceptual tools that may be more or less useful to address practical problems depending on their use in practice. It is in this sense that medicine is claimed to "invent" diseases (Hofmann 2001) or that a condition for a state to be a disease is that it is a potentially treatable condition (Cooper 2002). It is not simply that medicine treats states that are diseases, but that these states become diseases because they are treated as such by medicine. Of course, this does not mean that everything that medicine treats is a disease. Medicine treats many conditions. For instance, physicians provide assistance in pregnancy and childbirth, treatments to improve sport performance, and aesthetic surgery. My

[31] Of course, I am not claiming that medicine is the only tool to answer these questions. Here I simply point out that these are epistemic questions which medicine, often in collaboration with other disciplines, attempts to answer.

point is *not that everything that medicine treats is a disease, but that everything that medicine conceptualizes as a disease is a disease*.

This does not mean that it is not possible for conditions that were not previously considered diseases to become diseases, or that what is now considered a disease may cease to be a disease due to changes in medicine. As I have stated in the previous section, there are reasons that justify conceptual changes. If the state of knowledge in medicine in a given context implies a change in the reference, the inferential role or the epistemic goals of a medical concept (such as "disease"), then this concept changes semantically. The notion of disease is, in Ereshefsky's terms, a combination of state descriptions and normative claims, and the state descriptions and normative claims of medicine are shaped by the practice of medicine itself. Conceptual changes in medicine are determined by changes in medical practices, and not only the other way around. Our medicine does not make the same state descriptions and normative claims as that of the 19th century or that of Classical Greece because medical science is radically different and treats today what it did not treat back then.[32]

A conceptual change occurs when there is a change in any of the three dimensions of a concept (the concept's reference, its inferential role, or its epistemic goal). From a pragmatist point of view, a conceptual change in the notion of disease would be justified in those cases in which the state of medical knowledge allows us to think that a change in any of these dimensions would help us to achieve the practical goals of medicine. Thus, there are cases in which medical knowledge changes and certain conditions cease to be considered diseases because this categorization proves useless to achieve research purposes, make scientific inferences, or aid in the discovery of new medical techniques or tools. For instance, drapetomania, left-handedness, and homosexuality are no longer considered diseases. The notion of disease that has been used in medicine for centuries covered these cases but, given the medical changes in recent decades, the notion of disease has acquired a meaning that does not allow for

[32] Scientists have found cancer in fossils dating millions of years. However, this disease as such did not "exist" in the Jurassic in the sense that I argue in this chapter.

these conditions to be considered pathological. The reasons why certain conditions cease to be considered diseases can be very diverse and should be examined case by case,[33] but it is undeniable that this type of conceptual change has occurred very frequently in the history of medicine. Moreover, there are other conditions that did not use to be addressed by medicine and are now understood as diseases. Epilepsy is no longer a sign that the gods have chosen a person as their preferred or condemned one, but rather a neurological pathology, and obesity is no longer a manifestation of opulence, but a chronic multifactorial affliction. According to the current conception of disease, these conditions were already diseases, even if they were not initially considered as such. The point here is that they were not considered as such not because the notion of disease was being misinterpreted, but because the very conception of epilepsy and obesity has undergone conceptual changes.

The history of medicine shows many conceptual changes of this type—conditions that cease to be diseases or begin to be interpreted as such—and presumably more conceptual changes will happen in the future because medicine is in constant evolution.[34] New diseases will arise and old diseases will change their meanings in the cases in which such changes prove useful to achieve the goals of medicine. Thus, the notion of disease changed its reference and inferential role when it ceased to serve to pursue the epistemic and practical goals of explaining and fixing that which departed from the social norm or from the culturally acceptable to assume the goal of explaining the biological processes

[33] Conceptual changes in medicine, such as the exclusion of certain conditions from disease classifications, may have quite different justifications. In some cases, these changes are due to a more detailed medical knowledge of body functioning, while in other cases these changes stem from broader social transformations, such as the moral condemnation leading to the end of slavery, secularization, and the LGBT rights movement, for example. My point here is not that conceptual changes in medicine are due only to advances in medical knowledge, but that these results occur when there are changes in any of the three components that I have discussed previously. As I have already pointed out, these changes may be caused by social or extra-medical factors, such as changes in the cultural values. The pragmatist approach that I endorse here claims that medical practice determines medical concepts, but it cannot be ignored that this medical practice is itself conditioned by its social context.

[34] And can never stand outside of the cultural, social, historical and political context in which it is situated

and functions that entail suffering and incapacity. I suggest that the recent philosophical interest of some authors in categorizing aging as a disease is perhaps an indicator of a conceptual change in biogerontology.

2.4.3. The Conception of Aging as a Disease from the Pragmatist Approach

I think that the pragmatist approach in the philosophy of medicine is very close to the pragmatic proposal by Callahan and Topinkova in the debate on the theoretical definition of aging. Callahan and Topinkova argue that aging should be treated as a disease because medicine can and should do it. At the same time, however, they maintain that aging is not a disease. Callahan and Topinkova remain committed to a definition of disease that they do not explain but believe to be objective and uncontroversial. In my view, this conceptual conservatism underlies an objectivist view which is not justified and is based on an erroneous understanding of how concepts are shaped in science.

I propose to go one step beyond Callahan and Topinkova and take on the "pragmatist turn". Medical practice determines what a disease is. Obviously, medicine treats many conditions without considering them to be diseases: cosmetical issues, sports performance, among others. Not everything that is the subject of medical practice is a disease, but everything that medical practice treats as if it were a disease is a disease, because practice determines the meaning of a concept, as well as its possible changes.

The advances in biogerontology have greatly increased our understanding of the aging process and have changed the concept of aging accordingly. Thus, aging is no longer simply seen as the passing of time, but as a whole set of biological processes that have their origin at the cellular level of organisms and that can be described using the language of biological theory.[35] Aging is less of a

[35] It is also interesting to note that this pragmatist approach to the notion of aging is compatible with a pluralism like that advocated by authors such as Dupré (1993) or Sandra Mitchell (2003) in the philosophy of science. The term "aging" may refer to different concepts, some of which may appeal to a natural state and some of which may appeal to a set of biological processes

"mystery" to biology. Present-day biogerontologists consider that "aging" is an umbrella term that actually refers to specific cellular phenomena. In particular, they have identified the so-called "nine hallmarks of aging": altered cellular communication, cellular senescence, deregulated nutrient-sensing, epigenetic alterations, genomic instability, loss of proteostasis, mitochondrial dysfunction, stem cell exhaustion, and telomere attrition (López-Otín et al. 2013). As a result, we can see that the reference of "aging" has changed in biogerontology because the inferential role of the concept of "aging" has also changed with the advancement of knowledge in cellular biology. For contemporary biologists, aging is the outcome of concrete cellular mechanisms (i.e. these nine hallmarks).

The current biological knowledge and advances in biomedical technology have made biogerontology adopt the aim to slow, stop, and even reverse aging (Juengst et al. 2003). In the present, aging is a technical concept that is at the core of certain medical practices. This means that the epistemic goals of the concept of aging have also changed: aging is not only a concept that serves to understand what happens to organisms after a certain age, but it is also key to the research and the design of treatments that seek to extend and improve life. One of the epistemic goals of the current concept of aging is to know how it is possible to intervene in this cellular process. This was not an epistemic goal of the traditional concept of aging, which defined it as a natural, universal, and inevitable process.[36] My claim is that this notion of aging as a disease meets the epistemic goals of the notion of disease: to contribute to research, to help to make scientific inferences, and to lead to technical discoveries.

analogous to those of paradigmatic cellular diseases, such as various cancer types. Several different conceptions of aging can coexist, both in biogerontology and in the ordinary language. The task of philosophers would be to discern and refine the conception of aging that is relevant for each case by taking into account the scientific practices and the epistemic goals with respect to which the term "aging" is used.

[36] Perhaps this explains why some very influential experts on aging, like Medawar (1952, 1955), considered unfeasible to treat aging as a disease. Technology in the middle of the last century lacked the potential to effectively treat aging and it was quite difficult to imagine that someday that would be an actual possibility. Consequently, from a pragmatist view, biogerontology had not yet "invented"—in Hofmann's terms—the conception of aging as a disease.

§2.5. Concluding Remarks

Is aging a disease? Well, that depends on what conception of aging and what concept of disease are involved. In the philosophy of medicine, several notions of disease have been proposed. Perhaps aging as it is understood in biogerontology fits classic definitions of disease very poorly, but it is striking that in the philosophy of aging it is frequently debated whether aging is a disease without first explaining the definition of disease that is assumed. For this reason, in this chapter I have analyzed the main proposals that discuss the characterization of aging as a disease and I have contrasted them with the debate in the philosophy of medicine about the notion of disease.

From a pragmatist approach, I have argued that the notion of aging as understood by biogerontology is going through a conceptual change that affects its reference, its inferential role, and its epistemic goals. Today's scientific knowledge has modified our deeper understanding of what it means to age. As a result, the notion of aging as a disease has emerged replacing the traditional notion of aging as a non-diseased natural process, and providing a useful technical concept for those who want to understand and treat aging processes.

The current state of the biology of aging makes it possible to understand aging as a condition which can be addressed at its very cellular basis. In this sense, aging is not very different from other diseases of cellular origin and there seems to be no good reason not to include it on the medical agenda as a disease. As I have already observed, there are pressing ethical and political reasons why treating aging as a disease is desirable and, furthermore, there does not seem to be any theoretical grounds not to consider that aging is, according to the criteria used by current medicine, a disease.

Of course, this raises many worries about the risks involved in understanding aging as a disease. For instance, it could be argued that medicalizing aging could lead to the stigmatization of large sections of the population that, until now, had not been considered diseased. It would also mean

a new distribution of resources dedicated to healthcare systems that would probably involve profound social transformations. An approach to the ethical implications of the notion of aging as a disease must contrast these reasons with those of authors such as Caplan or Callahan and Topinkova, who argue that treating aging as a disease would bring great benefits.

One of the main advantages of adopting a pragmatist approach to the notion of aging as a disease is that, by assuming that medical practice determines the meaning of the theoretical terms of medicine, the implications of the potential medical treatment for aging are highlighted. When a notion outside the technical vocabulary of medicine, such as aging, becomes a technical concept, this represents a change not only in medical theory, but also in medical practice.

Theoretical concepts are prone to semantic change. Whether adopting the conception of aging as a disease is beneficial or not is something that biogerontology will decide depending on whether it helps to achieve its epistemic goals. Treating aging as a disease would make it such, at least for the moment, but there is still a lot of normative room to discuss whether this is something that we want to do or whether it is more convenient to treat aging as something else.

Chapter 3: "Ageless Bodies"? The Distinction between Anti-Aging Treatments and a Cure[37]

Summary

In this chapter, I will reply to the bioconservative position which maintains that there is a universal goal in biogerontology: "ageless bodies". This radical biotechnological intervention in humans would entail a series of catastrophic consequences both for individuals and for society as whole. In order to respond this, I will explain the differences between anti-aging treatments and a cure. I first will discuss and expand David Gems' pragmatist approach to treat aging—a logical, useful, and realistic way to addressing the process itself. Next, I will show how great success is not necessary in the first phases: what is really important is to intervene in the underlying cause. With this in mind, I will distinguish more research lines which, despite sharing the same starting point, make up different scientific communities. In my view, the treatment of aging does not imply its possible cure. Rather, it tries to control and protect us from the ravages of aging, aspiring to a healthier life. Therefore, the bioconservative concern is not as great if its strong criticism focuses on more plausible scenarios like the one that Gems defends.

§3.1. Introduction

3.1.1. From Medieval Potions to Telomere Lengthening

Among the promises that supporters of transhumanism (TH) notoriously make, one of the most plausible ones is the possibility of arresting aging in the near future (Cordeiro & Wood 2018; Kurzweil 2005; Wood 2016).[38] A recurring theme throughout the known history of humanity is our species' desire to avoid death

[37] I would like to thank Nicholas Agar, Antonio Diéguez, Walter Glannon, Eric Juengst, Juan José Padial, and Cristian Saborido, who read previous versions of this chapter and made helpful comments and suggestions. Suzanne Day is especially acknowledged for her detailed review of the final version of this chapter.

[38] In another perspective, see de Grey & Rae (2007).

by prolonging youth indefinitely. In Western and Eastern traditions, there is a wide range of mythological stories which aim to illustrate this dream. For instance, Cleopatra, Queen of Ancient Egypt, is said to have bathed in donkey milk to preserve her beauty and radiant youth. Furthermore, a key feature in the legend of Shangri-La, a mythical land isolated from the rest of the world, is that the people inhabiting it were almost immortal and they aged very slowly (cf. Gruman 1966; Marfany & Soley 2013). As Nick Bostrom says:

> In the Sumerian Epic of Gilgamesh (approx. 1700 B.C.), a king sets out on a quest for immortality. Gilgamesh learns that there exists a natural means—an herb that grows at the bottom of the sea. He successfully retrieves the plant, but a snake steals it from him before he can eat it. In later times, explorers sought the Fountain of Youth, alchemists labored to concoct the Elixir of Life, and various schools of esoteric Taoism in China strove for physical immortality by way of control over or harmony with the forces of nature. The boundary between mythos and science, between magic and technology, was blurry, and almost all conceivable means to the preservation of life were attempted by somebody or other. (2005a: 1-2)

Nowadays, the epic of Gilgamesh has been replaced by the attempt to control the proliferation of various cancer types with the insights of cellular biology, just one example of medicine's traditional struggle against diseases. In addition, there have been groundbreaking advancements in aging research, especially since it has been discovered that the aging process depends on biochemical and genetic factors (López-Otín et al. 2013: 1194) (**Figure 2**).

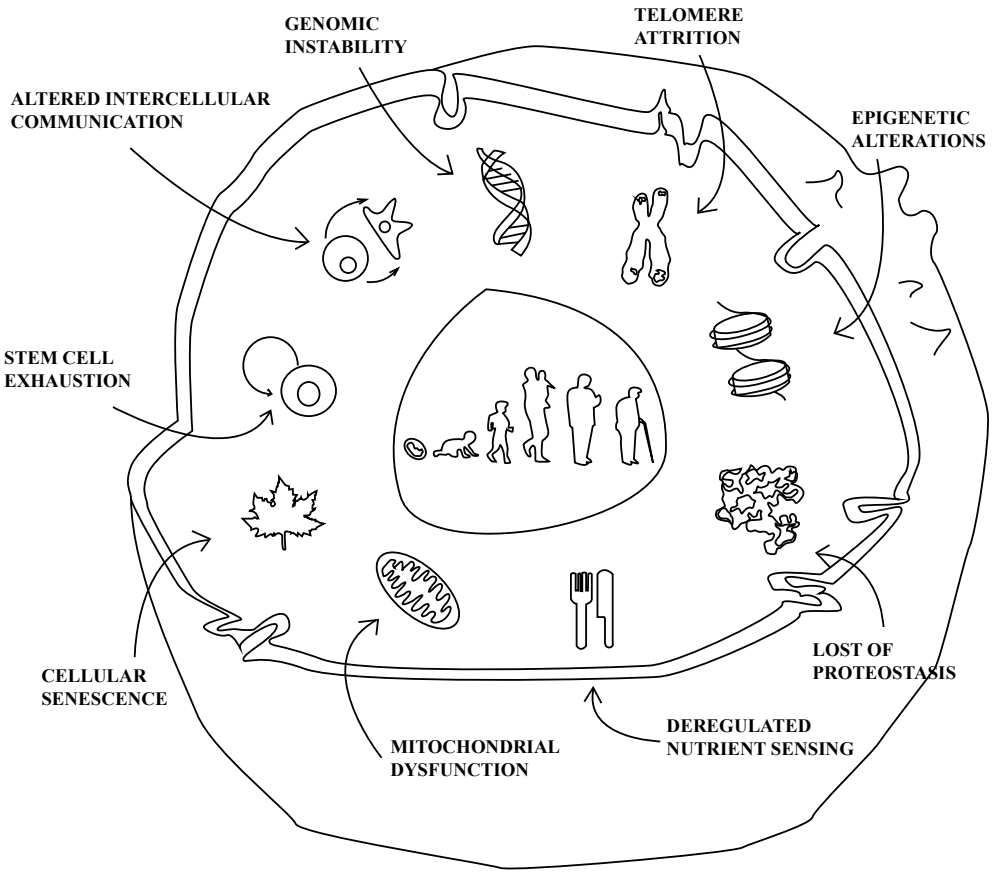

Figure 2. The scheme enumerates the nine hallmarks of the aging process. Adapted from C. López-Otín et al. (2013: 1195; Figure 1).

Thus, with this scientific knowledge, the possibility of treating aging is no longer a supernatural story, like in the epic of Gilgamesh, but it has found some empirical support in experiments conducted with model organisms in different laboratories, with special emphasis on mammals.[39] Biogerontologists understand more about how and why we age.

In 2009, the Nobel Prize in Physiology or Medicine was awarded to three scientists for their research on the telomerase enzyme and telomeres: Elizabeth

[39] I am indebted to Antonio Diéguez for recommending examining different types of experiments in model organisms related to the possibility of treating aging. I have chosen telomere lengthening as a treatment in mice because the results of these studies are well-known in the scientific community. More possibilities in the debate can be evaluated in these reviews (see Longo et al. 2015; Moskalev et al. 2017; complementarily, Diéguez 2019: 8-10).

H. Blackburn, Carol W. Greider, and Jack. W. Szostak. Briefly, telomeres are the ends of chromosomes. These are regions of non-coding DNA, highly repetitive, whose functions are the division of cell, the structural stability of chromosomes, and the life span of cell lines, among others.

In particular, María Blasco and her colleagues have mainly focused their work on the lengthening of telomeres. They introduced stem cells with extra-long telomeres in chimeric mice who were in the embryonic phase, resulting in a significantly extended life span (Marion et al. 2009; Varela et al. 2016; see also the classical paper by Blasco 2005). Each cell division causes telomeres to lose length until they become so short that the cell dies, incapable of dividing again—most diseases emerge at this point. In order to halt and even reverse this process, telomeres can be artificially lengthened by means of the telomerase enzyme, but this may also entail risks (i.e. cancer). In Blasco's study, these risks were averted by avoiding genetic manipulation of telomerase activity and using stem cells grown *in vitro* with spontaneous long telomeres instead. Following the hierarchy of López-Otín et al. (2013) (**Figure 3**), telomere lengthening addresses a primary hallmark of aging, which could be what triggers a series of damaging consequences that progressively accumulate with time. In mice, lengthening telomeres can influence the control of and protection from ARDs such as various cancer types, thus intervening in the aging process itself. Mice with longer telomeres than normal in their species live on average 13% longer, they are thinner, and their health is better—without genetic manipulation (cf. Muñoz-Lorente et al. 2019; Whittemore et al. 2019). Blasco and her colleagues are trying to transfer the success of telomerase activity in mice to humans.

Figure 3. Functional interconnections between the hallmarks of aging. Top: primary hallmarks which related to cellular damage. Middle: antagonistic hallmarks which related to compensatory responses to damage. Bottom: integrative hallmarks which are the end result of the previous two groups of hallmarks, responsible for the functional decline. Adapted from C. López-Otín et al. (2013: 1205; Figure 6).

3.1.2. Bioconservative Concerns: "Ageless Bodies"

As our bodies age, we lose flexibility, immune response, memory, muscle strength, or speed. Humans who die of old age suffer the accumulated effects of years of dependence, disability, and weakness. Sadly, for many people, the last years of their lives are often a battle to preserve quality of life to the extent that this is possible within the realities of declining cognitive and physical capacities. Against these grim realities, the position of bioconservatism can be difficult to understand.

Bioconservatism is an ethical, philosophical, political, and religious way of thinking which rejects many radical biotechnological developments and a large number of scientific promises for the future. Bioconservatism is characterized by a conviction that these radical advances risk compromising the existence of some fundamental property that imposes strict essentialist limits. There are various reasons given for this, including the alteration of human nature, the ethics of gifts, concerns about loss of dignity, or the fear of playing God (Fukuyama 2002; Habermas 2003; Sandel 2007). Bioconservatives are, within different perspectives, right-leaning religious or skeptical about the benefits of modern. What unites them is the fear of ceasing to be human and waking up in

a world very different from the one we live in today. In order to further examine the bioconservative perspective, I will now focus on the arguments of Leon Kass.

In short, Kass (2003) sets forth the following argument. His perspective begins by acknowledging that the greatest dream of human beings has always been overcoming aging and living longer. Now, for many biogerontologists, who know more about this process, this dream would seem to be progressing towards an eventual reality. The case for "ageless bodies" is that the treatment of cognitive and physical decline, the elimination of dependence, disability, and weakness, are conducive to living fully enjoying a "good quality of life" as human beings for all of our existence. If aging is a disease that could be corrected in itself, Kass proposes that many would see that our mortality, the condition that makes us humans, as something that can also be overcome. Mortality is the symbol of our finitude; our decline as living, aging organisms is precisely what allows us to accept mortality. Thus, the possibility of "ageless bodies" invites us to reconsider the meaning of everything, even our own life. All humans are born, grow, develop, age, and die. Life could hardly be understood beyond this biological circle. Therefore, Kass asserts that old age is not a life period that we should eliminate, as they claim with an "eraser", but rather it is the last stage of this life's journey—an *essential one*, without which the process is incomplete.

This alteration would entail a wide range of catastrophic consequences for humans from an individual and social perspective. For instance: (1) What would the family structure be like if the period of reaching maturity were a longer period than now?; or (2) what is more, what would the relationship between generations be like if biologically speaking, there were no difference between children and parents? From Kass' bioconservative approach, any attempt to live longer is a way to alter or modify our human essence—and thus is undesirable.

In this chapter, I will present an argument that challenges the universality of the bioconservative approach according to the treatment of aging: in contemporary biogerontology there are more research lines than those solely seeking the end of aging. To present my position, in §3.2, I will defend Gems'

approach of AATs as a hypothetical picture to intervene in this biological process from a pragmatist perspective, that is, one that is logical, useful, and realistic. Next, in §3.3, I will show how the really important challenge now is to start the first phases of AATs even if the result is not as successful as one would like. This hypothetical picture of AATs is different from those who advocate a cure for aging, since, at best, ARDs will be controlled and decelerated for as long as possible. This is significantly different from stating that biogerontology will repair all cellular damage in our body. Finally, in §3.4, building on this distinction between AATs and a cure, I will show how what Kass considers "ageless bodies" is only one possibility in biogerontology. Treating aging will not imply the catastrophic consequences for individuals and society that he suggests. Instead, intervening in the process itself aims at a healthier life.

§3.2. What Is an Anti-Aging Treatment?

3.2.1. Gems' Approach

Beyond the bioconservative concerns, based on the search for "ageless bodies" by the scientific community, there is a position characterized by the attempt to treat the aging process itself. To analyze this, I draw primarily on Gems' approach (2014) for three reasons: (1) he defines aging from a pragmatist position; (2) he prioritizes intervening already in humans' aging process; and (3) he rejects how medicine has traditionally focused on the secondary causes of diseases rather than underlying cellular damage. After answering about whether aging is a disease, one wonders if biogerontology can do something against this process. To demonstrate this, I here divide Gems' approach into three key points.

First, Gems argues that aging gives rise to a broad spectrum of ARDs in later life, which leads inevitably to death. For him, aging is a "special sort of disease"—a syndrome of multiple pathologies with multiple causes (2014: 14).[40]

[40] A syndrome is a set of symptoms that occur together and are characteristic of a disease or a specific pathological condition caused, sometimes, by the concurrence of more than one disease.

If aging is a syndrome, it is likely to share general characteristics with other diseases that also lead to serious pathologies. Since aging is accompanied by these severe pathologies, one would expect that, whatever the underlying cause, it would be accompanied by an increase in cellular damage (cf. López-Otín et al. 2013) (**Figure 2**). Thus, the idea of death of "pure aging", as aging without pathologies, is a myth for Gems. After all, one person dies of a heart attack or stroke, and not simply because this person is old.

Second, Gems defends that there is a strong desire among biogerontologists to "shift from the theoretical knowledge to translation research", that is, identifying of promising paths to turn the classic biology of aging into a new medical practice.[41] This shift is dependent on two objectives of the scientific community: reaching an agreement about the most promising approaches as well as the most appropriate biomarkers to treating aging in humans (2014: 14). While these two objectives are necessary, they are not enough to fully realize biogerontologists' translation research goals. The real challenge is to "familiarize" people with aging research and to show that its nature is analogous to other diseases—those which are assumed by everyone to the possibly eradicated through medical intervention (i.e. AIDS, Alzheimer's, cancer, or tuberculosis).

Finally, Gems presents the definition of AATs because he considers medicine's traditional focus on the treatment of ARDs to be ineffective. He argues that AATs can be summarized in two goals: (1) mainly controlling and protecting humans from the broad spectrum of ARDs; and (2) at best, sufficiently improved somatic maintenance could to stop aging altogether (2014: 16) (**Figure 4**).[42] Since the nature of aging remains unclear, the concept of AATs requires some hypothetical picture to intervene in humans. A definition of AATs is not only

[41] Gems focuses on the prevailing classical ideas since the evolutionary biology from the mid-20th century (Hamilton 1966; Maynard Smith 1962; Medawar 1952; Williams 1957).

[42] Gems presents both goals but its priority is the control, protection, and, if possible, deceleration of ARDs, until the possible complete elimination of aging. In the rest of the chapter, I will only focus on the first goal, which fits with the pragmatist approach of chapter 2.

important to clarify the goals but also to ensure that these goals are met. And this represents a shift from medicine's traditional approach: to treat each ARDs separately and without assuming any interrelation. Instead, this approach would be to treat the underlying aging process itself: cell damage. Gems illustrates a hypothetical picture as follows:

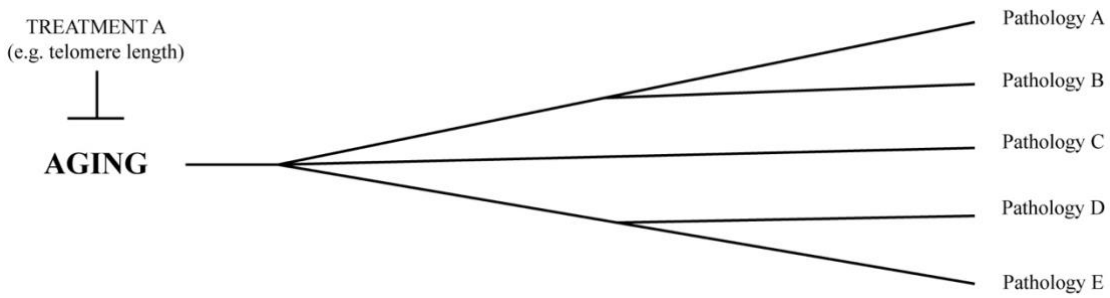

Figure 4. Schematic representation of AATs. Adapted from D. Gems (2014: 16; Figure 1).

Medicine's traditional approach is based on repair when the disease has emerged rather than prevention. Regardless of the starting moment of AATs, what Gems argues is not to continue trying to find a treatment against ARDs in the last stage of life.[43] Instead, Gems really wants to develop a research line that intervenes in the underlying cause of ARDs in order to control, and even decelerate, all those effects of aging in old age. For him, the separate treatment of ARDs makes no sense, as it would simply prolong the person's life for a while (cf. Bostrom & Roache 2008); being healthier throughout life requires a new shift in biogerontology.

[43] In this vein, Suresh I. Rattan points out the same shift towards a new biogerontology. In his words: "Another, more rational, approach involves targeting specific age-related diseases. Although this is usually effective in curing or halting a specific disease, it does not address ageing itself. Cancer therapy, for instance, will ideally eliminate cancerous cells and restore the affected organ or tissue to its original disease-free state. Nevertheless, although it reduces the risk of dying from cancer, it does not address other age-related diseases and disorders such as Parkinson's or Alzheimer's diseases, dementia, progressive organ failure or cardiovascular diseases" (2005: 27).

Why not avoid the development of these diseases altogether? After showing Gems' approach, I will introduce a series of details about his ideas to clarify and expand the concept of AATs.

3.2.2. Expanding Gems' Approach

The goal of biogerontology is primarily fueled by the attempt to break the practical-theoretical barriers and have the first phases of AATs applied in humans. I suggest that, though AATs could be very desirable, one must be cautious. This research line looks promising, but it is far from proclaiming the end of aging (§3.3). According to the above, it is important to take some perspective with regard to AATs and be aware of their limitations: *treating aging does not imply the end of all ARDs, nor does treating aging preclude the possibility that some ARDs could escape from the scope of treatment*.

From Gems' approach, I consider that a good strategy to understand AATs related to ARDs is as follows: (1) later manifestation of ARDs or at least a considerable number of them; (2) shorter time duration of ARDs or at least a considerable number of them; or (3) less serious effects of ARDs or at least a considerable number of them. I argue that this good strategy fits with the first main goal proposed by Gems while exemplifying scenarios for the new biogerontology shift.

Here are two small expansions of Gems' approach. First, while the ultimate goal of AATs would be the control of and protection against the broad spectrum of ARDs, there is nothing in biogerontology that guarantees this goal—at least with the current state of science. While aging is the common cause, preventive AATs may not successfully cover the full range of all possible pathologies A, B, C, D, and so on (**Figure 4**). What is more, a treatment X may work differently for pathologies A, B, or C. By this I mean that although the pathology A (Alzheimer's) could appear later in the aging process this does not imply that it does it simultaneously with the emergence of pathology B (pancreatic cancer). Perhaps pathology B also has less severe effects on the individual compared to pathology A. The above hypothetical scenarios more

specifically reveal the potential pitfalls and weaknesses of preventative AATs. Therefore, AATs must intervene in the maximum number of pathologies as well as the "severe effects" of aging.

The best possible scenario for biogerontology would be one in which the three goals of AATs (later manifestation, shorter duration, and less serious effects of ARDs) are successful, which differs markedly from the attempt to eliminate aging completely. Moreover, there is one fundamental idea defended by Leonid Gavrilov and Natalia Gavrilova that is related to these aims: not all diseases are associated with aging, but there is no disease whose risk increases with age that is not related to aging. Aging as a biological phenomenon is a process that increases the intensity of comorbidities with age. ARDs are consequences of aging (2018: 123). Of course, aging is more than these diseases that are associated with its progression. That is why there are additional hallmarks that characterize this process (cf. López-Otín. et al. 2013) (**Figure 1**).

Not all diseases will be treated by intervening on aging itself, but if we intervene on aging itself, we will treat many diseases. As noted previously, current medicine treats ARDs separately and without assuming any interrelation, but if aging is treated as the underlying cause of ARDs, addressing them separately would no longer be a priority for medical intervention. In other words, this biogerontologist shift is to focus on the primary rather than the secondary causes (**Figure 5**). For a long time, medicine's traditional approach has been trying to fix problems after they have already appeared; biogerontology now tries to prevent them from an early age in order to have a healthier life.

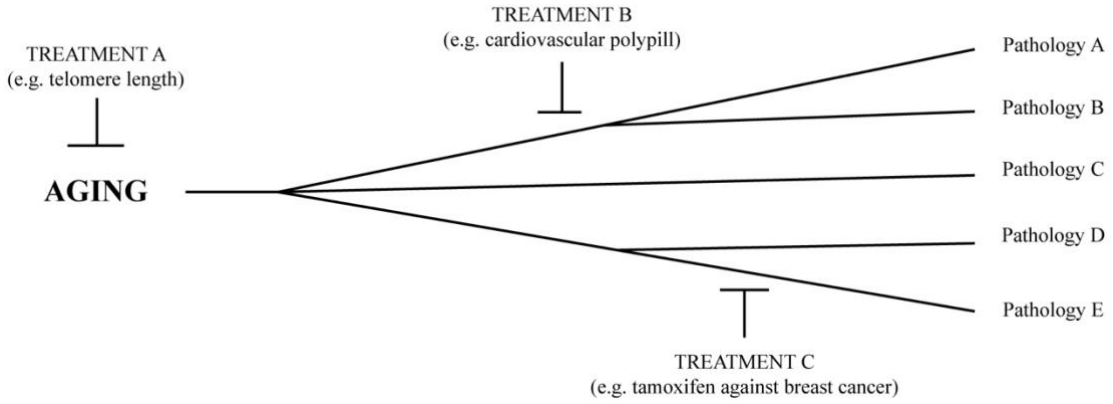

Figure 5. Schematic representation of differences between AAT and medicine's traditional approach (treatment B and C). Adapted from D. Gems (2014: 17; Figure 3).

Figure 5 is an informative illustration for what I argue here, especially in terms of providing a critique of medicine's traditional approach against diseases. Treatment C against breast cancer is only successful against this specific disease. Treatment A against aging does not only intervenes in the process itself, but it also renders the need for treatments B and C obsolete. In this vein, Rattan argues that "the underlying knowledge will soon allow researchers to develop therapies that intervenes in the ageing process and treat several age-related diseases and frailties" (2005: 27).

Second, I explain the concept of AATs in Gems' approach as one characterized by three key features (logical, useful, and realistic) and which should include the application of a preventive approach to ARDs as a decisive criterion (2014: 17). Although Gems does not delve into the details, these three characteristics make up the pragmatist proposal that he presents. From his approach, I understand that AATs are part of a hypothetical picture in the sense that it is a promising research line in biogerontology but still very incipient to achieve highly successful results. Even though knowledge about the biology of aging in other model organisms is not complete, steps have already been taken towards a clinical practice that seeks benefits for the population—there is a framework to intervene in humans' aging process with the current state of science. The possibilities of AATs are not definitive and surely, not as robust as

we would like them to be, but they are the beginning of the intervention in terms of changing how we address ARDs.

The possibility of treating aging is not a fantasy. There are already experiments in model organisms that show us that this is a realistic scenario. By contrast, the claim that the end of aging will be certain in the future is extremely optimistic.

§3.3. The Distinction between Anti-Aging Treatments and a Cure

3.3.1. Treating Aging: Beyond its First Results

So far, in §3.2, I have argued that AATs provide a logical, realistic, and useful hypothetical picture to treat the aging process itself by addressing the underlying cause of a broad spectrum of ARDs. Now, anew question arises: Should a treatment in its first phases have great success? Otherwise, would that be a limit to its development? Beyond the bioconservative approaches, there are voices who advocate that aging is inevitable and that there is little or nothing we can and should do to treat it directly (Agar 2010, 2014; Glannon 2002a, 2008; Hayflick 2000, 2007). As I have argued, biogerontology must begin to develop AATs. Not surprisingly, I will show that the indicator of great success in its first phases is not-necessary. Rather, I argue for treatments which, despite not knowing with certainty whether their success rate will be very high, we consider a promising research line based on sufficient evidence to establish proof of concept. In the first phases, this would be enough. The treatments must have a first phases in which they are not definitive, as long as evidence suggests that they could successfully intervene in whatever the scientific community wants to intervene.

I consider that biogerontology has to alleviate the suffering caused by the effects of aging and improve the population's health, and not only the effects of aging as manifesting in old age but also from the early stages of life. This is the preventive character that Gems exposes and differentiates it so dramatically from medicine's traditional approach, always focused on repairing. For him, it is

meaningless to try to treat an age-related disease when it has already appeared and its damage is very severe in the body, for two reasons: (1) in an advanced stage of the disease, a treatment to completely reverse the condition becomes difficult to obtain; and (2) in the best case, if we treat a pathology (A) in an elderly person, this does not preclude the development of further pathologies (B), (C), or (D) (**Figure 5**). A person who survives a specific type of cancer can die of another cancer or simply of a different age-related disease. Therefore, the best possible strategy is to start the first versions of AATs with the hope that they will improve with continued iterations and upon further discoveries.

Consider the origins of chemotherapy as a similar case study related to the non-necessity of great success in the first treatments.[44] From the moment that we were able to intervene in the progression of some types of cancer, we did it. Why not think analogously about aging 80 years later?

The first effective antineoplastic chemotherapy was successful due to decades of extensive cancer research, but also to the accidental findings made in connection with mustard gas, which was widely used as a weapon during World War II. In 1942, Dr. Lindskog administered nitrogen mustard (an agent analogous to mustard gas) intravenously to a middle-aged man suffering from a radioresistant lymphosarcoma in his trachea. This treatment resulted in the disappearance of the patient's tumor, who would have otherwise died of suffocation (Hirsch 2006: 1519). Mustard compounds were further investigated in subsequent decades of medical research. They brought short-term benefits for a number of patients, especially those with Hodgkin disease and lymphosarcoma, but also caused problems with chemoresistance and chemotoxicity. Exposure to these toxic compounds took a heavy toll on the health of many young patients, who developed other pathologies resulting in their

[44] Another well-known case is heart transplantation. The first transplant occurred at the University of Mississippi in 1964. Dr. James Hardy and his team transplanted the heart of a chimpanzee into a dying patient, who only lived one hour and a half after receiving it. Today, the life expectancy of a heart transplant patient is at 12 years after the operation, although in many cases it is much higher, since the average takes into account patients who may die just after the operation.

premature death. Derivatives from mustard agents continue to be used today against some types of cancer (Papac 2005; Smith 2017; see also the seminal paper by Adair & Bagg 1931). Mustard gas and its first derivatives, despite being highly primitive compared to modern treatments, are regarded as the origins of chemotherapy. Another important point is that during World War II cancer was treated in itself and in spite of the side lethal effects of these agents, suffering individuals saw their health condition improved.

In this sense, I defend Gems' risky proposition: *treating the aging process itself with the same emphasis that we currently place on treating ARDs*. Many people will be surprised to finance projects and invest a long time in such a complicated task, entailing ambitious and costly interventions. However, we have also invested a lot in treating ARDs with mixed results to justify it. Now is the time when biology's knowledge makes it possible to create treatments for aging, both theoretically and technologically. Biogerontologists should begin to treat the aging process in their daily scientific activity, focusing on a specific hallmark of aging and refusing to continue intervening in individual ARDs separately as if there were no interrelation. There may not be consensus about the shift that is taking place in the community, but biogerontologists' experiments do show a trend change in their research lines. In the 40s, it was impossible to think that the medicine of that time could ever achieve success in treating cancer, even if it was minimal. Would anyone refuse not to treat Alzheimer's or cancer separately? Then why not do it from a common approach?

Having demonstrated that the development of treatments for aging (in this case, broadly discussed as AATs) should not depend exclusively on greatly successful results in the first phases, I will now demonstrate how AATs are substantially different from a cure for aging.

3.3.2. The Lernean Hydra and the Dragon Tyrant

In the previous section, I have shown that it is not necessary to have an initial great success in order to begin developing the first phases of AATs. I have

incorporated two ideas about the possibility of treating aging itself: the arguments for AATs development are based on sufficient scientific knowledge on the biology of aging and these AATs are preceded by significant success in other model organisms. These two ideas guarantee success, which, if not complete, is significant if we set it off against medicine's traditional approach against diseases. Now, I will distinguish what AATs is as compared to a cure. In order to explain this distinction, I will introduce what I understand by the concept of cure.

A cure is a subset of procedures to treat diseases or symptoms towards a "favorable outcome" with 100% success. A cure implies that there is a certainty that a disease or symptom will not be present after a medical intervention. Such a cure will be the final phase of the treatment, as afterwards will be no of the pathology left to treat.

Building on this definition of "cure", I point out three crucial differences when compared to AATs: (1) nothing guarantees that there will be a "favorable outcome"; (2) success can be minimal or partial in the first phases of treatment development; (3) aging is not eliminated—at best, it is decelerated. According to the above, developing AATs does not imply that a cure will not be obtained in the future. Perhaps it is due to a lack of technological means, economic resources, and temporal factors. Not all treatments lead to a cure, but the cure needs all treatments to work to reverse the desired target pathology (complementarily, López Otín et al. 2013) (**Figure 2**). The question is not: "Should we and can we cure aging?", but rather: "Is it beneficial to develop AATs to intervene in the aging process itself?" The point here is that the goals of the scientific community change, as some seek AATs and others a possible cure. Those research lines are independent and could overlap at some point (or not). By this I mean that 100% success in an AATs does not imply a cure for aging, but simply a great success of that AATs.

In my view, AATs have the following three objectives: (1) later manifestation of ARDs or at least a considerable number of them; (2) shorter

duration of ARDs or at least a considerable number of them; or (3) less serious effects of ARDs or at least a considerable number of them. Moreover, nothing guarantees that these three objectives will be achieved with the current state of science. In order to develop a cure, these three objectives should be achieved, but even these are not enough. Only the complete elimination of aging by repairing each of the hallmarks is what would guarantee compliance with this approach (de Grey 2003). That is why, although the starting point may be common (that is, the underlying cause of aging), the objectives are significantly far from each other, to the point that we have two different scientific communities.

From my position, I prioritize the research line focused on AATs since these are in line with the current state of science. Achieving one of the objectives of AATs would already be a great success according to my approach, while for other scientists it would not even be an intermediate step towards complete elimination. The treatments against some types of cancer are very successful and this does not imply: (1) that this research line is focused on a cure in its last phases; nor (2) that a cure will be obtained at some point. The fact of not having eliminated cancer, understood universally, has not stopped cancer research. There are many diseases that have no cure but there are really effective treatments that improve the health of the persons suffering from them.

Being moderate, the goal of AATs is more feasible but less hopeful—at least in contrast to the optimism of finding a cure as fast as possible. In 1971, Richard Nixon proclaimed the "war on cancer" in an effort to find a cure by means of increased research to improve understanding of cancer biology and the development of more effective cancer treatments. Not surprisingly, 50 years later, cancer still has no cure (understood in terms of universality). There are many types of cancer that are treated with successful results. For more than 20 years, de Grey has proclaimed the "crusade against aging". He argues that we have a 50% chance of achieving a cure. However, the mistake of both Nixon and de Grey was to think of a date X on which cure Y would be found—a definitive point at which a specific method of eradication would be achieved. Therefore, whether

we can and should cure aging is a tricky question. The real challenge is to develop AATs and that these become increasingly successful.

This difference between AATs and a cure can be illustrated through two well-known allegorical stories referenced in the literature:

Gems' approach based on the development of AATs	**Bostrom's approach based on the development of a cure for aging**[45]
The battle with aging is akin to that between Heracles, the hero of Greek mythology, and the multiheaded Hydra. Each time Heracles hacked off a head, two more would sprout in its place. Likewise, the old man successfully treated for prostate cancer may not long afterward stagger back into the physician's office with macular degeneration and dementia (2011a: 279).	The general ethical argument in the fable is simple: there are obvious and compelling moral reasons for the people in the fable to get rid of the dragon. Our situation with regard to human senescence is closely analogous and ethically isomorphic to the situation of the people in the fable with regard to the dragon. Therefore, we have compelling moral reasons to get rid of human senescence (2005b: 277).

Figure 6. Two different stories that illustrate two approaches to aging.

We can target the heart of the Hydra of aging rather than continually and futilely cutting its heads, making little progress overall, especially at the end of life. Being precise, I have to introduce a warning: this does not imply that the Hydra dies, following Gems' example (2011a). Rather, since cutting its heads has proved ineffective at weakening it, targeting the heart represents a shift in strategy. Unlike Gems, Bostrom (2005b) argues for the end of aging: what really matters is

45 This approach refers to Bostrom's fable. This would be the opening paragraph: "Once upon a time, the planet was tyrannised by a giant dragon (...). It demanded from humankind a blood curdling tribute: to satisfy its enormous appetite, ten thousand men and women had to be delivered every evening at the onset of dark to the foot of the mountain where the dragon tyrant lived" (2005b: 273). As I will show below, the battle with aging is akin to that of the dragon tyrant.

to cure it, and any attempt to start at an intermediate stage only moves us further away from the final goal. Therefore, treatment and cure for aging are two different lines of research since there are two communities in biogerontology working on them—their beliefs, epistemic goals, and values are different.

3.3.3. Anti-Aging Treatments and Decelerating Aging: Two Sides of the Same Coin

Finally, this distinction I have established between medicine's traditional approach, AATs, and a cure for aging has a correspondence with a series of already classical categories in the literature. Three possible outcomes of aging research dominate the cultural, philosophical, political, and social discussions of its prospects: "compressed morbidity", "decelerated aging," and "arrested aging" Juengst et al. (2003).[46] They expose this framework to show different possibilities to guide aging research from a theoretical point of view, although it is also a hypothetical scenario. Here, I will justify AATs as the search for decelerated aging and vice versa. These are two sides of the same coin. In short:

> In general, biogerontologists' aspirations can be summarized by three paradigms. The most conservative is commonly described as compressed morbidity. The goal is to forestall the chronic ailments of old age by intervening in underlying aging processes that make us vulnerable to them, rather than to attack them piecemeal (...). Realization of this paradigm will result in a society with many more very old people playing active roles until their final, swiftly fatal, decline. A more ambitious paradigm, decelerated aging, seeks to slow the fundamental processes of aging (...). The most radical paradigm seeks arrested aging. The goal is to continually restore vitality and function by reversing the processes of aging in adults. Some scientists envision that restoration could be accomplished by removing damage inevitably caused by basic metabolic processes, with progress feasible within about a decade. (2003: 1323)

[46] Alternatively, see the "outcomes" of Christopher Wareham (2016) inspired by Juengst et al. (2003). Gems already comment on the usefulness of this framework is useful to discuss what should be done regarding aging (2011a: 280).

I have defended throughout this chapter how there are different ways of approaching aging and how they exclusively depend on the goal that each scientific community pursues. The technological means and even the mentality of the biogerontologists have varied substantially in two or three decades .This is the substantial difference between the three approaches that have been covered in this chapter, i.e. three goals of research: (1) medicine's traditional approach against diseases is focused on the treatment of ARDs separately and without assuming any interrelation, that is, a restorative approach that acts at the end of the person's life; (2) AATs are focused on the preventive treatment of the underlying cause of aging, that is, the primary cause from which all ARDs originate during the person's entire life; and (3) a cure aims at the complete elimination of all cellular damage during the person's entire life. The correspondence is as follows:

Eric Juengst et al. (2003)	**Different Research Lines**
Compression of Morbidity	Medicine's traditional approach
Decelerated Aging	AATs
Arrested Aging	Cure

Figure 6. A table of the three "outcomes" of aging (left-hand side) by E. Juengst et al. (2003) and research lines on aging corresponding proposals in this chapter (right-hand side).

According to this framework, the category of decelerated aging does provide a logical, useful, and realistic way to understand our possibilities to live healthier lives. This category is aligned with the goals of those who defend that biogerontology has to focus on AATs. From this perspective, this category is

more desirable than compression of morbidity, in other words, medicine's traditional approach against diseases. Thus, the shift in biogerontology is from treating ARDs separately to treating the underlying cause of aging. As Rattan says, "rational anti-aging strategies based on scientific evidence aim to slow down ageing process by preventing and/or delaying physiological decline and regaining lost functional abilities" (2005: 27). This category is not inspired by utopian scenarios such as arrested aging. Not everything is science fiction, but neither is it within the realm of biogerontological possibility.

§3.4. "Ageless Bodies"? A Response to Kass

I have shown the differences between AATs and a cure. In order to do so, I have discussed the research goals that the scientific community pursues. In my view, the most plausible position is to defend the development of AATs, which controls and protects us from the broad spectrum of ARDs and which characterizes the process of aging itself— characterizing ARDs as the secondary causes (expressed conditions) of the underlying disease (aging). If we see ARDs as secondary causes, then it makes no sense to intervene in them separately, but rather we would want to treat the underlying process.

In response to Kass, I argue that not all biogerontology is focused on searching for "ageless bodies". From the bioconservative approach, the goal of biogerontology is only one: developing a cure. Something similar would be to state that all oncology wants is a universal treatment against all types of cancers. This is a reduction of how the scientific community works. While certain bioconservative precautions are not only understandable, but also valid, they only focus on radical approaches. This would be the level at which Kass' definition of "ageless bodies" would make sense. But those who defend the treatment of the aging process itself are not talking about the end of the process.

Bioconservatism cares about the alteration or modification of some of the properties that make us humans. As I have shown previously, simply pursuing AATs would entail a shift away from medicine's traditional approach to treating

diseases and towards a more integrative approach. From our current possibilities, the population's health would be improved and this would not be the same as playing God, as bioconservatives fear. Indeed, this approach would be integrated into what has always been tried since the origins of medicine. The difference is in the target shift: from ARDs to aging itself. This shift would represent an approach to aging that is more complete and it would allow the scientific community to rethink its goals, since we always want to have a "good quality of life". If in the last century we could have targeted cellular damage, we would have done so.[47] The difference lies in the type of intervention rather than in the benefit that is desired for the individuals. Therefore, in addition to a reductionist position, Kass makes two mistakes in terms of what is intended from an intermediate position on aging.

Many arguments against the treatment of aging are in fact against the treatment of longevity (see de Winter 2015; Schramme 2013). As Gems advocates, there are two levels whose acceptance is not and should not be regarded as equivalent: (1) reducing large-scale ARDs; and (2) in the best-case scenario, achieving life extension (2011a: 280).[48] There is a relationship but it is not one of necessity. The lengthening of telomeres, despite having the improvement of health as its first objective and giving extra life as its secondary one, will not make us the new Methuselahs. Perhaps life will be substantially longer, but we will not live a millennium or anything similar.

Another big concern is that the promise "the end of aging" (Cordeiro & Wood 2018; de Grey & Rae 2007; Wood 2018) has more impact than the research projects that pretend to treating aging, whose goals are more modest.[49] Kass'

[47] See the increase in life expectancy last century (Christensen et al. 2009; Oeppen & Vaupel 2002; Vaupel 2010).

[48] As I explained in a previous note, Gems defends two objectives but prioritizes the treatment of ARDs as a more realistic option.

[49] See Agar (2010: Ch.4; 2013: Ch. 6; 2015: Ch. 9). He is quite skeptical of promises that go substantially beyond the realm of scientific possibilities. Furthermore, he criticizes super-enhancements such as those proposed by some defenders of the most extreme versions of technological optimism (cf. Bostrom 2014; Harris 2007; Hughes 2004; Kurzweil 2005).

concern is justified in the sense that he has attacked the most extreme version of aging treatment. If we rely on biogerontology and its successes in model organisms, there is nothing to simulate a cure.[50] Biogerontologists make the intermediate position more visible and attempt to capture everyone's attention. Kass' reductionism is a reflection of the power of what proponents of getting a cure. There should be a social change that involves decreasing that excitement around such news and to show how minimum benefits are more desirable and more likely to become real. Of course, many people are skeptical because they consider these goals unworkable and they do not just want to read hopeful slogans. Thus, the goal becomes more realistic, along with logical and useful, and is seen as science and not as science fiction.[51]

Treating aging will not bring about an extension of the vigor that characterizes adulthood, as if we lived with the condition of our 20s until the time of our death.[52] What I defend is mitigating the effects of aging from the moment that we begin to age. Of course, this may make that vigor last somewhat longer, but what should be evaluated as positive is the following: the world's population will be healthier for longer than it currently is. According to the above, old age will not disappear like taking an "eraser", neither will the human life-cycle would not be modified beyond what we currently recognize as being *human*.

It is time for society to prepare for the challenges of a somewhat different world in terms of aging.[53] We will not wake up tomorrow having a cure for aging,

[50] See in this sense the comparison made by Antonio Diéguez (2017: Ch. 2) between AI researchers and advocates of mind uploading.

[51] Treating cancer is not the same as proclaiming that we will find a cure in the future, regardless of when exactly in the future. I understand the shift in biogerontology in an analogous way, which justifies the existence of several lines of research on the same topic with different objectives. I owe this reflection to Nicholas Agar during my research stay at Victoria University of Wellington. See in this sense, Mukherjee (2010).

[52] I realize that a personal desire does not imply a realistic scientific goal.

[53] Undoubtedly, this point of view on the treatment of aging is not exempt from an assessment of possible ethical and social consequences. For reasons of time and space, I will not discuss this normative perspective of my approach. There are a number of scenarios to assess—births, distributive justice, overpopulation, retirements, among others (cf. Bostrom 2005b; Cutas 2008; Davis 2005; Horrobin 2006; Gems 2011b; Juengst et al. 2003).

which we all can easily access by going to a pharmacy or a hospital, in a way that, moments after taking it, everything becomes radically different from how it is today. Nor will the changes be so profound that humans will cease to be what we are. Against bioconservatives, I argue that we must begin to place more value on the possible health benefits for people rather than on the possible dire consequences for individuals and society. In other words, why fear a future that will most likely not come to pass, if that fear prevents us from making tangible progress towards reducing human suffering? There has always been a greater emphasis on replicating science-fiction scenarios than on valuing the good reasons for serious science. The difference is based on a sufficient and necessary knowledge of aging biology to be able to deliberate on normative challenges. In the last century, there has been an incessant fight against many painful diseases. But, as in previous times, medicine was able to fight them to improve people's lives (e.g. infectious diseases) (Gems 2011a; notably, Vijg & de Grey 2014). *The question is not whether to try or not to treat but rather whether we have the funding and the means to do so*. However, this does not imply that a cure is possible. This type of approach is not logical, useful, or realistic.

§3.5. Concluding Remarks

In this chapter, I have introduced the distinction between AATs and a cure, including one criticism of Kass, who has argued only against one reductionist goal of biogerontology. The main ideas that I have presented can be summarized as follows: (1) AATs help us to think differently about *where* to intervene in the aging process; (2) AATs should begin to be developed already regardless of whether great successes are made; (3) a cure is not related to the biology of aging and exceeds our means and possibilities, or what is the same, it is a research line substantially different from the prevailing one which is currently defended in the scientific community, which seeks the deceleration of aging as its ultimate goal; (4) bioconservatives think of "ageless bodies" when actually there are more levels to treating aging than they would have us believe. The most realistic scenario is that of decelerated aging, leading to benefits in the population's health.

Chapter 4: Beyond the Weak and Strong Life Extension Division: "Don't Add Years to Life if You Cannot Add Life to Those Years"[54]

Summary

The philosophical and scientific debate about life extension is polarized between two views: a "weak" and a "strong" camp. They are divided over their approach to the age of Jeanne Calment, or what is the same, the maximum life span. In this chapter, I evaluate this division and I propose an alternative for thinking about the life extension possibilities. In order to do so, I will first review five key concepts in the literature, since some of them are misunderstood by the authors who defend this division. Furthermore, this division suffers from a major flaw: the failure to acknowledge that maximum life span is not a fixed number, and that there are no strong arguments to ensure that this is the limit to human longevity. Moreover, I will argue that these authors do not adequately capture the main aspect that we care about when grappling with aging—improving the quality of life throughout our existence. Therefore, I defend that "we should only add years of life if we can add life to those years", focusing on the search for a healthier life rather than any attempt to live longer than we currently do.

§4.1. Introduction

In the last two decades, the possibility of extending life expectancy and maximum life span has been a highly debated topic by both biomedical scientists (Blasco & Salomone 2016; de Grey & Rae 2007; Olshansky & Carnes 2002) and philosophers (Agar 2010; Davis 2018; Overall 2003). Our knowledge of aging is

[54] I would like to thank Antonio Diéguez, Stefano Giaimo, Walter Glannon, Gregor Greslehner, Francisco Lara, Laura Nuño de la Rosa, Andrés Moya, Cristian Saborido, Rebecca Walker, and Christopher Wareham, who read previous versions of this chapter, and made helpful comments and suggestions. Eric Juengst is especially acknowledged for this detailed revision of the final version of this chapter.

expanding, our technological possibilities are better, and many conceptual and normative questions are being opened. Against this backdrop, there are two well-known opposing groups related to a possible increase in human life: bioconservatives and transhumanists.

The former (bioconservatives) tend to interpret aging as a "natural", "normal", and "universal" process. They equate maximum life span with the human life-cycle and argue that efforts to push past it indefinitely are ultimately dehumanizing. For them, mortality is essential to the meaning of life—our goals and values depend on our finitude. What is more, if a human body could be sustained indefinitely, our personal identity would not depend on the temporal limits that necessarily define any particular person's lifetime (Fukuyama 2002; Kass 2003; Habermas 2003; Sandel 2007).

The opposing view, the one held by transhumanists, tends to interpret aging as a disease, a pathological process that is potentially curable. They argue that efforts to arrest aging are not only morally permissible, but that they should be given high priority within biomedical research. Accordingly, we should always keep striving to overcome the limits of our maximum life span just as we accept no limits on our health, no matter how old we may grow up to be. For these authors, living longer or even living forever would be the best possible scenario, as they believe that there should be no limits to our enhancement.[55] In saying so, transhumanists defend the most extreme position on life extension (Bostrom 2008; Kurzweil 2005; Harris 2007; Wood 2016).

Conceptually and normatively, bioconservatives and transhumanists are clearly incompatible. If these were the only possible positions, the debate would be stalled. For this reason, some authors have to tried to frame this debate in a way that can facilitate progress in biogerontology and philosophy beyond these

[55] One could simultaneously believe that (1) aging is not a disease; and (2) we should enhance ourselves without limits. This option seems quite unusual, but it is logically valid. I owe this comment to Gregor Greslehner.

two opposing views.[56] These authors generally do so by distinguishing two forms of life extension: (1) "weak" (moderate) efforts of current biomedicine to sustain a good quality of life in old age; and (2) "strong" (radical) efforts of some future biotechnology that will allow people to live healthy lives well beyond the current maximum life span (Lucke & Hall 2006; Moody 2001; complementarily, Glannon 2002a; Rantanen 2014). In the light of this division, these authors describe each of the possible scenarios to assess whether they are desirable for humans.

This chapter is about the weak and strong life extension division: I will take the approaches of Harry Moody (2001), and Jayne Lucke and Wayne Hall (2006) as significant examples (§4.2). First of all, in §4.3-4.4, I will review several key concepts that are used by authors that are proponents of this division. I will propose dividing these key concepts into two different categories: concepts that revolve around individual properties and concepts that revolve around population properties. Then, in §4.5, I will expose a serious flaw of this division. This flaw is related to how maximum life span should be quantified. According to the above, I argue that human life is more worth living when we have better health prospects for longer, regardless of whether we can extend it. In this regard, in §6, I will introduce a thought experiment to show that we should only add years of life if we can add life to those years—that is, adding a greater proportion of years spent at maximum physical functioning. Living a healthier life throughout our existence should be prioritized over any attempt to live longer than we live now. At the individual level, we never really know what our "old age" will look like until we get there. We all hope to be the "active" older person who is physically fit and free of ARDs, but nothing is a guarantee. By prioritizing an extension of the health span (rather than the maximum life span) we can make this "hope" more possible.

[56] As I already showed in **chapter 2** and also provided in **chapter 4**, I find myself in an alternative position to these two extremes in the debate on life extension.

§4.2. Mediating Models to Govern the Practice and Theory about Life Extension

The mediating models that appear in conceptual and normative debates over life extension can be classified into a weak and a strong camp. These authors aim to be clear about what is at stake in this dialogue between both extremes: bioconservatives and transhumanists. By means of these mediating models, they respond to different concerns, dilemmas, and problems about life extension. For instance, some of the classical questions go as follows: (1) Is it desirable to live longer than today's average? (Bostrom 2005a; Gems 2003; Temkin 2008); (2) Should we cure aging? (de Winter 2015; Murphy 1986; Schramme 2013); or (3) What kind of consequences and implications could be derived from life extension? (Davis 2005; Glannon 2002b; Gyngell 2015). This division leads them to respond to each of the challenges from their particularities rather than from a common theoretical framework that applies to all problems, as bioconservatives and transhumanists usually do. They argue that this is the only possible way to prevent the debate from getting stalled.

I will firstly present the division by Moody (2001), and by Lucke and Hall (2006), as mediating models to govern the practice and theory about life extension. Secondly, I will summarize the main ideas shared by different authors who defend this division.[57] Despite having significantly different starting points, they all pursue the same objective: evaluating what a post-aging world could look like.

Moody (2001) feels a strong tension between the idea of looking young in first person and the anthropological, philosophical, and social consequences of

[57] Broadly speaking, these authors do not tend to explicitly argue about what is aging before presenting the division between the weak and the strong camp. However, they implicitly defend that aging is not a disease and that it can hardly be cured. In this line, Walter Glannon affirms that "aging is the bane of our human existence. It is responsible for degenerative disease of the body and mind and is the cause of much pain, suffering, and diminished quality of life. It is a constant reminder of our mortality: Assuming that mortality is not a disease, and that aging is an intrinsic property of mortality, aging itself is not a disease" (2008: 175).

living longer than we live now. Taking his own ambivalence as a point of departure, this tension between a personal yearning and the normative restraint, an inner dialogue emerged. In order to position himself in this debate, Moody divides it into two camps. Briefly:

> 1. "Weak" life extension means increased average life expectancy—say, from 76 to 100, combined with compressed morbidity, with maximum lifespan remaining unchanged (at around 120 years). 2. "Strong" life extension means dramatically increased life expectancy—say, from 76 to 200 years, with continued compression of morbidity, and maximum lifespan rising to something like 240 years. (2001: 33-34)

Moody thinks that weak life extension is an extrapolation of the world as we know it—with substantial changes but recognizable from our history. This scenario will be available in the near future. Furthermore, biomedical interventions are already present. Life expectancy will increase by about 25 years, but the maximum life span will be around 120 years, which is the current record. For him, weak life extension would not involve as many terrible consequences as strong life extension. He implicitly justifies it on the basis of two features of his view: (1) an increase in life expectancy and not so much in maximum life span (from 122 to 128); and (2) no deep modifications in the human life-cycle. By contrast, Moody thinks that strong life extension requires that we imagine a world that has changed so dramatically that we can hardly recognize ourselves. He argues that this scenario will be available in the distant future. Its success will double life expectancy. In other words, maximum life span will exceed 200 years, which would be a new record. Finally, Moody ponders about whether anyone could fear life extension. In the radical scenario, he considers that the meaning of human life would not be very familiar to us. He argues this by rejecting possible scenarios which in many points substantially resemble what transhumanists promise.

Lucke and Hall (2006) point out that their distinction is influenced by Moody's position, which I have summarized above. In their words:

> '[S]trong lifespan extension' in which scientific advances increase both average and maximum lifespan, for example, enabling most people to live to be 112 years and some to 140 years; and 'weak lifespan extension', which is the incremental increase in average life expectancy resulting from continued improvement in the prevention and treatment of disease. (2006: 58)

Lucke and Hall argue that weak life extension is the real scenario for biogerontology in the near future. Life expectancy will increase to 100 years, but maximum life span will not overcome 130 years. Thus, there will be more healthy individuals as a result of medical prevention of cognitive and physical aging. They enumerate different therapies and treatments in this form, including gene influencing or regenerative medicine. Lucke and Hall argue that strong life extension will be based on diverse model organisms that have led to success in extending life. According to many authors, the advancements of science and technology will allow for these results to be extrapolated to humans. Lucke and Hall enumerate different therapies and treatments in this form: substances that mimic the effects of caloric restriction or telomere reactivation.

Now, I summarize each of the two forms under three premises which are shared by all these authors. Beyond Moody's, and Lucke and Hall's position, there is a long list of philosophers who have sustained this division (Glannon 2002a; Rantanen 2014). In addition, they take one step further in that they ensure that the weak and the strong camp are divided by the fixed value of maximum life span. Without any doubt, this is the best-known feature of mediating models.[58]

[58] I will take this measure since this really is implicit in each of the proposals. Specifically, Rosa Rantanen argues that "[c]onsiderable life extension involves manipulating aging in the later stages of human life. Extending the average length of human life beyond the current maximum of c. 120–125 years requires technologies that enable manipulation of the biological process of aging (senescence), which currently takes place in the later stages of every human being's life" (2014: 104). By contrast, she barely mentions what the radical form would be, but her idea may

They suggest that, for conceptual and normative purposes, there is a "weak" scenario characterized by trying to extend life expectancy until Jeanne Calment's record at most. In order to do so, they advocate maintaining biological adulthood for as long as possible, and eliminating the disability, frailty, and weakness of old age as quickly as possible. Thus, they predict success in achieving this goal by 2050, using concrete treatments drawn from current biomedicine. They believe that it is a feasible scenario and quite desirable for many of us.

They contrast this view with a "radical" scenario characterized by trying to extend life expectancy beyond Jeanne Calment's record, including doubling our maximum life span. They usually quantify it at 200-250 years and argue in favor of maintaining biological adulthood indefinitely, or what it is the same, the elimination of the aging process itself. Thus, they predict success in achieving this goal by 2070-2080, using future biotechnology. They believe that it is a utopian scenario and that it would not even be very desirable for many of us.

Before discussing a serious flaw underlying the weak and strong life extension division, I will criticize how it does not adequately correspond with the key biogerontological concepts.

§4.3. Reviewing the Key Concepts: Definitions

I have presented the weak and strong life extension division made by several authors. Now, I will evaluate the key concepts that appear in the scientific field that studies the biology of aging, and in the philosophical approaches that reflect on that science. In particular, there are some concepts which are often confused or misinterpreted by some authors in the debates over life expectancy, life span, and the possibility of life extension. Due to this confusion, there are a number of inconsistencies in this division. The problem is twofold: to begin with, it is not

be implicit in the following words: "It does not mean helping people to lead a healthy life until the age of 120 but rather helping people to live tens or, perhaps, eventually hundreds of years more than the current maximum age" (2014: 104).

well theoretically defined, and also, normative concerns cannot be inferred with certain guarantees.

Thus, I will now introduce a distinction between the concepts that revolve around individual properties and the ones that revolve around population properties (**Figure 7**).[59] I argue that this distinction is a good strategy to start the criticism of the weak and strong life extension division. In addition, in §4.6, this distinction will help me provide an alternative to think about life extension.

Individual concept	**Population concept**
Lifetime (age at death)	Maximum life span (oldest life time recorded for pop.)
	Life expectancy (average life time in pop.)
Health time (duration of individual functionality) Frail time (duration of individual non-functionality)	Health span expectancy (average vitality in pop.) Frail span expectancy (average disability in pop.)

Figure 7. Table presenting my own division related to the key biogerontological concepts. The right column represents those individual concepts and the left column represents those population concepts, including maximum life span, which refers to the species.

Maximum life span is a theoretical concept from biology which refers to the maximum length of time that a member of a given species can live. It is usually

[59] I owe Laura Nuño de la Rosa this suggestion to classify the key concepts into two different levels: individual and population. This distinction is a strategy used in many debates in the philosophy of biology.

defined empirically as the age at death of the oldest documented member of the species. Taking humans as an example, Jeanne Calment's record is 122 years and 164 days at a given environment and space-time, among other factors. Her life went beyond all other records of longevity, so when she died, she defined a new maximum life span for humans.

Lifetime is the time length beginning when a person is born and ending when this person dies. However, the theoretical concept of a species' life span is sometimes confused with a colloquial use of "life span" to refer to the duration of a particular individual's life, as when one says: "I know that my life expectancy is around 79 years, but I would like to see if I can extend my life span beyond that population average, so that I die after I turn 90". There are many factors which determine our own lifetime, such as alcohol consumption, diet, educational status, exercise, or smoking habits.

Life expectancy[60] is a statistical concept based on demographic studies of aging. It refers to the average number of years that members of a particular population are expected to live. There are many factors that influence life expectancy within any particular population, such as access to food and water, disease prevalence, environmental and social conditions, and levels of infant mortality. Life expectancy has two subsets: health span and frail span (**Figure 8**).[61]

[60] Moreover, one cannot separate the individual from the population. If every individual life is longer, then life expectancy in the population increases. If life expectancy in the population increases, the average individual does live longer. The two key concepts are interdependent. However, if the life of very few individuals, or rather, only of an economic elite increases, life expectancy will hardly change.

[61] I will not discuss health time or frail time when referring to how a specific person has lived. My goals are populations, as I will show throughout these pages.

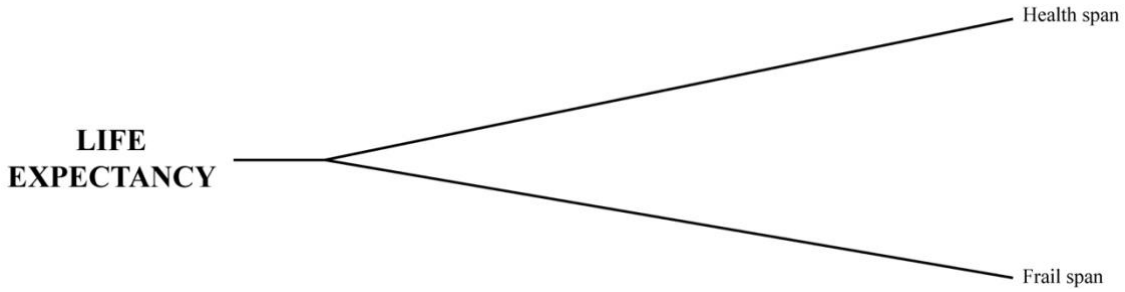

Figure 8. Scheme which represents how long we are healthy from a population perspective.

On the one hand, health span is a biogerontological concept which refers to the portion of a population's time that is spent in good health, free from diseases, and weakness of aging. This process is portrayed as a heuristic and simplified picture of a specific population.

On the other hand, the opposite biogerontological concept is frail span which refers to the portion of a population's time that is spent in age-related dependence and disability, especially in old age. Note that while both of these terms are sometimes contrasted with the individual sense of lifetime, these are both unrelated to the biological concept of life span.

§4.4. Reviewing the Key Concepts: Mistakes

I have presented five key biogerontological concepts. Seeing that these are very commonly used in the debate over life extension, I have considered it pertinent to define them in order to avoid certain mistakes (§4.3). These mistakes do not only occur in Moody's, and Lucke and Hall's position, but they are common among defenders of this division. I classify them as follows: (1) problems related to the concept of maximum life span; (2) problems related to the concept of universal life expectancy; and (3) asymmetry problems in this division.

It makes no sense to say that the maximum life span in humans is around 120 years as a matter of intrinsic human biology. At best, one might say that Jeanne Calment's age marks the record. This could be corrected as follows: they

would suggest that there is a plateau at around 120 years since only one individual has exceeded this age, Jeanne Calment.[62]

Similarly, it makes no sense to say that life expectancy is around 76 years as a universal measure. Life expectancy is a population concept; therefore, we should specify the country, culture, or social class to which we are referring. There are some substantial differences between populations. In Japan, the country with the highest number of centenarians per inhabitant and the highest average life expectancy, this is at around 85 years. By contrast, Eswatini barely exceeds 30 years.[63]

There is an asymmetry between the weak and strong life extension related to its own proposal (notably, Lucke & Hall 2006). In the first scenario, life expectancy increases for the whole species, while in the second one, the life expectancy of many people increases to 112 years. They use two different meanings of "life expectancy": for human beings in a broad sense and for a concrete population in a narrow sense. This asymmetry is based on a lack of clarification of the goals of biogerontology: whether it is for everyone or for an economic elite in developed countries. Weak life extension requires prevention and treatment policies quite close to the healthcare system in such countries. This seems to indicate that it is for everyone who has the possibility to pay for this type of life insurance. Strong life extension requires therapies that are likely to be limited to those provided by private biomedicine companies in the most developed countries. This seems to indicate that such a life extension is only for some people.

In short, these authors do not clearly express whether they believe that this extension will be of life expectancy or maximum life span, among other problems. While it is true that there are many other contingencies to take into

[62] See Rantanen's paragraph in a footnote above.

[63] Moreover, it is not the same to refer to the life expectancy of a person at birth than to discuss what the life expectancy of that person X could be at a time Y in which the circumstances and technological resources have changed dramatically.

account in this debate, we have to clarify the key biogerontological concepts. Now, I will show a flaw against the weak and strong life extension based on the fixed value of Jeanne Calment's age. After that, I will show my alternative to think about life extension possibilities, using the key biogerontological concepts defined in §4.3.

§4.5. Problems in Quantifying the Maximum Life Span

The most important problem with the division approach to classifying proposals in this debate is that the difference between the weak and strong forms of life extension cannot be explained in quantitative terms, as all these authors try to do. As I have noted previously, biogerontologists define maximum life span as a fixed value, based on the longest human life that we have documented to date. In fact, the existence of a limit on human longevity remains a puzzle in the biology of aging. From a theoretical perspective, we still do not actually know how long humans can live, or why we age as we do (Kirkwood & Austad 2000; Oeppen & Vaupel 2002; Olshansky, Carnes & Cassel 1990). Jeanne Calment's record is not the longevity limit for any scientific reasons, and I propose the idea of "Potential Additional Life" (PAL) to shed some light on this problem. PAL covers the period between the "Maximum Documented Life Span" (MDLS) and the "Maximum Theoretical Life Span" (MTLS). These can be defined as follows:

1. The MDLS is the unique performance of an individual of a certain species in terms of how long this individual lives with regard to the highest observed quota.

2. The MTLS refers to how long an individual of a certain species could theoretically live in ideal circumstances, given what we know about biology (see Weon & Je 2009).[64]

[64] They say: "Our estimate is in an agreement with the hypothesis of the maximum human lifespan to be around 125 years. This result suggests that the '125 years' may be a 'magic number' in human aging dynamics" (2009: 70). Contrarily to these authors, Aubrey de Grey defends that "quantitatively, what this means is that if a 10% per year decline of mortality rates at all ages is

The MDLS is 122 years and 164 days, although it can be readjusted if a person lives at least one day longer than Jeanne Calment. The MDLS can only increase or stay the same, while the MTLS is always equal to or greater than the MDLS. I would even say that the MTLS is always larger than the MDLS, because there is no obvious reason to think that something (i.e. an intrinsic biological limit) triggered the death of Jeanne Calment. She could have lived longer—perhaps not much longer—yet her death was still the product of some chance factor. At that age, it is quite likely that an infection was a sufficient cause for her death. So, the MTLS can fluctuate but only above the MDLS: as a totally hypothetical example, we might now optimistically say that the MTLS is 1000 years, but in a decade, we may come to the conclusion that it is 200 years, or, perhaps, that we were too pessimistic ten years ago and it is actually 1500 years.

Thus, the MDLS is a non-fixed value and it only makes sense in a specific space-time (with respect to a particular person's life). In addition, I defend that the MTLS is X years because this concept depends intrinsically on the prevailing states of demographic data and biogerontological research. The MTLS is a hypothetical value. In order to avoid Moody's (2001), and Lucke and Hall's position (2006), thinking about the weak and strong life extension division cannot be measured in quantitative terms. If effective life-extending technologies continue to be developed over time, both life expectancy and maximum life span calculations will change as well (life expectancy in Ancient Greece was around 28 years old, but Aristotle, according to different manuscripts, lived 66 years—almost certainly maximum life span at this time had already exceeded 70 years). Therefore, the gap between the MDLS and the MTLS is what really matters. I illustrate this with a sketch representing what I call the current longevity line.

achieved and sustained indefinitely, then the first 1000-year-old is probably only 5-10 years younger than the first 150-year-old" (2004: 725). Note that a transhumanist could affirm that we can free ourselves from our biological chains and live forever (I will present this movement in the next chapter). In this sense, the concept of MLTS would be infinite, that is, as much as we want.

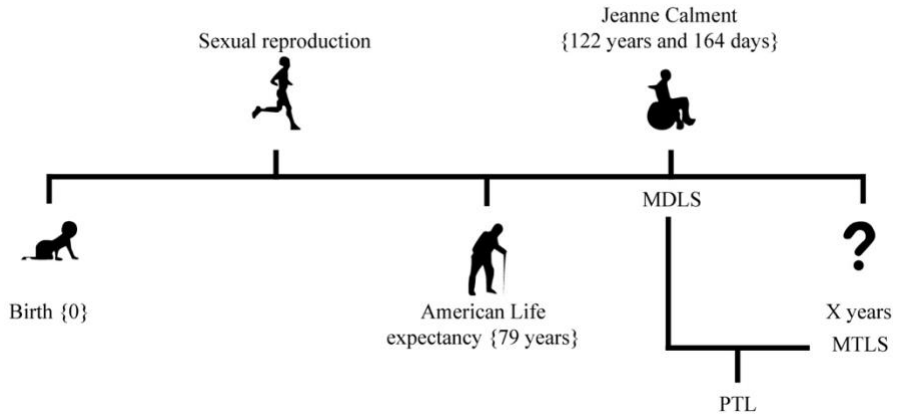

Figure 9. The current longevity line. These concepts are from 2020.

In order to understand the significance of PAL, consider the current study by Xiao Dong et al. (2016). They report that, firstly, the number of supercentenarians has not increased for more than 50 years; secondly, death has settled on a plateau of 115 years (complementarily, Gavrilov et al. 2017; Vijg & Le Borg 2017). 18 people have lived at least 116 years and 45 days, including Jeralean Talley, and no one has exceeded 120 years except Jeanne Calment. I justify the MTLS and PAL through some of the criticisms received in this study. Bryan Hughes and Siegfried Hekimi (2017), and Maarten Rozing and Thomas Kirkwood (2017), analyzing trends in the lifetimes of the longest-living individuals from France, Japan, and the United States from each year since 1968, found that both life expectancy and life span may continue to increase far into the foreseeable future (cf. Oeppen & Vaupel 2002; Vaupel & Kistowski 2005; Wilmoth 1998). Many of the longest-lived people were born before World War I. Current health conditions differ significantly from those at the time of their births, thus making the MTLS difficult to predict based on past data.

But even if maximum life span is not biologically fixed, it is conceivable that there is a biological limit on longevity that we do not yet know. In order to understand why this is so, consider the parallels between human longevity and the limits on how fast a human can run 100 meters. Jamaican sprinter Usain Bolt's record-setting performances have unleashed a wave of interest in the ultimate limits to human running speed. An eight-time Olympic gold medalist, he has

won the 100 m, 200 m and 4×100-m relay at three consecutive Olympic Games. Bolt improved upon his second 100 m world record of 9.69 with 9.58 seconds in 2009. The first documented record (1912) was set in 10.4 seconds in Stockholm, Sweden, by Don Lippincott and Jackson Scholz. The records have progressed in the last century, decreasing by more than 1 second. It is possible to think that there might be a sprinter who could bring down the 100-m record to 9.5 seconds. No one can say that Usain Bolt's record will never be exceeded, but that is entirely different from suggesting that we will go from having sprinters to having speedsters like *The Flash* (superhero in the DC Universe). In the comics, Professor Allain begins his analysis by studying the speed when he captures an arrow thrown by Oliver Queen (Green Arrow). He observed that Flash's speed reaches 37 m per second. It seems irrational to think that a person can run at the speed of *The Flash*, simply because of what we know about the structure of the human body and the physics of motion and speed—which could be equated to thinking of "New Methuselahs" (see Gems 2003; complementarily, Davis 2018).[65]

By the same token, just as the human skeleton and musculature are structurally composed in ways that allow us to reach a given maximum in sports (Marck et al. 2017), there are hallmarks of aging (López-Otín et al. 2013). We can see how the cases of Jeanne Calment and Usain Bolt, despite being valuable examples, are extraordinary. Just as there have been advancements in racing and trainings and methods are increasingly better, we have extended life expectancy through different milestones such as better hygiene or vaccines. In light of such an incremental progress, we can only expect that the MDLS might come closer to the MTLS over time, always showing that the MDLS and the MTLS depend on demographic data and the state of science. At present, the MDLS is Jeanne Calment's record and the MTLS is X. In the future, it could be balanced or even change its values for others that are still unknown.

[65] Another problem to be considered regarding the question of a limit to the human body's ability to run at an increasingly higher speed is whether it would result in injury beyond a certain point. There may be only so much that the human skeleton and musculature can do.

According to the above, PAL helps to clarify why the weak and strong life extension division cannot focus on the limit on human longevity—let alone a fixed number of "X" years. Incremental progress seems the most plausible position.

§4.6. The Peter Pan Drug: A Way to Live Healthier Lives

I have shown the mistakes in regard to the key biogerontological concepts in the weak and strong life extension division. Moreover, I have pointed out that the MDLS is a quantitative measure that does not adequately capture the main aspect of aging research. In my view, what really matters is to achieve a longer period of health span and a shorter frail span at population level, or, what is the same, to focus on the quality of life during our entire existence and not simply in the final years.[66] My proposal can be illustrated through a thought experiment about a hypothetical pill that I will call "the Peter Pan Drug" (PPD). The PPD shows what a desirable goal of biogerontology would be in the future.

> Imagine that we could take a pill that would decelerate aging in the same way that Peter Pan's growth was stalled in childhood. Unlike Jeanne Calment, we would retain all the vigor of young adulthood until we stopped taking the pill, at which point normal aging would resume. The PPD does not only control aging, but it is vital to its users' ongoing survival once they start taking it. If we decided to stop taking the pill at the age of 80, and then we still lived for 40 additional years of normal aging to the age of 120, would that not be a scientific revolution?[67]

[66] Many authors affirm that weak life extension has to focus on improving the quality of life in old age. By contrast, I will defend that we should be healthy for as long as possible, beyond any improvement in our last years. We must maintain a high level of functioning in our cognitive and physical capacities—longer than we do today. To read more about this, see chapter 2.

[67] I always imagine this hypothetical scenario from a population perspective: the PPD would be available to anyone who wanted it. In this way, the inclusion of health span as a priority in the medical agenda seems more evident.

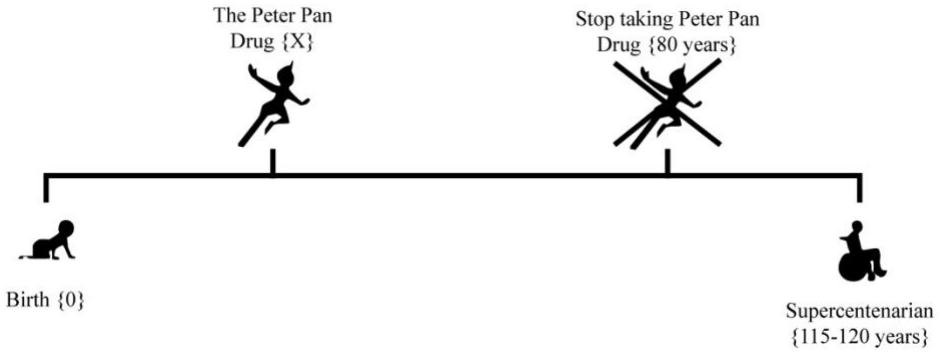

Figure 10. The PPD. Sketch representing a hypothetical timeline of human life with the pill.

This thought experiment shows us the turn that biogerontology has to take to emphasize controlling and slowing down aging rather than focusing on life extension as it is now, that is, a prolonged period in which our cognitive and physical capacities are at a level near zero. The opposite case of the PPD is the famous Greek myth of Tithonus, who was granted immortality without eternal youth, so he declined more and more with the passage of time until he became a cricket (de Grey 2008; notably, Williams 1999).

In order to do so, I propose a simple comparison between the weak and strong life extension division and my own proposal in this debate, having the PPD as an example to illustrate my idea. This comparison is also influenced by the previous flaw according to which the debate can hardly be quantified in terms of a definitive measure. While I have criticized this division during the previous sections, I have argued that mediating models are valid in order to continue developing the debate, as opposed to the more extreme positions. However, my alternative position goes beyond trying to overcome the MDLS and focuses on increasing our health span.

For some, a person who lives 123 years, but without any special improvement in their quality of life, will be in a "strong" scenario.[68] While the

[68] My goal would be that everyone in the world can access these improvements, having a healthier life. I am aware that life expectancy varies substantially from one place to another. Therefore, the increase must be significant for the population that we are referring to. One of the biggest

case of Jeanne Calment was an exceptional record, she suffered from a normal cognitive and physical decline at the end of her life. In other words, even though her record-setting lifetime defined the maximum life span: her health span was as typical as that of others of her time. My case with the PPD is quite different: a population who lives around 120 years (that is, less than Jeanne Calment's record), but whose health has been maximized. Their last years are full of activity; for example, diving in the Great Barrier Reef. In my view, it would be much "stronger" if their health span were longer. For them, if a person exceeds Jeanne Calment's record by a couple of years, it would be the beginning of a post-aging world. However, I argue that this would be "strong" for just the opposite reason: for an elderly population to sustain their cognitive and physical capacities for as long as possible.

Moreover, if old age were simply a stage, it would be overcome by biogerontology in the future. Using other words, de Grey defends the same idea: "a typical expression of this is that biogerontology is focused on 'adding life to years, not just years to life'" (2005: 659). Today's 80s are not the biological 60s yet, but we should be optimistic about this goal. Admittedly, today's 60s are not the same as a 100-year old person's.

Of course, if a person lived longer than Jeanne Calment in the future, it will be socially relevant news. This person could live a day longer than the MLSD without implying that treatments against aging are any better. In the best-case scenario, one person could have more robust genetics or a bit more luck than Jeanne Calment. Over the past 100 years, there has been a substantial improvement in health and social conditions almost everywhere in the world, albeit at different levels (Christensen et al. 2009; Oeppen & Vaupel 2002; Vijg & de Grey 2014). In most cases, these conditions were measured in terms of populations. However, there surely has been a readjustment of the MDLS. It is true that the data is not reliable, but someone would have reviewed the

challenges will be to reach less developed countries. For reasons of time and space, I will not discuss this issue — distributive justice — of a normative nature.

established record and the next person would do the same with their predecessor.

Taking this debate one step further, I defend that *we should not add years to life if we cannot add life to those years*.[69] The end of our lives is characterized by a prolonged period of dependence, disability, and weakness, and it is not very desirable that this be extended if our cognitive and physical capacities decrease to a level near zero. Is a longer life worth living if it is not healthy? Really, it is not. *Life expectancy must continue to increase if and only if our health span is much more extended than our frail span*, regardless of whether the MDLS continues to be 122 years and 164 days. I refuse to live the end of our lives in the current conditions, since this prevents us from developing the kind of life that we want, whatever that type of life is. Many people spend their last years in nursing homes simply waiting for death to come. We could all meet somebody who has escaped the ravages of aging for a very long period—the contrast being made here is that there are occasionally outliers who experience a longer-than-average healthspan compared to the population level of general decline. However, at a population level, there are many more people sitting in chairs without being able to walk or wandering in a world without memories. In my view, frail span has to diminish even if this entails some stagnation in the expectations of extending life. In this vein, I agree with Christine Overall when she writes that:

> If the available medical, social, and material resources are so limited that one's extra stretch of time is lived in misery, then that is a problem, and no prolongevist advocates the extension of human life if it can be lived only in poverty, pain, and ill health. (2003: 41)

[69] This statement is inspired by the well-known slogan "Don't simply add years to life but add life to years". However, my point is to argue how life extension is increasing the period of frail span to make it even longer than in the past. While much of our life is healthier, our last moments are very hard.

Thus, the goal of biogerontology should be to increase our quality of life without this implying that we live substantially more than now.[70]

§4.7. Concluding Remarks

My aim in this chapter was to clarify the conceptual confusions related to the possibility of extending life expectancy and life span. I have argued against the weak and strong life extension division for one major reason. The concepts of the MDLS, MTLS, and PAL have been employed to show that Jeanne Calment record's is just for now, and it was different before her, and so on. The weak and strong life extension division fails because it rests on the now demonstrably false premise that the MDLS is a fixed value. I have also argued that the attempt to classify life extension possibilities quantitatively makes no sense. Furthermore, a "strong life extension" based on health span is something completely different from what some authors have proposed (that is, living 130 years, since this is more than what Jeanne Calment lived). The goal of biogerontology should be to treat aging at a population level to ensure maximum quality of life in terms of health. Maintaining our cognitive and physical capacities for as long as possible and reducing the period of dependence, disability, and weakness must be prioritized over any attempt to increase life.

[70] There is no consensus in biogerontology as to whether being healthier will lead to living longer. Broadly speaking, anyone could argue that if our cognitive and physical capacities are optimal, our life would increase by some years, however few they were. By contrast, very few could say just the opposite.

Chapter 5: Transhumanist Immortality: Understanding the Dream as a Nightmare[71]

Summary

This chapter offers new arguments to reject the alleged dream of immortality. In order to do this, I firstly present an amendment to Michael Hauskeller's approach of the "immortalist fallacy" (2013). I argue that the conclusion "we (normally) do not want to live forever" does not follow from the premise "we (normally) do not want to die". Next, I introduce the philosophical turn from "normally" to "under these circumstances" to resolve this logical error. Then, I review strong philosophical critiques of this transhumanist purpose of immortality in the literature. There are two key questions related to the possibility of fulfilling this goal: the hard problem of consciousness and the personal identity dilemma. Finally, I defend a specific type of indefinite life and argue that it is more desirable than our current limited life.

§5.1. Introduction

5.1.1. An Optimistic Vision of Future Technology

Let me confess an almost daily concern: I do not want to die today. I am confident that I will not want to die tomorrow either. My anxiety about dying is based on my fear of the moment in which my conscious life will end. I cannot imagine what it would be like if I ceased to exist. This fear is an emotion which invades my mind and I can hardly suppress. Once dead, I will not be able to enjoy admiring the sunset in Oriental Bay, cooking Asian food, playing the piano, reading *The Divine Comedy*, or watching *Blade Runner 2049* again. This concern is

[71] I would like to thank Nicholas Agar, Suzanne Day, Aubrey de Grey, Antonio Diéguez, Walter Glannon, Alejandro González Jiménez-Peña, Eric Juengst, Alfredo Marcos, Andrés Moya, Andrés Ortigosa, and Jon Rueda, who read previous versions of this chapter and made helpful comments and suggestions. I owe Antonio Yuste-Ginel the idea of modifying the qualifier "normally". This idea was the catalyst for the rest of the chapter.

not mine alone: it drives the philosophy of existentialists, and much of both Eastern and Western religious thought.[72] My anxiety may have deep-seated evolutionary origins, and it even seems to be shared by other animals. Will there ever be a solution to this common fear?

The advancement of science and technology in the past half-century is opening up unprecedented horizons. The world is transforming, everything is changing—not only in terms of the way we live, but also in terms of how long. With science and technology increasingly pushing back the frontier of death, is it possible that the "death of death" will be fulfilled in the distant future? (Cordeiro & Wood 2018; Kurzweil 2005; Wood 2016). There is a distinguished group of authors who proclaim the advent of the Singularity, where the evolution of *Homo sapiens* will be directed by ourselves (Harris 2007: Ch. 1). The Singularity refers to the point in time when all the advances in science and technology will cause unimaginable biological, cultural, and social changes, impossible to predict or understand before this event. In the Singularity, there will be no distinction between human and machine, or between physical and virtual world. Raymond Kurzweil (2005) suggests that we think about the way in which technology has evolved over the past 100 years and project it into the future: there will be an exponential growth of diverse forms of technological progress after which the meaning of human life will be radically different—better than now. In this future, we will conquer the fear of an inevitable death by eliminating the inevitability of death itself. Many of the defenders of the Singularity typically endorse some version of TH.

TH is an anthropological, philosophical, political, scientific-technological, social, and even religious way of thinking about the transformation of human beings. It provides opportunities by developing emerging technologies to

[72] I do not deny that this debate would be radically different for an atheist compared to someone who believes in an afterlife. For the former, death is the end of our life. For the latter, death is only the end of our biological and earthly life before entering another plane of existence. My arguments hold for any rational person, regardless of their spiritual beliefs or lack thereof.

extraordinarily enhance ourselves—in many ways.[73] TH will enable our society to be healthier, longer-lived, and smarter, capable of selecting from a wide range of enhanced attributes and new traits. Bostrom, Kurzweil, Anders Sandberg, or David Wood, among others, present possible advantages and disadvantages—that is to say, benefits and risks—of these emerging technologies that could go beyond traditional conditions in terms of cognition, longevity, or physical performance—as well as morality. Their premise is that human beings at present do not enjoy the best of all possible states of existence. Thus, the human condition is questioned, it is no longer sacrosanct as some essentialists have defended (Kass 2003; Fukuyama 2002; Sandel 2007). On the basis of their optimistic vision of future technology, they want to free human beings from our biological chains, including death (Bostrom 2014; Kurzweil 2005; Wood 2016). Transhumanists justify this vision based on the assurance that technology is growing faster than we could have ever imagined, and it offers a new range of infinite possibilities and powers. In other words, today's science-fiction is a glimpse at tomorrow's reality. But what kind of world does technology have in store for us?

5.1.2. Digital Immortality: The Transhumanist Dream

In a recent philosophical paper on life extension, Larry Temkin (2008) wonders whether living longer is inherently living better. In this chapter, I begin with the claim that I want to live longer, regardless of whether that means living better than I do now. This starting point raises a significantly different question in this dissertation: does wanting to live longer entail wanting to live forever? (cf. Agar 2010; Fischer 1994; Gems 2003; Lucke & Hall 2006; Pijnenburg & Leget 2007; Preston & Dixon 2007; Williams 1973).

From the perspective of TH, living longer is the first step towards the ultimate goal of conquering death. This perspective envisions no limits to

[73] There is an extensive academic literature about the ideas defended by transhumanists in which the arguments for and against are exhaustively reviewed. These authors do not consider themselves bioconservatives, but they analyze, criticize, or reflect on central aspects of this movement (Agar 2010; Buchanan 2011; Diéguez 2017; Hauskeller 2013; Overall 2003; Roduit 2016; see more briefly, (Moya 2016; Hauskeller 2019).

humanity's ability for continuous enhancement. Furthermore, the destruction of the biosphere will not be an obstacle to our survival, if the form of immortality that the Singularity offers is not biological. For some transhumanists, while the body is simply "jelly" (Moravec 1989: 117), our minds may be uploaded into a computer (which is eternally functional) and, in this way, achieve digital immortality. Transhumanists claim that our hardware, like the human body, will be disposable. What will remain in perpetuity is our software i.e. our minds digitalized, even enhanced by future technology. We will be able to transfer our ideas or memories into virtual world in which we will live better than we live now. David Chalmers explains destructive mind uploading as follows:

> It is widely held that this may be the first form of uploading to be feasible. One possible form involves serial sectioning. Here one freezes a brain, and proceeds to analyze its structure layer by layer. In each layer one records the distribution of neurons and other relevant components, along with the character of their interconnections. One then loads all this information into a computer model that includes an accurate simulation of neural behavior and dynamics. The result might be an emulation of the original brain. (2010: 42)

TH (implicitly) defends destructive mind uploading because the biological chains are entirety gone by this point. The idea of digital immortality is a form of life extension in which we would live forever and never die. The result might look like an avatar behaving, thinking, and reacting like a person on the basis of that person's digital archive. In this line, Kurzweil (2005: Ch. 7) considers that digital immortality is forever as long as someone takes care of the information. In a very strict sense, even this immortality would not be absolute. Some may claim that this transhumanist purpose of immortality would never be possible. Imagine that our digital selves are erased by a computer virus or the heat-death of the universe. However, I approach digital immortality as if it were a possibility for complete immortality: life without an end, with "life" no longer being tied to biological limitations. In contrast to digital immortality, indefinite life is a form of life extension in which humans have already cured aging but they can die from external causes, such as accidents, dehydration, or murder, among other possibilities (Glannon 2002a). Life is (potentially) forever, in biological terms.

Even though life extension technology offers us the possibility to live longer, even forever, we would remain vulnerable to the possibility for life to end, as "life" is tethered to biology.[74]

In my view, immortality is a hypothetical scenario for which imagination is necessary because of the absolute lack of scientific-technological evidence. Thus, *immortality is neither an expected nor a realistic result of treating aging*. What is more, an extreme longevity, similar to Methuselah's life (969 years), does not imply that one can live forever. The objective of this rest if this chapter is to reject the alleged dream of immortality. My structure will be as follows: in §5.2, I will present an amendment to the immortalist fallacy (IF), inspired by Hauskeller's approach (2013). In §.5.3, I will review strong philosophical critiques of this transhumanist purpose of immortality in the literature: the hard problem of consciousness and the personal identity dilemma. Finally, in §5.4, I will conclude the chapter by suggesting a specific type of indefinite life derived from §5.1 and justified by §5.2 that it could be more desirable than our current limited life. Thus, I will argue that this does not only change our concept of "death", but also our concept of "life".

[74] Nicholas Agar makes a distinction between a zero and non-zero immortality, or "negligible senescence", as in Aubrey de Grey's project. Following Agar's words: "There's actually a big difference between immortality and negligible senescence. Whereas a negligible senescence being is *likely* to have a longer life span than a senescing one, an immortal being is *guaranteed* to. Immortal beings have a zero probability of dying over any future period of time. Negligible senescent beings have, in contrast, a nonzero probability of dying with each year that passes. The difference between them and us as we are now is that this probability does not increase" (2010: 113). Broadly speaking, we refer to the same distinction. However, I prefer to call it "indefinite life" because I argue that death is possible beyond the cure of aging. Even with a clear explanation, many people could still understand it wrong if I referred specifically to immortality. Complementarily, see some key differences between the cure for aging and the Singularity (de Grey 2015), or between the roadmap to human life extension and immortality (de Magalhães 2014).

§5.2. The Immortalist Fallacy: An Amendment to Hauskeller's Approach

5.2.1. A Logical Error?

Everyone wants to enjoy as much time as possible with their loved ones, as long as their cognitive and physical capacities are tolerable, broadly speaking. Many of us want more time for other purposes as well, like cooking international food, playing music, reading classic novels, visiting exotic countries, and watching cult movies, among other things. From this perspective, living longer could be better for humans.[75] However, there are two groups of authors who question whether adding more years of life, including quality of life in those years, would be desirable. The bioconservatives ask why our mortality is not enough (Callahan 1997; Kass 2003). By contrast, many transhumanists doubt that there is anyone who rejects the dream of immortality (Bostrom 2008; Kurzweil 2005). Now, I discuss that most radical view of the life extension possibilities: living forever and never dying.

Transhumanists argue that any significant extension of life we would turn us into better humans, in the sense that we would be better off than we are now. They assume that we appreciate being alive (life is good) and that we do not want to die (death is bad). Bostrom uses these premises to construct his main argument: (1) people "normally" appreciate being alive; (2) accordingly, they "normally" desire not to die; (3) they also have an (implicit) desire to have their life spans indefinitely extended; and (4) thus, they normally desire to live (potentially) forever (2008: 113-118).[76] Bernard Williams, in his famous seminal

[75] I assume a welfarist concept of living better. This concept entails several changes in anthropology, biology, morality, or psychology, which "increase the chances of leading a good life in the relevant set of circumstances" (Savulescu et al. 2011: 16). I do not believe that the meaning of life can be considered by religious or traditional doctrines. The defenders of "moral is better" justify that a good life is one that is led within a community that guides one's path (notably, Kass 2003).

[76] Bostrom uses these four premises for his main argument although only three of them are necessary: (1), (2), and (4). However, the incorporation of premise (3) does not modify the main argument.

chapter on immortality, reached a similar conclusion: "wanting something itself gives one a reason for avoiding death" (1973: 85). I assume an intermediate position in the debate between bioconservatives and transhumanists, but in order to establish it I first have to answer these two questions: (1) "Do we never want to die?"; and (2) "Do we want to live forever?". A useful starting point is Hauskeller's approach (2013), which argues that Bostrom commits what he calls the IF in making his four-step arguments:

> [T]his argument, plausible as it may seem at first sight, is misleading, because it is based on the premise that we (normally) do not want to die, which is then taken to imply that we *do* want live forever (i.e. have an implicit desire for indefinite life extension). Yet this conclusion is in fact not warranted. If you ask people whether they want to die, most of them will indeed deny it. However, if you ask, the *same* people whether they want to go on living forever, you may find that most will deny this too (…). People do normally appreciate being alive and accordingly desire not to die that they also have an (implicit) desire to have their lifespans indefinitely extended, that is, to live (potentially) forever. It is quite possible that a person does not want to die and still does not want to live forever. On the face of it his seems to be a blatant contradiction. How can we at the same time not want to die *and* not want to live forever? Obviously, if you do not die you will live forever and the only way to avoid living forever is to die. (2013: 89-90)

Hauskeller uses his critique of Bostrom's argument to reject the alleged dream of immortality. He argues that there is no logical entailment between the claim that "people (normally) do not want to die" and "people (normally) want to live forever".[77] In my view, the key to dismantling Bostrom's argument is the qualifier of the premise: "normally". My position does not only serve as an amendment to Hauskeller's approach, but also as a distinct framework to reject the dream of immortality of transhumanists. I will develop my own approach in §5.3, and more concretely, in §5.4.

[77] Hauskeller deduces it from common sense since there are not empirical data. Similarly, I will discuss this subject philosophically without citing any statistical data.

That a person does not "normally" want to die does not imply that the same person does not ever want to die (i.e. in the future). To clarify Hauskeller's approach, I propose a philosophical turn from "normally" to "under these circumstances". What does "normal" or "normally" mean for Bostrom or Hauskeller in the IF? They do not clarify whether it is "ideally", "generally", "naturally", "most of the time", or "most people". There are many possible meanings which would substantially change the argument. I understand "under these circumstances" as the anthropological, historical, psychological, political, and social context according to which every individual makes a claim about the IF. I do not want to die *under these circumstances* perhaps something that we all think by living a limited life now implies an implicit desire to live forever *under these circumstances*. This implicit desire to live forever is conditioned by two reasons: (1) I want to be alive today; and (2) I do not want to die today. I respond to the IF in my present. I cannot know what I would say in my future *under other circumstances*.[78] The fear of death justifies my desire to live indefinitely, more than anything else.[79]

Hauskeller thinks about the IF as a mortal human being, like any of us. Moreover, Bostrom and Kurzweil remain human beings, beyond their optimistic vision of future technology. They remain locked in the chains of biology. Death is the "inevitable destiny" of transhumanists if their dream does not come true. All of us are in the same scenario and we all project a future world that spans beyond our current limited life. The substantial difference between us is the new world that we want now. Thus, this reflection depends strongly on the context of every individual. I take a metaphysical step from Hauskeller's approach since I consider two possible scenarios in the IF: (a) the people being described are mortal; and (b) the people being described are already immortal. For me, Hauskeller's question, i.e. "How can we at the same time not want to die and not

[78] In other words, what I am saying is that it is incoherent to have any opinion about the attractiveness of living forever, or even of living to 1000, or only 100, because it is axiomatic that whether one wants to die now (or soon) or not depends on one's perceived quality of life at this given time and in the future.

[79] Pointing out that the fear of death and that death is bad is not the same question (cf. Williams 1973).

want to live forever?" (2013: 90) should be substituted by the statement: "We can under different circumstances not want to die and not want to live forever". I propose dissolving the contradiction by showing different responses in these opposing scenarios. We can desire or reject the alleged dream of immortality, but we do it under current circumstances, according to which our life is limited and death is possible.

In the first scenario, in which we are mortals, we are delaying the hands of the clock. Time is against us and death will come eventually. In the second scenario, in which we are already immortal, we would live without having to look at the clock. The clock does not exist anymore. In the first scenario, death is the "inevitable destiny" because mortal beings are all condemned to die, no matter how long we are able to delay our end. In the second scenario, death could be a "salvation" if it were the only way to move beyond our temporal existence. Otherwise, life would be a prison from which we could never escape. According to Hauskeller's approach, death would not always be something bad. Here, I defend the same ideas exposed by this author. However, living forever is not necessarily undesirable either, as I will defend in §5.3 and §5.4.

5.2.2. Is Death Always Bad?

I have amended Hauskeller's approach to the IF to suggest that where he qualifies his claims with "normally", it would be better to say "under these circumstances". Now, I evaluate the concept of "death" from my previous division between mortals and immortals. I follow Hauskeller's approach. As he says:

> Yet even if we should decide that death is indeed an evil, non-death (or living forever) need not be a good. From the fact that a person does not want to die it follows neither that (a) death is an evil to them, nor that (b) living forever is a good to them. If this were a valid argument, which it is not, then we could just as easily conclude from the fact that a person does not want to live forever, that, to them, (a) life is an evil and (b) dying is a good. (2013: 99)

Like Hauskeller, I strongly argue that the desire to live forever does not the imply desire not to die. The philosophical turn from "normally" to "under these circumstances" also shows how death could be "bad" or "good" depending on the context of every individual. For many people, the case of a persistent vegetative state is an example of a situation in which death might be considered a "salvation" rather than is "inevitable destiny". There is nothing in the desire not to die that infers that living forever is inherently desirable. The question is conditioned by the type of life that we would live.[80] Bioconservatives and transhumanists are not debating on the same matter. In other words, they are too divergent to engage with each other. The former will forever want us to accept death since life has always been limited. The latter will always want to conquer death since they desire immortality. In other words, Williams argued that "death is said by some not to be an evil because it is not the end, and by others, because it is" (1973: 83). Following Hauskeller's approach, but incorporating my amendment, I present the concept of death in the IF:

1. That a person does not want to die does not imply that either (a) death is bad to this person, or that (b) living forever is a good to this person. That a person does not want to die implies that this person wants to avoid it under a specific set of circumstances. That a person does not want to die implies that this person to be alive under these circumstances, but not that this person wishes to be immortal.

2. That a person does not want to live forever does not imply that either (a) life is bad to this person, or that (b) death is a good to this person. That a person does not want to live forever implies that this person wants to die but only under a specific set of circumstances. That a person does not want

[80] In the previous case the decisive reason was physical health. There are examples where the most influential factors are culture and time. Hara-kiri, is the classic Japanese ritual suicide by disembowelment. Samurai voluntarily stuck a dagger into their stomachs so as not to fall into the hands of the enemy or to atone for dishonor, or for a failure. Intolerable mental illness would be another example.

to live forever implies that this person wants to be alive today, but not forever.

Death is not essentially "bad" or "good", "undesirable" or "desirable"—and neither is life. I have proposed that whether death is seen as an "inevitable destiny" or as a "salvation" depends entirely on the circumstances of a person's life. Someone who is happy with the good experiences that life can provide may have compelling reasons to want to keep having those experiences indefinitely—or at least until they no longer seem so good.

However, someone could say that death could be avoided is only if we wished to (there would always be a way out).[81] In this vein, I will explain what I call the obligatory nature of immortality in TH. Taking this as a baseline, I will defend my own concept of death related to the IF. Similarly, I will present my concept of "life" according to this obligatory nature of immortality in §5.4. First, the Singularity is the point in time at which all the advances in technology will change the world as we know it today. This event will affect all humans without exception (Kurzweil 2005: Ch. 1). In other words, transhumanists seem to assume that all these changes will be universally accepted and integrated into daily life. In this line, I completely agree with João Pedro de Magalhães, who advocates that the Singularity will be inevitable (2004: 87). Second, digital immortality through destructive mind uploading would guarantee one could live forever and never die. Would technological suicide be possible? For these transhumanists, it is rather strange to end life when we have conquered death technologically after centuries. Kurzweil says that if we take care of the information, we will never die. Could we choose to totally cease to exist after our upload? Or is the choice out of our hands at that point? Someone could also consider that this possibility implies that the only true form of immortality would be an indefinite life. According to the above, I justify what I have presented previously in relation to the IF: (1) death is the "inevitable destiny" in our current limited life; and (2) death would be the

[81] I owe this suggestion to Alfredo Marcos. Because of this, I have incorporated what TH really shows at this point.

"salvation" in immortality only if it were possible. And transhumanists seem to disagree with one scenario in which death could be optional.

I have started my discussion with this question: "Do you never want to die?". From my point of view, it is a really abstract and subjective question. Rather, we should ask: "Do you never want to die under the current circumstances?". Along this line, John Harris says: "most people fear death, and the prospect of personal extended life-span is likely to be welcomed" (2000: 59). Absolutely. Transhumanists promise to live forever because they know that the fear of death would entail the acceptance of any type of life. Anything would be better than nothing for them. These authors consider that the IF to be meaningless, and conceptualize only a single scenario in which they conquer death and live forever. Thus, I have already presented a possible solution to the first question at the beginning of this section: "Do we not want to die?". No. Broadly speaking, and under tolerable circumstances, today we want to be alive. Tomorrow life itself might show us a world that we may prefer to escape through death. One of the most impossibilities is to predict how events in our lives will unfold from one day to the next.

Having shown the logical error from the perspective of individual desire, I take one metaphysical step. If wanting to live forever were our desire, would mind uploading be possible? Would future technology solve all the challenges of digital immortality?

§5.3. Arguments to Reject Digital Immortality

5.3.1. Strong Philosophical Critiques

I have presented my amendment to Hauskeller's approach to the IF (§5.2). Now, I consider it useful to review the critiques of the dream of immortality that are raised in the literature. Transhumanists have already shown all the (possible) benefits that mind uploading would have—and how it would improve people's lives in all aspects. For instance: (1) people could create multiple avatars of themselves to accomplish their goals; (2) people could enjoy unimaginable

pleasures for our senses; (3) people could save an emergency copy of their profiles; or (4) people with terminal diseases could live better and longer. However, I point out different problems that this type of "life"[82] could pose for us in the distant future. Everything is speculative, but I also think a scenario not as desirable as the one proposed by transhumanists. From this perspective, it is not only about the individual desire to want to live forever but also about whether this desire can be fulfilled technologically. *Transhumanists imagine what they would like to happen. Where there is a will, there is (not always) a way*. Perhaps this (great) difficulty is what really concerns transhumanists. Thus, I argue that there are strong reasons to show that the transhumanist goal is not an easy one.

By "strong" critiques, I am referring to those that directly undermine the very concept of digital immortality. Not surprisingly, there are serious difficulties in meeting this objective from a technological perspective. Here, I follow the ideas of Chalmers (2010) who argues that there are two key issues in the mind uploading debate: the hard problem of consciousness and the personal identity dilemma. Thus, my rejection of digital immortality is related to these two questions: (1) "Will an uploaded version of me be conscious?"; and (2) "Will I, upon uploading, still be me?". The concept of mind that Bostrom (2008) or Kurzweil (2005) defend is quite widely discussed in neuroscience and philosophy (notably, Diéguez 2017: Ch. 2). They assume that the mind is something analogous to software, to an information pattern that can be transferred to different hardware and function correctly. Consciousness would be one of those functions, such as the ability of my laptop to monitor its own functionality, to distinguish self from non-self by identifying computer viruses, and to understand voice commands. However, many authors show that this is a reduced version of who we are and that we hardly know what consciousness is—besides, we are not certain at all that it is everything that makes us who we are. Even supposing that consciousness were not a problem, the personal identity dilemma would still be present. For instance, if I could make copies of my mind, or I could transfer it to a silicon device, nothing would guarantee me that "he",

[82] Would a copy in a virtual would be "life" as we understand it now? For this reason, I have used quotation marks.

"she", or "that" is myself (see Agar 2010; Hopkins 2012; Pigliucci 2014). Agar presents this dilemma in relation to different possible scenarios after the uploading. In short:

> There are two possible consequences of uploading. The advocates of strong AI think that the computers we are uploaded into are capable of conscious thought. If Kurzweil is right, you will not only survive, but your powers of thought will be radically enhanced. If the doubters are right, then uploading is a nothing more than a novel way to commit suicide. (2010: 63)

We would try to avoid death by uploading our minds into a machine, but we could die in the process. If this is the case, then destructive mind uploading would just be a sophisticated way to end our lives. Even more, I suggest that we are afraid of death but we are not aware that we could face an even more fearful future. *The most frightening monsters are not dragons or witches; they are those that we cannot yet imagine*. There is a third possible scenario besides mind uploading as a way to end our lives or the transhumanist success: we have survived our mind uploading but neither us nor the world around us is what we really wanted. In this vein, de Magalhães proposes a similar idea when he says that:

> Due to the both creative and destructive nature of the human mind, the dilemma is whether the technological singularity will be a bridge to wonderland or if it will mean the end of human civilization. (2004: 85)

This nightmare of immortality characterizes the possible scenario resulting from TH in which we would be obliged to accept not only all the technological changes of the Singularity, but also the impossibility of ceasing to exist. After the Singularity, the type of life that we would live would be radically different from our current ones, and according to TH, these new lives would be much better than anything that we can dream of. Now, we imagine our lives projected towards a vague, abstract idea of finality, knowing we are mortal (complementarily, Kitcher 2014: 99-100). A serious for everyone to consider would be: "Do you know *enough* of what mind uploading would be like (that is, a digital immortality) to say "yes" to the transhumanist dream?".

Typically, only the two extreme options of the debate are presented for consideration by the wider society: essentialist mortality (Fukuyama 2002; Kass 2003) and digital immortality (Bostrom 2008; Kurzweil 2005). However, it is possible that most people unknowingly hold an intermediate position like the one that Hauskeller and I have described previously. Based on my amendment to the IF, they would want to keep living indefinitely as long as they can live under their current circumstances. They would not want to live forever because they can imagine themselves under other circumstances in which they would rather die. The probability of seeing paradise on Earth is the same as that of seeing hell. What is more, they are not two sides of a coin since we do not even know whether there are two or more options.

Hauskeller thinks that many people want to live forever simply because they imagine a radically different future (2013: 100). From my perspective, there is an assumption that in the future we will live better than now. TH seems to consider only the success of destructive mind uploading, but it is also possible that life in the future could be more unbearable anything we could ever imagine. I would like to live a life in which I recognized myself. Kurzweil (2005) states that life will be better than now after the Singularity. We will have a brain and body beyond the limits of biology. This is what he calls Transcendence. He wants our existence to be as we need it and want it at any time. We will be the ones to create ourselves. Some human beings would want to have a different avatar every day; others would reject being able to imagine that they are angels and that they were born with feathered wings on their backs. Transhumanists want immortality, but they are mortal. They, and all of us, will be released from their biological chains after the explosion of the Singularity. They just need to be patient.[83] However, what type of life we would live without death?

[83] The transhumanist perspective actually claims to want this vision of the future, rather than merely starting that "this is the inevitable future towards which we are headed". The prediction of a certain future does not necessarily imply that this is what one wants. For many others, there is a very large gap between the future that may lie ahead and what they would really want.

§5.4. The Defense of a Specific Type of Indefinite Life

5.4.1. Changing the Concepts of "Death" and "Life"

In §5.3, I have presented strong critiques to reject the alleged dream of immortality. The fact that transhumanists want to live forever does not imply that they can, at least today. Now, I will defend my own approach. One of the questions which started my argumentation was: "Do you want to live forever?". In the literature, this question has also appeared as follows: "Is more life is always better?" (Gems 2003).

I say that it depends on many factors. Following my argument that the desire for ongoing life is context-dependent, most people will want to keep living if the set of circumstances is ideal for them; for instance, if they can continue to live with their loves ones and under cognitively and physically tolerable conditions. Upon assessing my current circumstances, today I would answer: yes, more life is indeed better. Nevertheless, I am sure that there could be a time when my circumstances change so much that I would not want to continue to endure them. If a digital immortal existence were ultimately boring or oppressive, I might desire to end it rather than endure it forever. I defend that the answer to the question will always be both personal and temporary—and contingent on the context. Not everyone wants the same thing, nor does one person want the same thing from day to day. And it is difficult, if not impossible, for the person who wants to live to understand the perspective of a person for whom death is desirable. At the same time, no one knows for sure whether they will ever change their desire to live, or to die. I could not assume the answer of another person since the desire to die or live is entirely personal. The only question that I can possibly answer is whether I myself would prefer to keep living rather than die under the current circumstances. From my view, absolutely. I do not want to die today. I probably will not want to die tomorrow either. The fear of death is present in my current limited life. Does this imply my desire to live forever? Not really, as I will explain below.

The question is not only about the value of changing the concept of "death" but also the concept of "life". Not being able to die, one of the greatest milestones that humans dream of, implies a radical modification of what we understand by our existence as humans. TH promises to evade the "inevitable destiny" of death through an optimistic vision of future technology. However, what would be the price? According to my amendment to Hauskeller's approach, we think about overcoming death from our finitude, but we also project the type of life we would like to live in the future. Now, if we were immortal would we want a similar life to the current limited one, in terms of our interests and values? It seems that, in one way or another, we would like to prolong a state of joy to infinity. We do not want what we do not know, what is beyond the limits of our mind, although this may be better. Our concept of "life" depends on who we are—it is the view from where we stand, so to speak. In other words, if we were not *Homo sapiens*, or even something similar, it is entirely possible that the concept of "life" would not exist—or at least, not in its current form. Enjoying certain activities or dreaming of a better future is specifically human. One question this raise is whether as a transhuman we would retain the same desire for immortality that we have as humans. TH takes one metaphysical step further by detaching itself from the biological body. If we cannot achieve the desired digital immortality, there is no reason to be uploaded. We would like to admire the sunset at Oriental Bay, cook Asian food, play the piano, read *The Divine Comedy*, or, watch *Blade Runner 2049* once again. In this dystopian movie, Ryan Gosling walks through a desolate and demolished planet Earth where all our omens have come true. However, this very pessimistic future is imaginable for us. Thus far, we project a life that is similar to the one that we live today. All of these activities would be possible in a virtual world as long as the upload is a success of TH.

I argue that it is impossible to know whether I would carry out all of these activities in a way that is similar to what I want under current circumstances. I would like to keep living if and only if the type of life that I would lead were not radically different from the current limited life that I enjoy today. Now, would I want my mind to be in a virtual world or something like that? Kurzweil (2005)

considers that the meaning of life is to appreciate and create a kind of knowledge which improves itself to direct us towards a higher "order". Therefore, death is a tragedy if a person's information is lost in time. True immortality would only be possible if we uploaded our mind into a computer. I do not claim that meaning of the life as envisioned by TH is the desire of all humans. Immortality is the dream of some people. Where they say "we", they should say "I", or "my colleagues".[84]

I defend a change in the concepts of "death" and "life" as follows: if X is death and Y is life, humans only worry about X without thinking that Y changes when X disappears. The interdependence between X and Y is so strong that we cannot imagine a world without X in which Y is still Y. A world without X in which Y is still Y is impossible because X does not exist anymore. Therefore, a world without X forces us to think of a world where Y becomes Y'. Transhumanists promise us a world without X in which Y' will be radically different from Y (i.e. after the explosion of the Singularity). From the TH perspective, we should not fear Y' for two reasons: (1) we would accept Y' since it is the consequence of the conquest of X; and (2) we would accept that Y' is not simply the consequence of the conquest of X, but also the possibility of living better than our current limited Y. However, if Y' does not practically resemble Y at all, is it worth conquering X? Most of society might want Y without X, but is it known that Y' will in no way resemble our Y? Is it possible to imagine a life without death? For TH, absolutely. Answering Gems' question, one could say that a longer life is not always a better life.

5.4.2. What Do I Want Now?

Now, let me confess what my dream is. I imagine a life free of aging and other diseases that limit my activities, plans, projects, and time with my loved ones; a life in which I would (potentially) live forever because I want to keep living indefinitely. However, I cannot give an answer as to how many years I would

[84] On many occasions, it has been pointed out that the dream of TH is a personal desire (cf. Diéguez 2017).

like to live. 10 more years? 100 more years? 200 more years? 1000 more years? Maybe, I would say, a little more for now.[85] There are open horizons of possibilities which I would still like to explore. If you ask me in a distant future, in which the transhumanist purpose has come true, my answer would surely be different. I am afraid to close my eyes and not be able to open them once again, but what if, in a dystopian scenario, I was afraid of never being able to close them and always having to continue looking at a terrifying world?[86] I imagine that nobody finds it desirable to die for what is known as external causes: accidents, dehydration, or murder, among other possibilities. I, under current circumstances, would not want to die from any of the above. I defend committing suicide so that "under other circumstances" we can free ourselves from life. I convert into a virtue what for TH is a sign of weakness: the biological body. The fact of having it gives us the possibility to die both when we do not want and when we want to. One could desire life extension without desiring immortality. On some occasions, one must sacrifice something to obtain something else.

Following my previous reflection, I fear X but I am aware that without X, I could not keep Y, at least as I know Y today. I do not defend a static Y because my circumstances are changing day after day. Y would change radically if I were in a vegetative state tomorrow. It is a Y recognized by me and those around me. I do not accept an unknown Y' just to avoid X. What is more, I do not give up X to have an "eternal" Y'. Therefore, I do not accept what TH defends: the desirability of uploading our minds into a computer.[87] First, this desire is quite improbable to achieve in the future. Second, if it were real, this type of existence implies something unknown that many people would not necessarily want. It is not, in other words, an inherent desirability.

[85] My current circumstances are optimal in all aspects of my life. Even in this section I argue that one can answer this question only for oneself.

[86] This comment is not meant to taken literally. As I have shown in several sections, we may not have eyes after the Singularity.

[87] I would understand that a person on their deathbed would think the following: "Before I die, I will upload myself. I have little to lose and something to gain". But then again, this refers to a specific set of circumstances that influences the desire (deathbed, rather than peak of health).

This specific type of indefinite life that I think humans should seek lies between our current limited life and the dream of immortality: we would be assuming that it would be optional to want to keep living, that death would be avoidable for a certain time, and that it would be reversible, since we would have a "salvation". We could continue adding years of life, but, on the other hand, we would be die (unless there are external causes) the ones who we decide if we want to die. Even in the case of bioconservatives, this gives them the possibility of living their mortality to a certain extent. It seems to me, that this might indeed be the central point of the argument: what does one want, to live forever? No. To die? Also no. What is desired is the ability to *decide to end.*

My current concern is not wanting to die. Death is the end of my life. My desire is not to face the moment in which I will lose everything. I do not want to live forever and I reject the transhumanist dream. How can I accept what I can hardly imagine? If it were possible, I would want to live better as long as my life had a very similar meaning as it has today.[88] These are my conditions, my set of circumstances, under which I accept the idea of an unending life. Everything would change under other circumstances. This is what I have called the specific type of indefinite life. Significantly different from destructive mind uploading of transhumanists. Significantly different from the sacrosanct life of bioconservatives.

I believe that I have satisfactorily answered the IF discussed by Hauskeller. Nevertheless, I need some more time to think about it.[89]

[88] I have always been seduced by J.R.R. Tolkien's vision of elven immortality: they do not die of diseases or show the serious effects of aging like humans. However, they are exposed to war wounds, and more surprisingly, they can get bored of their own lives (and even "die of grief"). This would be the end that I would want for my own existence. When the time comes, I would decide for myself that I no longer want to live. I wish to have a placid death beyond dependencies, and weaknesses. Something like not waking up from a dream.

[89] I owe this reflection to Eric Juengst during my research stay at UNC.

§5.5. Concluding Remarks

In this chapter, I have analyzed and discussed the transhumanist dream of immortality. First, I have suggested an amendment to Hauskeller's approach of the IF. The key to disambiguating the IF is the imprecise premise "normally". I propose a philosophical turn towards context-dependency, so that the desire to live is considered to be dependent on the circumstances of every individual. The answer will be different if (a) we are still mortal; and (b) we are already immortal. The value of death is related to these circumstances. Second, I have reviewed strong critiques against mind uploading in the literature. Two great challenges about mind uploading were presented by Chalmers (2010): the problem of consciousness and the personal identity dilemma. According to the above, digital immortality could be a nightmare for humans. Death would be a "salvation" when we do not want to live forever, if and only if this were possible. Otherwise, the immortality will no longer be so much of a dream. Finally, I have argued in favor of a specific indefinite life which is more desirable than our current limited life. I would like to enjoy a life in which I would recognize myself, my loved ones, and the world where I live. Would there be anything better than deciding when is a good time to die? Once those things are no longer possible, my current fear of death should fade into acceptance and I would be released from this fear.

Chapter 6. Global Summary: Treating Aging. Living Healthier as Long as Possible, but Not Forever

This is the end of my journey. This is the start of my academic life. This dissertation was a philosophical analysis about life extension. My argument for pragmatism has been based on its capacity to clarify whether aging is a disease, I have defended the development of AATs according to the current shift in biogerontology, and I have claimed that this is the kind of stance that ought to be adopted if we want to promote a healthier life. Taking the debate one step further, I have discussed the possibility of living longer if this does not imply an improvement in the quality of life.[90] Furthermore, I have rejected any attempt to aspire to the alleged dream of immortality for distancing itself from any scientific progress within the realm of possibility.

Thus, the next scientific challenge should be how to maintain a high level of functioning of our cognitive and physical capacities as long as possible, while minimizing the years of dependence, disability, and weakness. This proposal does not seek that we live a better old age, but rather that our entire existence be healthier. The scientific community has shifted its research priorities away from medicine's traditional approach in order to treat the aging process itself. It is not simply the desire of biogerontologists to improve people's health, but also to use scientific advancements to change what we can expect from our lifetime. My study, therefore, produces a change in the way we see aging and its possible treatment.[91]

[90] Remembering my statement from the end of chapter 3: "Do not add years of life if we cannot add life to those years".

[91] I owe a great part of my bioethical concerns to the conversations with the members of my research group in Granada, led by Francisco Lara. I would also like to thank Suzanne Day's involvement in this dissertation by showing me many sociological implications of my own work. In this vein, we will develop a project on the following questions: "Do people expect that science is actively trying to find ways for us to live forever?" (de Grey 2009; Juengst et al. 2003; Lucke & Hall 2005; Lucke et al. 2010; Partridge et al. 2009; Pijnenburg& Leget 2007; Ribeiro et al. 2008; Stock et al. 2007; Turner 2004); "In the triad disease, illness, and sickness, what will be the

§6.1. What I Have Achieved Using the Pragmatist Approach

In this final chapter, I want to address what might seem like the loose ends of this dissertation. Mainly, I propose a connection between all the chapters from a common thread. It is now time to draw some general ideas from my contribution, regardless of everything that I have discussed with reference to many philosophers and scientists in previous sections. Moreover, will I highlight a series of texts which have helped me to think about each of the ideas of this dissertation. In this vein, I have been inspired many times by de Aubrey de Grey's thought, who, despite being controversial in his statements, has a rigorous knowledge of aging, of possible interventions in humans, and, of which scenarios would be the most desirable from multiple perspectives.

The whole project has been nourished by the nature of my philosophical concerns that I have learned during my PhD studies. When one is immersed in the scientific literature, one can fall into the error of forgetting one's true philosophical motivations.[92] Many times, one's motivation becomes obfuscated reading about AATs and trying to assess how promising they are instead of rethinking how useful they can be for their own philosophical analysis.

conceptualization of aging and the relationship between the three components?" (Boyd 2000; Casado da Rocha & Etxeberria 2014; Hofmann 2002, 2013, 2016; Saborido 2020; Susser 1990); and "Would extended life be boring?" (Beglin 2017; Bortolotti & Nagasawa 2009; Davis 2018; Fischer 1994, 2005; Scheffler 2013; Temkin 2008; Williams 1973). These types of discussions will be a new line in my future research.

[92] This project has researched some of the most important conceptual problems in regarding to aging and life extension. I have not discussed all the discrepancies issues among scientists. Instead, I have asserted what I can do as a philosopher and what my limits are. Anecdotally, a common question from the public has been: "What can I do to live better and more?" And I have always answered the following: "I am not a physician but a philosopher who studies medicine. For any advice in that regard, you should ask your medical specialist". I mainly owe the help provided to John Dupré, Javier González de Prados, Gregor Greslehner, Cristian Saborido, Javier Suárez, and David Teira, among other philosophers.

Within this framework, the project has achieved a twofold goal. First, it has diagnosed the theoretical commitments that underlie the question of whether aging is a disease. At this stage, I would like to clarify a point. I have never said—and would never dare to do so—that the other philosophers and scientists that have responded to this question were not proposing a successful answer, or that they were not proposing it properly or rigorously. Rather, I intend to say something completely different: many of the authors who have asked questions about the nature of aging have not taken into account the difficulty of the concept of disease in the literature (i.e. the philosophy of medicine). My purpose was to investigate which were the theoretical assumptions that underlie the question of whether aging is a disease. It is now a good moment to restate de Grey's advice:

> First: Is aging a disease? Some gerontologists will just tell you, "No, it is separate from age-related diseases." Some will say, "No, but it is a risk factor for age-related diseases." Some will say, "No, it is the set of precursors of the age-related diseases." Some will say, "Yes, it is the set of precursors of the age-related diseases"! Self-evidently, whether X is a Y depends not only on the definition of X but also on the definition of Y, so one might excuse this chaos on the basis of a failure to agree on what is and is not a disease—and there is indeed no such agreement. But it gets worse. (2013: 89)[93]

According to the above, I have always responded to this question from a knowledge of both X and Y. In addition, I have shown how important it is to not only to theoretically define aging but also to highlight how beneficial it would be to include it in the medical agenda.[94]

After that, I have shown how there are already experiments in model organisms that are involved in treating the aging process itself rather than its

[93] Despite defending this viewpoint, he does not engage in a debate about defining disease. To be honest, since my review on this issue, this has only been investigated by Arthur L. Caplan (2005), Gunnar de Winter (2015), and Thomas Schramme (2013).

[94] Another issue for a new line of research concerns whether the conceptualization of aging as a disease is sufficient for its inclusion in the medical agenda. I would like to investigate what other factors are necessary for this purpose.

secondary causes. The pragmatist approach shows how, although we do not yet have all the possible theoretical knowledge, there is enough to develop AATs for humans. This is the transition from basic biology of aging to a new medical practice. In other words, what really matters is that these contribute to reducing the serious effects of aging on people's lives. These AATs are understood as a hypothetical picture that is logical, useful, and realistic as a future possibility for addressing aging, although they cannot be yet precisely defined.[95] The success of the treatment begins simply with the intervention in the disease itself, regardless of whether or not it works at first. As I have already mentioned with regard to the case of cancer and chemotherapy, it is quite common that the first phases do not turn out to be as effective as one would like. Therefore, AATs would be equivalent to "decelerating aging", two sides of the same coin.[96]

Secondly, I have proposed an alternative for thinking about life extension possibilities.[97] On numerous occasions, the overcoming of the MDLS has been discussed as one of the greatest challenges of biogerontology. By contrast, I have pointed out that adding years to life should not be a scientific goal if these are not accompanied by health. That is to say, I have argued that the first objective must be to provide control and protection against the broad spectrum of ARDs. In the best-case scenario, life would be extended. But I would never defend the opposite scenario, which is coincidentally what is happening in the most developed countries: we live longer but we have a few years with a very low quality of life. Of course, I wonder: in many contexts would this not be surviving more than anything else? Along these lines, de Grey says that:

> I feel strongly that only by the accumulation of irrefutable data of this sort will the Tithonus error be truly corrected. Any effort by publicly funded sources to

[95] At this point, I wanted to add that there is a strong personal interest in making these types of treatments more effective.

[96] I have never claimed that those who defend other types of research goals—i.e. a possible cure against aging—are not doing science. What I have argued is that their optimism is greater than mine. This differs widely from totally speculative proposals (cf. Cordeiro & Wood 2018; Kurzweil 2005).

[97] Facing the weak and strong life extension division (see chapter 3).

> support, hence legitimize, intervention in aging is a step forward, but most such efforts do not powerfully challenge the Tithonus error. The idea of focusing our explicit goals on lifespan rather than healthspan certainly sounds, at first hearing, like a remarkably poor way to challenge the Tithonus error; but we have more than half a century of experience teaching us that the more obvious approach is ineffective, whether commercially or politically. (2008: 714)

This does not mean living longer, but rather living under the best conditions for a larger proportion of one's lifetime. Based on that, the lives of many human beings could be more desirable, enabling them to achieve whatever goal they want. I have defended a shorter life than my country's life expectancy if this life is accompanied by a high level of functioning of or cognitive and physical capacities. I have even taken it one step further by affirming that I'd prefer to die earlier if I can save myself from a biological decline so severe that it prevents me from developing the kind of life that I want. I have defended a modest but plausible revolution—similar to the development of antibiotics and vaccines, or to the improvements in terms of hygiene in the last century. Today, there is no doubt that all these milestones have made our lives different, in the sense that we do not only live longer than before, but also under better conditions and with more years of good health.

After discussing whether living longer is better, one wonders if we want to live forever. At the end of this section, I will show that a critical position in this debate is in line with some stances in the philosophical discussion on TH, such as the one defended by Antonio Diéguez.

§6.2. Influence of Diéguez's Approach

The end of his journey had a point of departure. The final part of my dissertation is meant to be a continuation of the work developed by Diéguez (2017), at least in some philosophical points. He has always defended a critical position in relation to TH. I summarize his words as follows: "this is what you promise, but

you should present more serious ideas to me, and only then I will begin to believe everything you say" (cf. Bostrom 2014; Cordeiro & Wood 2018; Kurzweil 2005).[98]

His arguments are well directed against those vague thoughts, which have flourished in this discipline, and as such his position has been fundamental to the central questions of my dissertation. There are some interesting ideas in TH, but one of the complicated tasks is to know which ones to keep as tangible and which ones to discard as speculation when all of them seem to be intermingled in a hypothetical wish box. Furthermore, Diéguez's conceptual clarification in terms of weak spots, ordering of the ideas of other researchers, and his strong rejection of everything that is more science fiction than real science, is noteworthy. In sum, Diéguez provides an exhaustive examination of everything said so far from the perspective of someone who does not believe that the promises of TH are so desirable.

In this chapter, I have used Diéguez's approach to warn against transhumanists' tendency to distort the realities of scientific advancement. This movement prevents the results of biogerontologists from being more visible, simply because the news that they offer are much more encouraging and innovative. In other words, transhumanists are generating illogical and unrealistic illusions (i.e. the "death of death") and attracting followers to join their cause with great enthusiasm, but they will not be able to give them anything in return. Undoubtedly, my proposal, based on the Diéguez's approach, is more modest and surely less spectacular. This is the point where I would like to stress the "preventive" character of Diéguez's approach by putting fundamental values such as the conception of human beings, their body, and their relationship with the world before any possible technological development, however desirable this could be.

Similarly, my proposal is based on a series of perspectives that I share with Diéguez. Briefly, they are: (1) case-by-case evaluation; (2) common sense against

[98] In other words, a strong skepticism about the technological optimism of these authors.

personal interests; (3) priorization of population goals over individual achievements; and (4) application of scientific-technological evidence. Each of these perspectives has been used in this dissertation.

In this sense, my commitment has been to offer a new point of view, philosophically speaking. Diéguez has developed a theoretical framework which contains an interesting battery of questions and I have selected several of them to answer. He has drawn many lines on the ground, and I have followed the ones that I have considered the most promising.

My aim has been to argue that Diéguez's critical approach could be translated a real alternative to the current status quo. It is perhaps my youth that has pushed me to take many of his ideas to propose something more personal. A new generation also brings fresh ideas which contrast with much of what has already been discussed in the literature. My contribution to this debate is not based on purely theoretical knowledge, but also on how it has decisively influenced my current lifestyle on multiple levels (cf. Blasco & Salomone 2016; Longo 2018).

In order to conclude with the influence of Diéguez's approach, I would like to comment on the following excerpt, since it is the one that has inspired me the most throughout these pages. In his words:

> I don't know anyone who doesn't want to live more than 100 years, maybe 150 (as long as it is in a good physical and mental condition, that is, prolonging youth, not old age). This life extension, in addition, does only belong to the field of science-fiction, such as mind uploading into a computer, but it is something that real science says it can achieve. But would we want to live ten thousand, or one hundred thousand, or ten million years? Are we even able to make an informed judgment about something like that, when it is impossible to just imagine it? Is immortality a supreme goal which deserves everything else to be sacrificed? Is it worth it to live a life indefinitely without giving or receiving sincere love, surrounded by people with whom the deepest ties—even those of paternity or

> maternity—are long lost, no matter how many emotional substitutes can be provided through technological procedures? (2017: 199)[99]

First of all, everything seems to support what Diéguez says in the first sentence of this excerpt. However, it always depends on the circumstances of each person, the wish to live today or the wish to die. Undoubtedly, it does not only depend on the maintenance of our cognitive and physical capacities, but also on whether our lives are extended along with those of our loved ones. The answer to the question "Do you want to live longer?" is always context-dependent; it is "yes" as long as they and I are looking forward to living longer.

Second, we always want to prolong the conditions of youth and not those conditions associated with the decline experienced in old age; that is, sustaining biological adulthood for the longest possible time.[100] This does not imply that the values acquired with age, such as temperance or wisdom, would be lost, but simply that one's biological age would not coincide with one's chronological age. A better end of life will only be possible as long as we have been healthier during the previous years.

Finally, it is unquestionable that transhumanist immortality entails a series of serious problems and that few people would wish for a life that they cannot imagine. This is something very different from thinking that we have a reduced existence. Rather, it is the opposite, without having to fall into the trap of TH. I

[99] This is the original in Spanish: "No conozco a nadie que no quiera vivir más de 100 años, quizás 150 (siempre que fuera en buenas condiciones físicas y mentales, es decir, prolongando la juventud, no la vejez). Este alargamiento de la vida, además, no pertenece solo al ámbito de la ciencia ficción, como el volcado de la mente en un ordenador, sino que es algo que la ciencia real dice poder alcanzar. Pero ¿queríamos vivir diez mil, o cien mil, o diez millones de años? ¿Somos siquiera capaces de formular un juicio informado sobre algo así, cuando es imposible tan solo imaginarlo? ¿Es la inmortalidad un objetivo supremo por el que merece sacrificarlo todo? ¿Vale la pena vivir indefinidamente una vida sin dar ni recibir amor sincero, rodeados de personas con las que los vínculos más profundos—hasta los de paternidad o maternidad—hace tiempo que se perdieron, por muchos sustitutos emocionales que puedan proporcionarse mediante procedimientos tecnológicos?" (2017: 199).

[100] Colloquially it is commonly said that one wants to have all the good things about youth with the mentality of a person who has already had many experiences in life.

have always advocated a life similar to ours but that remains as human as we want it to be. The transhumanist dream collides with many of our fundamental ideas of what a better life would be like, so it seems that we should calmly take this movement. That is why Diéguez says "I hope that the things continue like this much longer" (2017: 203).[101] It seems logical that he is living his life keeping in mind that he does not want it to end. He simply wants to enjoy a good book and drink an excellent wine on a terrace watching a beautiful sunset.

I wonder whether deciding my time to die, after a life with a high level of functioning of my cognitive and physical capacities, would not be the most beautiful way to end my existence. In an elven sense, as I quoted previously, even if it were extended almost to infinity, I would eventually say: "I have lived enough". All stories have an ending, and I want the ability to write my own one.

[101] This is the original in Spanish: "Espero que la cosa continúe así mucho más tiempo" (2017: 203).

Bibliography

A

Adair, F. E., & Bagg, H. J. (1931). Experimental and clinical studies on the treatment of cancer by dichlorethylsulphide (mustard gas). *Annals of Surgery*, 93(1): 190-199.

Agar, N. (2010). *Humanity's End: Why We Should Reject Radical Enhancement*. Cambridge, MA: MIT University Press.

Agar, N. (2013). *Truly Human Enhancement: A Philosophical Defense of Limits*. Cambridge, MA: MIT University Press.

Agar, N. (2015). *The Sceptical Optimist: Why Technology Isn't the Answer to Everything*. Oxford: Oxford University Press.

Arking R. (1998). *Biology of Aging*. Sunderland, MA: Sinauer.

B

Beglin, D. (2017). Should I choose to never die? Williams, boredom, and the significance of mortality. *Philosophical Studies*, 174(8): 2009-2028.

Bengtson, V. L., & Settersten Jr., R. (eds.). (2016). *Handbook of Theories of Aging*. New York: Springer.

Blasco, M. A. (2005). Telomeres and human disease: Ageing, cancer and beyond. *Nature Reviews Genetics*, 6(8): 611-622.

Blasco, M. A., & Salomone, M. (2016). *Morir joven, a los 140.* Barcelona: Paidós.

Boorse, C. (1976). Wright on functions. *Philosophical Review*, 85(1): 70–86.

Boorse, C. (1977). Health as a theoretical concept. *Philosophy of Science*, 44(4): 542-573.

Bortolotti, L., & Nagasawa, Y. (2009). Immortality without boredom. *Ratio*, 22(3): 261-277.

Bostrom, N. (2005a). A history of transhumanist thought. *Journal of Evolution and Technology*, 14(1): 1-25.

Bostrom, N. (2005b). The fable of the dragon tyrant. *Journal of Medical Ethics*, 31(5): 273-277.

Bostrom, N. (2008). Why I want to be a posthuman when I grow up. In B. Gordijn and R. Chadwick (eds.). *Medical Enhancement and Posthumanity* (pp.107-136). Dordrecht: Springer.

Bostrom, N. (2014). *Superintelligence: Paths, Dangers, Strategies*. Oxford: Oxford University Press.

Bostrom, N., & Roache, R. (2008). Ethical issues in human enhancement. In J. Ryberg (ed.). *New Waves in Applied Ethics* (pp. 120-152). New York: Palgrave Macmillan.

Boyd, K. M. (2000). Disease, illness, sickness, health, healing and wholeness: Exploring some elusive concepts. *Medical Humanities*, 26(1): 9-17.

Brigandt, I. (2009). Natural kinds in evolution and systematics: Metaphysical and epistemological considerations. *Acta Biotheoretica*, 57(1-2): 77-97.

Brigandt, I. (2010). The epistemic goal of a concept: Accounting for the rationality of semantic change and variation. *Synthese*, 177(1): 19-40.

Buchanan A. E. (2011). *Better than Human: The Promise and Perils of Enhancing Ourselves*. Oxford: Oxford University Press.

Buffenstein, R. (2005). The naked mole-rat: A new long-living model for human aging research. *The Journals of Gerontology Series A: Biological Sciences and Medical Sciences*, 60(11): 1369-1377.

Bulterijs, S. et al. (2015). It is time to classify biological aging as a disease. *Frontiers in Genetics*, 6: 205.

Brunet-Rossini, A. K., & Austad, S. N. (2004). Ageing studies on bats: A review. *Biogerontology*, 5(4): 211-222.

C

Callahan, D. (1997). Living to be 100: Good or bad? *Journal of Applied Gerontology*, 16(3): 267-269.

Callahan, D., & Topinkova, E. (1998). Is aging a preventable or curable disease? *Drugs & Aging*, 13(2): 93-97.

Caplan, A. L. (2005). Death as an unnatural process: Why is it wrong to seek a cure for ageing? *EMBO Reports*, 6(1): 72-75.

Caplan, A. L. (2017). How can aging be thought of as anything other than a disease? In T. Schramme and S. Edwards (eds.). *Handbook of the Philosophy of Medicine* (pp. 233-239). Dordrecht: Springer.

Casado da Rocha, A., & Etxeberria, A. (2014). Towards autonomy-within-illness: Applying the triadic approach to the principles of bioethics. In H. Carel and R. Cooper. *Health, Illness and Disease* (pp. 69-88). New York: Routledge.

Charlesworth, B. (2000). Fisher, Medawar, Hamilton and the evolution of aging. *Genetics*, 156(3): 927-931.

Chalmers, D. J. (2010). The singularity: A philosophical analysis. *Journal of Consciousness Studies*, 17(9-10): 7-65.

Christensen, K. et al. (2009). Ageing populations: The challenges ahead. *The Lancet*, 374(9696): 1196-1208.

Cooper, R. (2002). Disease. *Studies in History and Philosophy of Science Part C: Studies in History and Philosophy of Biological and Biomedical Sciences*, 33(2): 263-282.

Cordeiro, J. L., & Wood, D. (2018). *La muerte de la muerte. La posibilidad científica de la inmortalidad física y su defensa moral.* Barcelona: Ediciones Deusto.

Cutas, D.E. (2008). Life extension, overpopulation and the right to life: Against lethal ethics. *Journal of Medical Ethics*, 34: e7

D

Davis, J. K. (2005). Life-extension and the malthusian objection. *The Journal of Medicine and Philosophy*, 30(1): 27-44.

Davis, J. K. (2018). *New Methuselahs: The Ethics of Life Extension*. Cambridge, MA: MIT University Press.

Dawkins, R. (2006). *The God Delusion*. New York: Houghton Mifflin Company.

de Grey, A. D. (2003). The foreseeability of real anti-aging medicine: Focusing the debate. *Experimental Gerontology*, 38(9): 927-934.

de Grey, A. D. (2004). Escape velocity: Why the prospect of extreme human life extension matters now. *PLoS Biology*, 2(6): 726-730.

de Grey, A. D. (2005). Life extension, human rights, and the rational refinement of repugnance. *Journal of Medical Ethics*, 31(11): 659-663.

de Grey, A. D. (2008). Combating the Tithonus error: What Works? *Rejuvenation Research*, 11(4): 713-715.

de Grey, A. D. (2009). Cracks in social gerontology's pro-aging edifice. *Rejuvenation Research*, 12(1): 1-2.

de Grey, A. D. (2013). The desperate need for a biomedically useful definition of "aging". *Rejuvenation Research*, 16(2): 89-90.

de Grey, A. D. (2015). The Singularity and the Methuselarity: Similarities and differences. In B. Goertzel and T. Goertzel (eds.). *The End of the Beginning: Life, Society, and Economy on the Brink of Singularity* (pp. 151-169). San José: Humanity+ Press.

de Grey, A. D., & Rae, M. (2007). *Ending Aging: The Rejuvenation Breakthroughs that Could Reverse Human Aging in Our Lifetime*. New York: St. Martin's Press.

de Magalhães, J. P. (2004). Alice's dilemma. *Futures*, 36(1): 85-89.

de Magalhães, J. P. (2014). The scientific quest for lasting youth: Prospects for curing aging. *Rejuvenation Research*, 17(5): 458-467.

de Magalhães, J. P. (2015). The big, the bad and the ugly. *EMBO Reports*, 16(7): 771-776.

de Winter, G. (2015). Aging as disease. *Medicine, Health Care and Philosophy*, 18(2): 237-243.

Dennett, D. (1995). *Darwin's Dangerous Idea*. London: Penguin.

Diéguez, A. (2017). *Transhumanismo: La búsqueda tecnológica del mejoramiento humano*. Barcelona: Herder.

Diéguez, A. (2019). ¿Podremos vencer a la muerte? *Pasajes: Revista de pensamiento contemporáneo*, 57: 6-17.

Dong, X., B. Milholland, & J. Vijg. (2016). Evidence for a limit to human lifespan. *Nature*, 538(7624): 257-259.

Dupré, J. (1993) *The Disorder of Things: Metaphysical Foundations of the Disunity of Science*. Cambridge, MA: Harvard University Press.

E

Ereshefsky, M. (2009). Defining 'health' and 'disease'. *Studies in History and Philosophy of Science Part C: Studies in History and Philosophy of Biological and Biomedical Sciences*, 40(3): 221-227.

F

Faragher, R. G. (2015). Should we treat aging as a disease? The consequences and dangers of miscategorisation. *Frontiers in Genetics*, 6: 171.

Finch, C. E., & Hayflick, L. (1977). *Handbook of the Biology of Aging*. New York: Van Nostrand Reinhold.

Fischer, J. M. (1994). Why immortality is not so bad. *International Journal of Philosophical Studies*, *2*(2): 257-270.

Fischer, J. M. (2005). Free will, death, and immortality: The role of the narrative. *Philosophical Papers*, 34(3): 379-403.

Fukuyama, F. (2002). *The Posthuman Future: Consequences of the Bio-Technological Revolution*. New York: Farrar, Straus & Giroux.

G

Gavrilov, L. A., & Gavrilova, N. S. (2018). Is aging a disease? Biodemographers' point of view. *Advances in Gerontology*, 8(2): 123-124.

Gavrilov, L. A., V. N. Krut'ko, & N. S. Gavrilova. (2017). The future of human longevity. *Gerontology*, 63(6): 524-526.

Gems, D. (2003). Is more life always better?: The new biology of aging and the meaning of life. *Hastings Center Report*, 33(4): 31-39.

Gems, D. (2011a). The problem of aging: To treat, or not to treat? *American Scientist*, 99: 278-280.

Gems, D. (2011b). Tragedy and delight: The ethics of decelerated ageing. *Philosophical Transactions of the Royal Society B: Biological Sciences*, 366(1561): 108-112.

Gems, D. (2014). What is an anti-aging treatment? *Experimental Gerontology*, 58: 14-18.

Gems, D. (2015). The aging-disease false dichotomy: Understanding senescence as pathology. *Frontiers in Genetics*, 6: 212.

Glannon, W. (2002a). Extending the human life span. *The Journal of Medicine and Philosophy*, 27(3): 339-354.

Glannon, W. (2002b). Indentity, prudential concern, and extended lives. *Bioethics*, 16(3): 266-283.

Glannon, W. (2008). Decelerating and arresting human aging. In B. Gordijn and R. Chadwick (eds.). *Medical Enhancement and Posthumanity* (pp. 175-190). Dordrecht: Springer.

Godfrey-Smith, P. (2015). Pragmatism: Philosophical aspects. In J. Wright (ed.). *International Encyclopedia of the Social and Behavioral Sciences* (pp. 803-807). Oxford: Elsevier.

Goldsmith, T. C. (2006). *The Evolution of Aging: How New Theories Will Change the Future of Medicine*. Crownsville: Azinet.

Golubev, A. G. (2018). Is aging a disease? A biogerontologist's point of view: Senescence≠ disease. *Advances in Gerontology*, 8(2): 127-129.

González de Prado Salas, J. (2018). Whose purposes? Biological teleology and intentionality. *Synthese*,195(10): 4507-4524.

Goosens, W. K. (1980). Values, health, and medicine. *Philosophy of Science*, 47(1): 100-115.

Gruman, G. J. (1966). *A History of Ideas about the Prolongation of Life: The Evolution of Prolongevity Forever Functional Hypotheses to 1800*. (Transactions of the American Philosophical Society, 56). Philadelphia: American Philosophical Society.

Gyngell, C. (2015). The ethics of human life extension: The second argument from evolution. *The Journal of Medicine and Philosophy*, 40(6): 696-713.

H

Habermas J. (2003). *The Future of Human Nature*. Cambridge, UK: Polity Press.

Hamilton, W. D. (1966). The moulding of senescence by natural selection. *Journal of Theoretical Biology*, 12(1): 12-45.

Harris, J. (2000). Intimations of immortality. *Science*, 288(5463): 59.

Harris, J. (2007). *Enhancing Evolution: The Ethical Case for Making People Better*. Princeton: Princeton University Press.

Hauskeller, M. (2013). *Better Humans?: Understanding the Enhancement Project*. Durham, NC: Routledge.

Hauskeller, M. (2019). Ephemeroi-human vulnerability, transhumanism, and the meaning of life. *Scientia et Fides*, 7(2): 9-21.

Hayflick, L. (1998). How and why we age. *Experimental Gerontology*, 33(7-8): 639-653.

Hayflick, L. (2000). The future of ageing. *Nature*, 408(6809): 267-269.

Hayflick, L. (2007). Biological aging is no longer an unsolved problem. *Annals of the New York Academy of Sciences*, 1100(1): 1-13.

Hesslow, G. (1993). Do we need a concept of disease? *Theoretical Medicine*, 14(1): 1-14.

Hirsch, J. (2006). An anniversary for cancer chemotherapy. *JAMA*, 296(12): 1518-1520.

Hofmann, B. (2001). The technological invention of disease. *Medical Humanities*, 27(1): 10-19.

Hofmann, B. (2002). On the triad disease, illness and sickness. *The Journal of Medicine and Philosophy*, 27(6): 651-673.

Hofmann, B. (2013). Ethical challenges with welfare technology: A review of the literature. *Science and Engineering Ethics*, 19(2): 389-406.

Hofmann, B. (2016). Disease, illness, and sickness. In M Solomon, J. R. Simon and H. Kincaid (eds). *The Routledge Companion to Philosophy of Medicine* (pp. 16-26). New York: Routledge.

Holliday, R. (2006). Aging is no longer an unsolved problem in biology. *Annals of the New York Academy of Sciences*, 1067(1): 1-9.

Hopkins, P. D. (2012). Why uploading will not work, or, the ghosts haunting transhumanism. *International Journal of Machine Consciousness*, 4(01): 229-243.

Horrobin, S. (2006). Immortality, human nature, the value of life and the value of life extension. *Bioethics*, 20(6): 279-292.

Hughes, B. G., & S. Hekimi. (2017). Many possible maximum lifespan trajectories. *Nature*, 546(7660): E8-E9.

Hughes, J. (2004). *Citizen Cyborg: Why Democratic Societies Must Respond to the Redesigned Human of the Future*. Cambridge, MA: Westview Press.

J

Janac, S., B. Clarke, & D. Gems. (2017). Aging: Natural or disease? A view from medical textbooks. In A. M. Vaiserman (ed.). *Anti-Aging Drugs: From Basic Research to Clinical Practice* (pp. 11-34). Croydon: The Royal Society of Chemistry.

Juengst, E. T. et al. (2003). Biogerontology, "anti-aging medicine," and the challenges of human enhancement. *Hastings Center Report*, 33(4): 21-30.

K

Kass L. (2003). *Beyond Therapy: Biotechnology and the Pursuit of Happiness*. New York: Harper Collins.

Keane, M. et al. (2015). Insights into the evolution of longevity from the bowhead whale genome. *Cell Reports*, 10(1): 112-122.

Kirkwood, T. B. (1977). Evolution of ageing. *Nature*, 270(5635): 301-304.

Kirkwood, T. B. (1999). *Time of Our Lives: The Science of Human Aging*. Oxford: Oxford University Press.

Kirkwood, T. B., & Austad, S. N. (2000). Why do we age? *Nature*, 408(6809): 233-238.

Kirkwood, T. B., & Holliday, R. (1979). The evolution of ageing and longevity. *Proceedings of the Royal Society of London B*, 205(1161): 531-546.

Kitcher, P. (1978). Theories, theorists, and theoretical change. *The Philosophical Review*, 87(4): 519-547.

Kitcher, P. (2014). *Life after Faith. The Case for Secular Humanism*. New Haven: Yale University Press.

Kurzweil, R. (2005). *The Singularity Is Near: When Humans Transcend Biology*. New York: Penguin.

L

Laplane, L. et al. (2019). Opinion: Why science needs philosophy. *Proceedings of the National Academy of Sciences*,116(10): 3948-3952.

Legg, C., & Hookway, Ch. (2019). "Pragmatism". In Edward N. Zalta (ed.), forthcoming. *The Stanford Encyclopedia of Philosophy*. URL =<https://plato.stanford.edu/archives/spr2019/entries/pragmatism/>.

Lemoine, M. (2013). Defining disease beyond conceptual analysis: An analysis of conceptual analysis in philosophy of medicine. *Theoretical Medicine and Bioethics*, 34(4): 309-325.

Lennox, J. G. (1995). Health as an objective value. *The Journal of Medicine and Philosophy*, 20(5): 499-511.

Longo, V. (2018). *The Longevity Diet: Discover the New Science behind Stem Cell Activation and Regeneration to Slow Aging, Fight Disease, and Optimize Weight*. New York: Avery.

Longo, V. D. et al. (2015). Interventions to slow aging in humans: Are we ready? *Aging Cell*, 14(4): 497-510.

López-Otín, C. et al. (2013). The hallmarks of aging. *Cell*, 153(6): 1194-1217.

Lucke, J. C., & Hall, W. (2005). Who wants to live forever? *EMBO Reports*, 6(2): 98-102.

Lucke, J. C., & Hall, W. (2006). Strong and weak lifespan extension: What is most feasible and likely? *Australasian Journal on Ageing*, 25(2): 58-62.

Lucke, J. C. et al. (2010). Anticipating the use of life extension technologies. *EMBO Reports*, 11(5): 334-338.

M

Marck, A. et al. (2017). Are we reaching the limits of Homo sapiens? *Frontiers in Physiology*, 8: 1-12.

Marfany, G., & Soley, M. (2013). *¿Por qué envejecemos? La respuesta de la ciencia a una vieja preocupación humana*. Barcelona: Edicions Universitat Barcelona.

Marion, R. et al. (2009). Telomeres acquire embryonic stem cell characteristics in induced pluripotent stem cells. *Cell Stem Cell*, 4(2): 141-154.

Maynard Smith, J. (1962). Review lectures on senescence-l. The causes of ageing. *Proceedings of the Royal Society of London. Series B. Biological Sciences*, 157(966): 115-127.

Medawar, P. B. (1952). *An Unsolved Problem of Biology*. London: Lewis.

Medawar, P. B. (1955). The definition and measurement of senescence. In G. E. W. Wolstenholme and M. P. Cameron (eds.). *Ciba Foundation Colloquia on Ageing* (pp. 4-15). London: Churchill.

Millikan, R. G. (1989). In defense of proper functions. *Philosophy of Science*, 56(2): 288-302.

Mitchell, S. (2003). *Biological Complexity and Integrative Pluralism*. Cambridge, MA: Cambridge University Press.

Moody, H. R. (2001). Who's afraid of life extension? *Generations*, 25(4): 33-37.

Moody, H. R. (2002). *Aging: Concepts and Controversies*. Thousand Oaks, CA: Sage.

Moravec, H. (1989). *Mind Children*. Cambridge, MA: Harvard University Press.

Moskalev, A. A. (2018). Is aging a disease? A genetist's point of view. *Advances in Gerontology*, 8(2): 125-126.

Moskalev, A. A. et al. (2017). A review of the biomedical innovations for healthy longevity. *Aging (Albany NY)*, 9(1): 7-25.

Moya, A. (2016). Hombres y cyborgs. *Ludus Vitalis*, 15(28): 227-230.

Mukherjee, S. (2010). *The Emperor of All Maladies: A Biography of Cancer*. New York: Scribner.

Muñoz-Lorente, M. A., A. C. Cano-Martin, & M. A. Blasco. (2019). Mice with hyper-long telomeres show less metabolic aging and longer lifespans. *Nature Communications*, 10: 4723-

Murphy, T. F. (1986). A cure for aging? *The Journal of Medicine and Philosophy*, 11(3): 237-255.

Myakotnykh, V. S. (2018). Is aging a disease? A geriatrician's point of view. *Advances in Gerontology*, 8(2): 130-131.

N

Neander, K. (1991). Function as selected effects: The conceptual analyst's defense. *Philosophy of Science*, 58(2): 168-184.

Nordenfelt, L. (1987). *On the Nature of Health: An Action-Theoretic Approach*. Dordrecht: Reidel.

Novoselov, V. M. (2018). Is aging a disease? *Advances in Gerontology*, 8(2): 119-122.

O

Oeppen, J., & Vaupel, J. W. (2002). Broken limits to life expectancy. *Science*, 296 (5570): 1029-1031.

Olshansky, S. J., & Carnes, B. A. (2002). *The Quest for Immortality*. New York: W. W. Norton & Company.

Olshansky, S. J., B. A. Carnes, & C. Cassel. (1990). In search of Methuselah: Estimating the upper limits to human longevity. *Science*, 250(4981): 634-640.

Olshansky, S. J., L. Hayflick, & B. A. Carnes. (2002). No truth to the fountain of youth. *Scientific American*, 286(6): 92-95.

Overall, C. (2003). *Aging, Death, and Human Longevity: A Philosophical Inquiry*. Berkeley, CA: University of California Press.

P

Papac, R. J. (2001). Origins of cancer therapy. *The Yale Journal of Biology and Medicine*, 74(6): 391-398.

Partridge, B. et al. (2009). Ethical, social, and personal implications of extended human lifespan identified by members of the public. *Rejuvenation Research*, 12(5): 351-357.

Pigliucci, M. (2014). Mind uploading: A philosophical counter-analysis. In R. Blackford and D. Broderick (eds.). *Intelligence Unbound: Future of Uploaded and Machine Minds* (pp. 119-130). Oxford: Wiley- Blackwell.

Pijnenburg, M. A. M., & Leget, C. (2007). Who wants to live forever? Three arguments against extending the human lifespan. *Journal of Medical Ethics*, 33(10): 585-587.

Preston, T. M., & Dixon, S. (2007). Who wants to live forever? Immortality, authenticity, and living forever in the present. *International Journal for Philosophy of Religion*, 61(2): 99-117.

R

Rantanen, R. (2014). Is considerable life extension an enhancement? *Global Bioethics*, 25(2): 103-113.

Rattan, S. I. (2005). Anti-ageing strategies: Prevention or therapy? *EMBO Reports*, 6(S1): S25-S29.

Reznek, L. (1987). *The Nature of Disease*. London: Routledge and Kegan Paul.

Roduit, J. A. (2016). *The Case for Perfection: Ethics in the Age of Human Enhancement*. London: Peter Lang Pub Incorporated.

Rose, M. R. (1994). *Evolutionary Biology of Aging*. Oxford: Oxford University Press.

Rozing, M. P., T. B. Kirkwood, & R. G. Westendorp. (2017). Is there evidence for a limit to human lifespan? *Nature*, 546(7660): E11-E12.

S

Saborido, C. (2014). New directions in the philosophy of biology: A new taxonomy of functions. In C. Galavotti, S. Hartmann, M. Weber, W. J. González, D. Dieks and T. Uebel (eds). *New Directions in the Philosophy of Science* (pp. 235-251). Cham: Springer.

Saborido, C. (2020). *Filosofía de la medicina*. Barcelona: Tecnos.

Saborido C., & Moreno, A. (2015). Biological pathology from an organizational perspective. *Theoretical Medicine and Bioethics*, 36(1): 83-95.

Saborido C. et al. (2016). Organizational malfunctions and the notions of health and disease. In E. Giroux (ed.). *Naturalism in the Philosophy of Health: Issues and Implications* (pp. 101-120). Cham: Springer.

Sandel, M. J. (2007). *The Case Against Perfection*. Cambridge, MA: Harvard University Press.

Savulescu, J., A. Sandberg, & G. Kahane. (2011). Enhancement and well-being. In J. Savulescu, R. ter Meulen and G. Kahane (eds.). *Enhancing Human Capacities* (pp. 3-18). Oxford: Wiley-Blackwell.

Schramme, T. (2013). 'I hope that I get old before I die': Ageing and the concept of disease. *Theoretical Medicine and Bioethics*, 34(3): 171-187.

Scheffler, S. (2013). *Death and the Afterlife*. New York: Oxford University Press.

Smith, S. L. (2017). War! What is it good for? Mustard gas medicine. *CMAJ*, 189(8): E321-E322.

Stock, G., D. Callahan, & A. D. de Grey. (2007). Debate: The ethics of life extension. *Rejuvenation Research*, 10(3): 407-416.

Susser, M. (1990). Disease, illness, sickness; impairment, disability and handicap. *Psychological Medicine*, 20(3): 471-473.

Szasz, T. (1974). *The Myth of Mental Illness: Foundations of a Theory of Personal Conduct*. New York: Harper & Row.

T

Temkin, L. S. (2008). Is living longer living better? *Journal of Applied Philosophy*, 25(3): 193-210.

Turner, L. (2004). Life extension research: Health, illness, and death. *Health Care Analysis*, 12(2): 117-129.

V

Valenzano, D. R. et al. (2015). The African turquoise killifish genome provides insights into evolution and genetic architecture of lifespan. *Cell*, 163(6): 1539-1554.

Varela, E. et al. (2016). generation of mice with longer and better preserved telomeres in the absence of genetic manipulations. *Nature Communications*, 7: 11739.

Vaupel, J. W. (2010). Biodemography of human ageing. *Nature*, 464(7288): 536-542.

Vaupel, J. W., & Kistowski, K. G. V. (2005). Broken limits to life expectancy. *Ageing Horizons*, 3: 6-13.

Vijg, J., & de Grey, A. D. (2014). Innovating aging: Promises and pitfalls on the road to life extension. *Gerontology*, 60(4): 373-380.

Vijg, J., & Le Bourg, E. (2017). Aging and the inevitable limit to human life span. *Gerontology,* 63(5): 432-434.

W

Wakefield, J. C. (1992). The concept of mental disorder: On the boundary between biological facts and social values. *American Psychologist*, 47(3): 373-388.

Wareham, C. (2016). The transhumanist prospect: Developing technology to extend the human lifespan. In G. Scarre (ed). *The Palgrave Handbook of the Philosophy of Aging* (pp. 517-538). London: Palgrave Macmillan.

Weon, B. M., & Je, J. H. (2009). Theoretical estimation of maximum human lifespan. *Biogerontology*, 10(1): 65-71.

Whittemore, K. et al. (2019). Telomere shortening rate predicts species life span. *Proceedings of the National Academy of Sciences*, 116(30), 15122-15127.

Williams, B. (1973). *Problems of the Self*. New York: Cambridge University Press.

Williams, G. C. (1957). Pleiotropy, natural selection and the evolution of senescence. *Evolution*, 11(4): 398-411.

Williams, G. C. (1999). The Tithonus error in modern gerontology. *The Quarterly Review of Biology*, 74(4): 405-415.

Wilmoth, J. R. (1998). The future of human longevity: A demographer's perspective. *Science*, 280(5362): 395-397.

Wood, D. (2016). *The Abolition of Aging. The Forthcoming Radical Extension of Healthy Human Longevity*. London: Delta Wisdom.