

## **Afterlife Beliefs, Life Extension and Gender: Evidence for Life Extension Technologies Reduces Death Thought Accessibility Among Males**

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### **Abstract**

**Purpose:** This study investigates whether reading about Indefinite Life Extension (ILE) can reduce death thought accessibility, particularly among men, as a way to manage death-related concerns. The study aims to explore gender differences in the psychological function of ILE as a terror management strategy. **Methodology:** An experimental design was used, involving 110 American undergraduate students. Participants were randomly assigned to read about ILE, the afterlife, or a neutral technological advance (teleportation) following a mortality salience prime. The primary outcome measured was death thought accessibility (DTA), with gender as a key variable. **Findings:** The results revealed that, after being reminded of mortality, reading about the possibility of ILE significantly reduced DTA among men compared to the control condition. However, this effect was not observed among women, who did not show a similar reduction in DTA after reading about ILE. **Research Implications:** These findings contribute to the growing literature on the terror management function of ILE, highlighting the role of gender in moderating responses to death-related concerns. The study suggests that ILE may serve as an effective strategy for men in managing existential anxiety, whereas women may rely more on traditional beliefs in the afterlife. **Originality/Value:** This study offers new insights into the gender-specific psychological mechanisms underlying the appeal of life extension technologies, expanding the understanding of how different groups use ILE as a tool for managing death anxiety.

**Keywords:** Death; gender differences; immortality; life extension; terror management.

### **Abstrak**

**Tujuan:** Penelitian ini menyelidiki apakah membaca tentang Perpanjangan Umur Tanpa Batas (*Indefinite Life Extension*, ILE) dapat mengurangi aksesibilitas pikiran tentang kematian, terutama di kalangan pria, sebagai cara untuk mengelola kekhawatiran terkait kematian. Studi ini bertujuan untuk mengeksplorasi perbedaan gender dalam fungsi psikologis ILE sebagai strategi manajemen ketakutan terhadap kematian. **Metodologi:** Desain eksperimental digunakan dalam penelitian ini, melibatkan 110 mahasiswa sarjana Amerika. Partisipan secara acak ditugaskan untuk membaca tentang ILE, kehidupan setelah mati, atau kemajuan teknologi netral (teleportasi) setelah diingatkan tentang kematian. Hasil utama yang diukur adalah aksesibilitas pikiran tentang kematian (*Death Thought Accessibility*, DTA), dengan gender sebagai variabel kunci. **Temuan:** Hasil penelitian menunjukkan bahwa setelah diingatkan tentang kematian, membaca tentang kemungkinan ILE secara signifikan mengurangi DTA di kalangan pria dibandingkan dengan kondisi kontrol. Namun, efek ini tidak diamati pada wanita, yang tidak menunjukkan pengurangan DTA setelah membaca tentang ILE. **Implikasi Penelitian:** Temuan ini berkontribusi pada literatur yang berkembang tentang fungsi manajemen ketakutan terhadap kematian dari ILE, dengan menyoroti peran gender dalam memoderasi respons terhadap kekhawatiran terkait kematian. Studi ini menyarankan bahwa ILE dapat berfungsi sebagai strategi yang efektif bagi pria dalam mengelola kecemasan eksistensial, sementara wanita mungkin lebih mengandalkan keyakinan tradisional tentang kehidupan setelah mati. **Orisinalitas/Nilai:** Penelitian ini menawarkan wawasan baru tentang mekanisme psikologis yang spesifik gender dalam menarik minat terhadap teknologi perpanjangan umur, memperluas pemahaman tentang bagaimana kelompok yang berbeda menggunakan ILE sebagai alat untuk mengelola kecemasan terhadap kematian.

**Kata Kunci:** Kematian; perbedaan gender; keabadian; perpanjangan umur; manajemen ketakutan.

## INTRODUCTION

Existential thinkers have long noticed that human beings have an everlasting urge to for immortality and death transcendence (Becker, 1973; Brown, 1959; Greenberg, Pyszczynski, & Solomon, 1986; Kierkegaard, 1980; Solomon, Greenberg, & Pyszczynski, 2015). Religion has been the most prominent satisfier of this urge so far, by providing people with beliefs in *literal immortality* through different afterlife beliefs (Dechesne et al., 2003; Heflick & Goldenberg, 2012; Jackson et al., 2018; Jong, Halberstadt, & Bluemke, 2012; Norenzayan & Hansen, 2006; Vail et al., 2010). But people may also gain protection from a sense of *symbolic immortality* through their offspring, group identifications, personal achievements in art, science, business, politics and so forth and memory in the minds of others which will last beyond their physical demise (Dechesne et al., 2003; Florian & Mikulincer, 1998; Greenberg et al., 1986; Lifshin, Horner, Helm, Solomon, & Greenberg, 2021; Lifton, 1979). In more recent times, scientific advances may provide an alternative way to battle death – by offering the possibility for *indefinite life extension* (ILE) through medical technologies (De Grey & Rae, 2007). However, while this field along with other anti-aging research holds tremendous promise to improve (and potentially save) human lives (Davis, 2016; Partridge, Underwood, Lucke, Bartlett, & Hall, 2009; Schloendrom, 2006), many are sceptical and critical of such efforts, and there are differences in how much such technologies are accepted by the general public (Kogan, Tucker, & Porter, 2011; Lang & Rupprecht, 2019; Pijnenburg & Leget, 2007; Underwood, Bartlett, Partridge, Lucke, & Hall, 2009). Can the possibility for ILE be an adequate immortality strategy that may allow people to manage existential concerns as religious and spiritual beliefs do? Would this new immortality strategy appeal to everyone or only to people who are not already invested in religious immortality strategies (i.e., atheists)?

To begin and answer these questions, studies have examined various factors that may contribute to peoples' acceptance or rejection of ILE technologies (Donner et al., 2015; Partridge, Lucke, Bartlett, & Hall, 2011; Turner, 2004). Two factors that have been found to be related to support for such technologies are level of religiosity and gender.

Religiosity, and belief in the afterlife was found to be inversely related to support for ILE technologies (Ballinger, Tisdale, Sellen, & Martin, 2017; Underwood et al., 2009), especially after being primed with death (Lifshin, Greenberg, Soenke, Darrell, & Pyszczynski, 2018). Furthermore, findings show that an increase in support for ILE after thinking about death was associated with a decrease in belief in the afterlife among less religious people. Thus, although traditional afterlife beliefs and ILE both serve the same psychological purpose of terror management, they may be conflicting or alternative means of achieving protection against death.

Gender, has been consistently found to be predictive of support for ILE, with men, who generally report being less religious than women, also reporting more positive attitudes towards ILE and support these technologies more than women do (Arber, Vandrevalla, Daly, & Hampson, 2008; Barnett & De La Garza, 2022; Barnett & Helphrey, 2021; Lifshin, Helm, Greenberg, Soenke, & Pyszczynski, 2019; Partridge et al., 2011). These differences can be partially explained by higher religiosity among women and higher investment in science by men (Lifshin et al., 2019).

Overall findings provide partial support to the idea that support of ILE technologies can serve a death anxiety buffering function, at least for some people (Lifshin et al., 2018, 2019; Vail, Soenke,

Waggoner, & Mavropoulou, 2020). Terror management researchers may employ various techniques to test if a psychological construct (e.g., self-esteem, belief in the afterlife) serves a death anxiety buffering function (for a review of TMT hypotheses, see, e.g., Schimel et al., (2019)). In the context of indefinite life extension, researchers have used the mortality salience (MS) hypothesis to demonstrate the existential function of support for life extension by showing that priming participants to think about death may increase such support among atheists (Lifshin et al., 2018). Studies also used the anxiety buffer hypothesis to demonstrate how affirming beliefs in the possibility of indefinite life extension can reduce defensiveness after mortality has been primed among atheist participants (Vail et al., 2020).

Another way to examine the existential function of ILE could be by examining if validating it may reduce the accessibility of death-related thoughts to consciousness (DTA: Death Thought Accessibility) after mortality has been salient. Previous studies in the framework of TMT have used this method to demonstrate how affirmation of (immortality providing) cultural worldviews helps the repression of DTA (Arndt, Greenberg, Solomon, Pyszczynski, & Simon, 1997), while threatening these beliefs increases them e.g., Schimel et al., 2019). The more people can strongly adopt immortality beliefs and terror management strategies, the more they can reduce DTA (Lifshin et al., 2021). However, to this date no study has tested the effects of affirmation of the possibility of ILE on DTA.

In the current study, we wanted to further test the impact of information supporting the possibility of ILE on reducing existential concerns, while also considering the possible moderating roles of religiosity and gender. To this end, we experimentally tested if, after mortality is made salient, reading about the possibility of life extension would reduce the cognitive accessibility of death-related thoughts (death thought accessibility; DTA) compared to reading about support for the possibility of an afterlife, or about a neutral technological advance (teleportation). Generally, both reading about either way to feel existence could be lengthened should reduce DTA, but support for ILE should be most effective in reducing DTA for men and for people low in religiosity. Our findings could increase our understanding of the psychological function of ILE, and the possible influence of gender and religious beliefs in support for or objection to ILE research.

## RESEARCH METHOD

Participants were American undergraduate students at a large southwestern university, who completed the study for partial course credit. After removing three participants with procedural errors (one had a suspicion that the manipulation article was fabricated), data from 110 participants were analyzed. This included 76 females and 34 males ( $M_{age} = 18.64$ ,  $SD = 1.30$ ). A sensitivity power analysis indicated that we could detect a medium effect size ( $f = .30$ ) in an ANCOVA with 3 groups and 4 covariates (e.g., religiosity, gender, and potentially age and preexisting attitude towards ILE).

The study was conducted in the fall semester of 2013. Participants entered the lab and completed the study in separate cubicals, where the materials were presented to them on the computer. Upon entry to the lab, the experimenter told the participants that the study was investigating the relationship between different measures of personality, reading preferences and linguistic styles. This was done in order to provide a cover story for the presentation of the articles and for the measure of DTA, and in order to hide the connection between the articles, the mortality salience primes and the dependent variables.

After informed consent was obtained, all participants were exposed to the classic mortality salience induction, and then randomly assigned to read an article that either supports the possibility of ILE ( $n = 36$ ), consciousness after death ( $n = 37$ ) or a technological advance that is not related to death – teleportation ( $n = 37$ ). This was followed by another short passage in order to provide an additional distraction after the

articles, which might have also primed death and might, therefore, require a delay before measuring DTA (Martens, Burke, Schimel, & Faucher, 2011). Then, participants completed a word-completion measure of DTA. After the dependent variable, the participants also completed several filler questions regarding the readings and their literacy preferences to strengthen the cover story. Finally, participants were thoroughly debriefed and probed for suspicion. The materials listed below are in the order they were presented.

**Preexisting Religiosity and afterlife beliefs.** The participant's religious affiliation and the importance of these religious beliefs (1 = *not at all important*, 9 = *extremely important*) were assessed in the mass screening survey several weeks before the time of the experiment. These measures were used in previous terror management and life extension-related research (Lifshin et al., 2018; Lifshin, Greenberg, Weise, & Soenke, 2016; Lifshin et al., 2019). Participants also completed a measure of intrinsic and extrinsic religiosity using the 20-item religious orientation scale (Allport & Ross, 1967). Pre-existing belief in the afterlife was assessed using a 1-item continuous scale ("Do you think that you will live once again after you die [e.g., in a heaven or through reincarnation]?" on 1 = *Certainly not*, 9 = *Certainly yes*) and a 1-item categorical question of belief in an immortal soul ("Do you believe that your soul will live on after you die?" answers were *Yes*, *No*, or *I don't know*) as in previous research (Lifshin et al., 2016, 2019).

**Personality fillers.** To aid the cover story, participants were presented with the 33-item Marlow-Crowne social desirability questionnaire (Crowne & Marlowe, 1960).

**Mortality salience induction.** In order to make mortality salient for all participants, we used the MS prime that is prototypically used in TMT research (Greenberg et al., 1990). Specifically, the participants were asked to "Please briefly describe the thoughts and emotions that the thought of your own death arouses in you" and to "Jot down as specifically as you can, what you think will happen to you as you physically die and once you are physically dead".

**Personality filler and delay.** To further aid the cover story and provide a delay between the MS induction and the dependent measures, participants completed the 60-item PANAS-X (Watson & Clark, 1991) and subsequently the Morningness and Eveningness scale (Horne & Östberg, 1976). This was done in light of research demonstrating that the effect of MS manipulation should be measured after a short delay period between the priming and the dependent variable (Greenberg, Pyszczynski, Solomon, Simon, & Breus, 1994; Pyszczynski, Greenberg, & Solomon, 1999).

**Article manipulations** (see Appendix 1). To manipulate the possibility of ILE, we used the pro-life extension essay and previous related research (Helm, Lifshin, Greenberg, & Pyszczynski, 2022; Lifshin et al., 2018). This article describes how ILE can be achieved in this lifetime. In the control condition, we used a comparable article discussing the evidence for the continuity of the soul (i.e., literal immortality) which was also based on previous terror management research (Dechesne et al., 2003; Vail et al., 2020). Finally, we added a more neutral scientific article that did not discuss death or immortality, but rather the possibility of teleportation technologies. All articles were about the same length and format. Participants were also presented with a neutral non-scientific article that served as a delay and distraction after the manipulation (Appendix 2). At the end of the materials the participants also completed filler questions regarding their liking of the article, how much they think it is several filler questions about their literacy preferences (Appendix 3).

**Death Thought Accessibility (DTA).** To measure the accessibility of death-related thoughts to the participant's consciousness, we used the word fragment completion task, as in past (Greenberg et al., 1994; Martens et al., 2011; Schimel, Hayes, Williams, & Jahrig, 2007). Participants were presented with 20-word fragments and were instructed to complete the fragments with the first word that came to mind. Six of these fragments were designed so that they could be completed with either a neutral or a death word. For

example, one fragment consisted of the letters COFF\_\_ and could thus be completed as COFFEE or as death-related COFFIN. The possible death-related word completions were *buried*, *dead*, *grave*, *killed*, *skull*, and *coffin*. The remainder of the fragments could only be completed as neutral words (see Appendix 4).

## RESULTS AND DISCUSSION

### Preliminary Analysis

A series of preliminary analyses indicated that there were no differences between the experimental groups in gender,  $\chi^2(2) = 2.26, p = .323, \varphi_c = .14$ , soul belief,  $\chi^2(4) = 5.98, p = .201, \varphi_c = .17$ , as well as age, social desirability and the different measures of religious beliefs,  $F_s < 1.64, p_s > .199$ . There was also no difference between the conditions in negative emotions,  $F = 0.05, p = .953$ . There was however a marginally statistically significant in positive emotions,  $F(2, 107) = 2.46, p = .091, \eta_p^2 = .044$ , however, considering that this was measured before the manipulation (after the death prime), it might be due to random error. We nevertheless tested if a positive effect might affect the results.

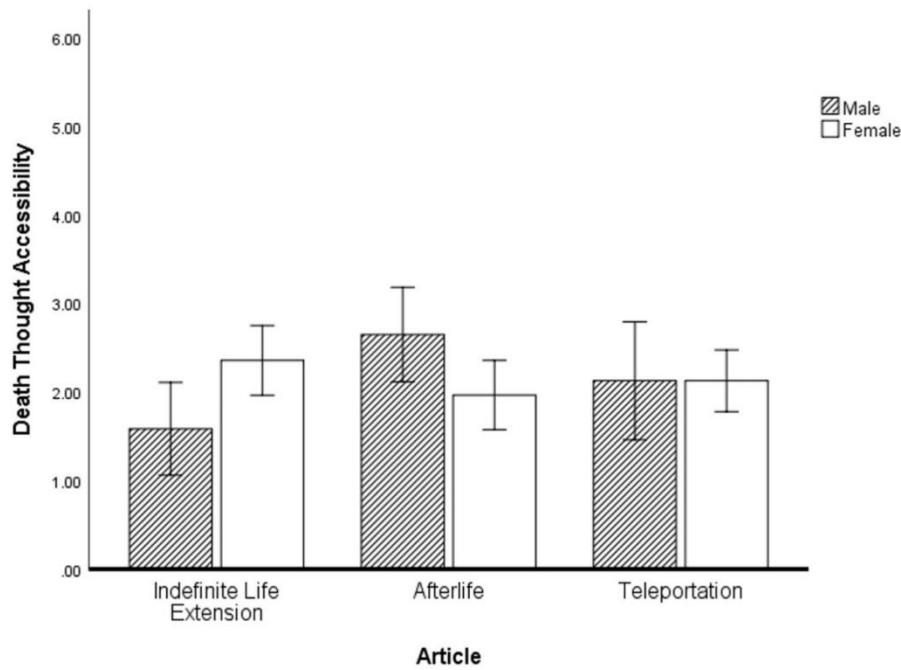
### Primary Analysis

Our first hypothesis was that both the consciousness after death condition and the ILE possible condition would reduce the participants level of DTA compared to the control condition. Our second hypothesis was that males and low religious participants would have lower DTA in the ILE possible condition compared to females and more religious participants, respectively. However, initial analyses indicated that there were no interactions with the different measures of religiosity, and so religiosity was added only as a covariate in the model. Social desirability was also found to be related to DTA, so we also tested it as an additional covariate. Thus, we conducted a 2 (gender: female vs. male)  $\times$  3 (type of article: ILE plausible, consciousness after death, or teleportation) between subject ACNOVA, for differences in DTA, while controlling for the participants' importance of religiosity, intrinsic religiosity and social desirability scores (afterlife beliefs were not statistically significant covariates). Confidence intervals for means and mean difference were also estimated using bootstrapping with 5,000 resamples to reduce error due to the small sample.

This analysis indicated that religiosity, intrinsic religiosity and social desirability were statistically significant covariates,  $F(1, 101) = 7.96, p = .006, \eta_p^2 = .073$ ,  $F(1, 101) = 4.97, p = .020, \eta_p^2 = .052$ , and  $F(1, 101) = 4.08, p = 0.46, \eta_p^2 = .039$ , respectively. The main effects for type of article and gender were not statistically significant,  $F_s < 1.01, p_s > .369$ , but importantly, there was a significant gender  $\times$  type of article,  $F(2, 101) = 4.74, p = .011, \eta_p^2 = .086$ .

Pairwise comparisons indicated that there was a statistically significant difference between conditions among men,  $F(2, 101) = 3.89, p = .024, \eta_p^2 = .072$ , but not among women,  $F(2, 101) = 0.97, p = .381, \eta_p^2 = .019$ . As shown in Figure 1, the ILE manipulation decreased DTA for men ( $M = 1.58, SE = .26, 95\% CI [0.94, 2.17]$ ) compared to the afterlife manipulation ( $M = 2.65, SE = .27, [1.93, 3.36]$ ),  $p = .006$  (bootstrap  $p = .029$ ), and also compared to the teleportation condition – although this difference was not statistically significant ( $M = 2.13, SE = .34, [1.62, 2.63]$ ),  $p = .206$  (bootstrap  $p = .184$ ). On the other hand, among women there was a non-statistically significant trend in which DTA was slightly lower in the afterlife condition ( $M = 1.97, SE = .20, [1.61, 2.31]$ ) compared to the ILE ( $M = 2.36, SE = .20, [1.95, 2.77]$ ),  $p = .168$  (bootstrap  $p = .159$ ), and teleportation condition ( $M = 2.13, SE = .18, [1.82, 2.44]$ ),  $p = .546$  (bootstrap  $p = .500$ ). Looking at the interaction from the other direction, while men had lower DTA than women after the ILE manipulation,  $F(1, 101) = 5.50, p = .021$  (bootstrap  $p = .041$ ),  $\eta_p^2 = .052$ , women had lower DTA

than men in the afterlife condition,  $p = .044$  (bootstrap  $p = .092$ ),  $\eta_p^2 = .040$ . At the same time, men and women did not differ in DTA in the teleportation condition,  $F(1, 101) = 0.00$ ,  $p = 1.00$ . These results remained similar if we did not control for social desirability, or any one of the measures of religiosity (although the effects were smaller).



**Figure 1 The Interaction Between Experimental Condition (ILE Plausible, Consciousness After Death, or Teleportation) and Gender (Female or Male) on Death Thought Accessibility (N = 110).**

## Discussion

The purpose of the current study was to further explore the terror management function of ILE and afterlife beliefs. We conducted a study to test and compare the effects of the possibility for ILE and the existence of the afterlife on the ability to suppress DTA after mortality salience among men and women with different levels of religiosity. Our results showed that there were no statistically significant interactions between the experimental conditions and levels of religiosity, but there were different effects among men and women. For men, reading about the possibility of ILE reduced the accessibility of death related thoughts compared to reading about the possibility of an afterlife, and compared to the teleportation condition (although the latter difference was not statistically significant). These effects were different for women, who in the ILE had more DTA than men, and had generally lower DTA in the afterlife condition (although these differences were not consistently statistically significant).

These results are generally consistent with other terror management research on the potentially anxiety buffering properties of the possibility of ILE (Lifshin et al., 2018; Vail et al., 2020), using new methodology. They further augment this literature by directly showing that ILE can reduce death thought accessibility. Our results are also consistent with previous findings regarding gender differences in support for ILE as a terror management strategy (Lifshin et al., 2019), as again, men seem to find ILE more appealing than women (and women seem to find afterlife beliefs more appealing than men). Although we

did not find an interaction with religiosity, our measures of religiosity were statistically significant covariates in the model predicting DTA, in line with previous TMT research.

These findings suggest that traditional religious beliefs in the afterlife may pose a somewhat different terror management strategy than an endorsement of ILE technologies, which may appeal more to men. We can only speculate regarding the specific gender related beliefs that may underline these gender differences in both belief in the afterlife and attitudes towards ILE. They may only be partially explained by levels of religiosity and attitudes towards science (Lifshin et al., 2019), and further research is needed to better understand this difference.

More broadly, the findings illustrate the psychological death-anxiety buffering function of ILE immortality beliefs. As ILE technologies may become a possible reality, how might they affect investment in religiosity or other traditional immortality-providing constructs? What larger impacts might this have on societies? Many questions remain open for investigation.

The current study did however have several important limitations that should be taken into consideration. Primarily, the sample size was relatively small, and our confidence in these findings, as well as our ability to detect three-way interactions between the conditions, gender, and religiosity, was limited. Furthermore, we conducted only one study, so these effects should be replicated. We note that we also did not pre-register this study, since it was conducted prior to the large emphasis on this practice in the field. Finally, but importantly, we should note that the fact that our sample consisted primarily of young American undergraduate students, hinders our ability to generalize these findings to people of different education levels, ages, social identities, and from different cultures. For example, this particular sample might have been more accepting of ILE technologies than other populations.

Future research should, therefore, attempt to replicate these findings with larger and more diverse samples. Larger samples may be vital to enable enough statistical power to thoroughly investigate the complex relationship between religious beliefs, gender and attitudes towards. Although we did include several different measures of religious beliefs in this study (e.g., the impotence of religiosity, afterlife beliefs, intrinsic and extrinsic religiosity), future studies may more closely investigate which aspects of religious or afterlife beliefs, in particular, may relate to endorsing ILE. This may be done using a combination of qualitative and quantitative methods when looking at specific samples (Underwood et al., 2009), as well as in attempts to compare and contrast how different religions may vary in attitudes towards ILE. It may be for example that different types of afterlife beliefs (e.g., belief in heaven vs. belief in reincarnation) may matter for the relationship between religiosity and the appeal of ILE technologies.

## **CONCLUSION**

This study found that the potential for Indefinite Life Extension (ILE) serves a psychological function in reducing Death Thought Accessibility (DTA), particularly among men. In contrast, traditional beliefs in the afterlife were more effective in lowering DTA among women. This highlights significant gender differences in terror management strategies, with men showing a stronger preference for the strategies offered by ILE technologies, while women tend to rely more on traditional religious beliefs.

This research contributes to the literature on Terror Management Theory (TMT) by demonstrating that belief in the possibility of ILE can function as a strategy to mitigate death-related anxiety, especially for men. Additionally, it offers new insights into gender differences in approaches to immortality strategies, and how both traditional religious beliefs and modern technologies play roles in managing existential anxiety.

This study has several limitations that should be considered. First, the relatively small sample size limits the ability to detect more complex interactions between experimental conditions, gender, and religiosity. Second, the study was conducted with a sample of young American undergraduate students, which may limit the generalizability of the findings to broader populations with different cultural and social backgrounds. Future research should aim to replicate these findings with larger and more diverse samples. Additionally, further studies could explore specific aspects of religious beliefs that may be related to endorsing ILE, as well as investigate differences in attitudes toward ILE across various religions and afterlife beliefs.

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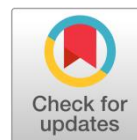
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## **APPENDIX**

### **Appendix 1: Article manipulations for Indefinite Life Extension, Afterlife and Teleportation.**

#### **Do You Want to Live Forever?**

**By Sherwin Nuland on June 1, 2013**

Believe it or not, it's now a scientific fact is that biological immortality is within our reach. Scientific developments in the last few decades have laid the foundation for a new class of medicines: rejuvenation biotechnologies. Rejuvenation biotechnologies are targeted therapies that apply the principles of regenerative medicine across the entire scope of the damage of aging. In other words, instead of merely slowing down the accumulation of aging damage in our tissues, rejuvenation biotechnologies will remove, repair, or replace the damaged cellular and molecular machinery. This means that with every round of therapy, a person's eyes, hearts, arteries, and bones will not just suffer less ongoing degradation of their structures, but could actually become more youthful and healthy in their structure and function. Scientists from various disciplines now believe that with these new technologies, people who are now under 30 years of age will be able to live up to a 1000 years!

SENS (Strategies for Engineered Negligible Senescence) is a huge anti-aging plan incorporating many different therapies to be applied simultaneously to people, thereby rejuvenating all organs at the cellular and molecular level. SENS is based on stem cell and gene therapy technology, as well as on the big advances that were made in tissue engineering for the past 5 years (e.g., Rosenblatt et al, 2009). Furthermore, SENS includes some very radical new technologies like finding bacterial enzymes that can degrade unusual compounds.

In his recent work "*Programmed differentiation of mouse embryonic stem cells using artificial signaling pathways*" Professor David Weiss from the department of biological engineering at MIT, forms the proof of principle that stem cells can be differentiated into different types of cells by using standard interchangeable parts (BioBricks) and standardized cell-to-cell signaling mechanisms. In one of these studies, Weiss and colleges (2012) used this method to prolong the lifespan of rats in 18 months (that's a 90% increase!). Furthermore, a company called Alteon, in Parsippany, NY, has run clinical trials of molecules that reliably reverses the effects of some conditions associated with aging in humans.

Scientists such as Dr. Aubrey De Grey of Cambridge University and Gil Hershberger of Harvard medical school, predict that there is a good chance of giving 30 years of extra healthy life to those who are already in middle age, within 25-30 years from now (e.g., de Gray, 2007; 2013; Hershberger & van Knippenberg, 2011). Moreover, after the first treatments produce positive results, scientist will be able to improve the SENS therapies thereafter, so that they give the same people (beneficiaries of the 30 extra years) another 30, and another, to infinity. This is what they refer to as "longevity escape velocity" (de Gray, 2013)

#### **So how does SENS work?**

Decades of research in aging people and animals has established that there are seven major classes of such cellular and molecular damage: cell loss and tissue atrophy, nuclear mutations, mutant mitochondria, death-resistant cells, tissue stiffening, extracellular aggregates and intracellular aggregates.

For each major class of aging damage, a prototype strategy for its removal or repair either already exists, or is foreseeable from existing scientific developments. Below are the specific “Rejuvenation Biotechnology” listed for each kind of aging damage in the table (de Gray, 2013)

<b>Aging Damage</b>	<b>Year Discovered</b>	<b>Rejuvenation Biotechnology</b>	<b>SENS Strand</b>
Cell loss, tissue atrophy	1955 <sup>1</sup>	Stem cells and tissue engineering	RepleniSENS
Nuclear [epi]mutations (only cancer matters)	1959 <sup>2</sup> , 1982 <sup>3</sup>	Removal of telomere-lengthening machinery	OncoSENS
Mutant mitochondria	1972 <sup>4</sup>	Allotopic expression of 13 proteins	MitoSENS
Death-resistant cells	1965 <sup>5</sup>	Targeted ablation	ApoptoSENS
Tissue stiffening	1958 <sup>6</sup> , 1981 <sup>7</sup>	AGE-breaking molecules; tissue engineering	GlycoSENS
Extracellular aggregates	1907 <sup>8</sup>	Immunotherapeutic clearance	AmyloSENS
Intracellular aggregates	1959 <sup>9</sup>	Novel lysosomal hydrolases	LysoSENS

Nevertheless, even after we have used these new therapies to repair an aging tissue, metabolic processes will continue to cause new damage. This simply means that rejuvenation biotechnologies are not a one-off fix, but will need to be periodically repeated to preserve youthful function. With this type of groundbreaking SENS research, aging will never be the same again.

Read more: [http://www.technologyreview.com/featuredstory/403654/do-you-want-to-live-forever/page/3?page=2%2C2&mitr\\_page=2&nopaging=1#ixzz2UeeeMiGa](http://www.technologyreview.com/featuredstory/403654/do-you-want-to-live-forever/page/3?page=2%2C2&mitr_page=2&nopaging=1#ixzz2UeeeMiGa)  
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## **New scientific evidence for consciousness after death**

**By Sherwin Nuland on June 1, 2013**

One of the most exciting scientific developments of the past decade has been the findings from rigorous scientific investigation of the near-death experience. Although scientists were initially skeptical of these reports, recent studies conducted by leading researchers at Harvard Medical School and Princeton University very strongly suggest that these experiences are very real indeed, and may suggest that some sort of existence does in fact continue after the physical death of the body. The following is a summary of the major points made in a recent summary of this research, reported by Dr. Henry Zimmerman of the Harvard Medical School.

There is remarkable similarity in the reports of over 600 separate people who were declared clinically dead but were then revived and regained consciousness, including the following: (a) an out-of-body experience in which the person experiences the sensation of floating above the room and observing medical attempts to revive his or her body, (b) a feeling of moving through a tunnel of bright light toward an even greater source of light, (c) an absolute feeling of comfort and safety and an absence of fear or pain, and (d) some form of contact with previously departed loved ones or other caring persons. These same experiences were reported by virtually all people, regardless of religious background or belief. Even avowed atheists have reported this experience.

In one famous case, a psychologist who had written articles critical of previous reports of this experience reported nearly identical events after nearly dying after a swimming accident; this of course led to a dramatic change in his opinions about the meaning of the near-death experience (Hirschberger et al, 2010).

A large scientific study - called the AWARE Study (see De Grey et al, 2011) that was conducted across Europe and America determined that in the cases where careful physical measurements could be taken, there were no signs of physical brain activity during this period, even when the most modern equipment was used. This shows that the body had clearly stopped its physical functioning while these experiences were occurring.

Perhaps most remarkably, people have been able to report the physical details of the room in which this occurred that could be seen only from the perspective of above the room. In other cases, detailed reports of conversations had in the room by medical personnel have been made. A total of 98% of people who have this experience return absolutely convinced that death is not the end of existence.

Dr. Carl Becker, a Professor of Bioethics and Comparative Religion at Kyoto University, Kyoto, Japan has researched near death experiences in Japanese and American hospitals for 30 years.. Becker examined four ways in which near death experiences may be considered objective:

- (1) Paranormal knowledge that is later verified
- (2) The similarity of deathbed events in different cultures
- (3) Differences between religious expectations and visionary experiences
- (4) Third-party observations of visionary figures, indicating that they were not merely subjective hallucinations (Becker, 1984).

Although additional research on this topic is clearly needed, the majority of medical authorities now acknowledge that these experiences provide serious evidence for the possibility that existence continues after the point of physical death.

Read more at: <http://www.wired.com/wiredscience/?p=155740>

## **Would you like to use teleportation?**

**By Sherwin Nuland on June 1, 2013**

Teleportation involves dematerializing an object at one point, and sending the details of that object's precise atomic configuration to another location, where it will be reconstructed. What this means is that time and space could be eliminated from travel -- we could be transported to any location instantly, without actually crossing a physical distance.

Many of us were introduced to the idea of teleportation, and other futuristic technologies, by the short-lived *Star Trek* television series (1966-69) based on tales written by Gene Roddenberry. Viewers watched in amazement as Captain Kirk, Spock, Dr. McCoy and others beamed down to the planets they encountered on their journeys through the universe.

In 1993, the idea of teleportation moved out of the realm of science fiction and into the world of theoretical possibility. It was then that physicist Charles Bennett and a team of researchers at IBM confirmed that quantum teleportation was possible, but only if the original object being teleported was destroyed. This revelation, first announced by Bennett at an annual meeting of the American Physical Society in March 1993, was followed by a report on his findings in the March 29, 1993 issue of *Physical Review Letters*. Since that time, experiments using photons have proven that quantum teleportation is in fact possible.

Today, far from being a science fiction dream, teleportation happens routinely in laboratories all around the world in the form of quantum teleportation. This is restricted at present to tiny particles, such as individual photons, or to quantum properties of atoms. But the question naturally arises as to whether it will ever be possible to teleport larger objects and even human beings.

Teleportation can be realized with either photonic qubits or matter qubits. In 2010, scientists were able to successfully teleport the quantum state of an atom without any physical link (e.g., Davis et al, 2010). In 2012, physicists teleported photonic qubits a record distance of 143 km (Yin et al, 2012). Teleporting matter qubits over long distances is more difficult than teleporting photonic qubits because it requires quantum memories and a strong interaction between light and matter. In a previous experiment, scientists have performed material teleportation without a strong light-matter interaction, and achieved a distance of 1 m. However, the low photon-collection efficiency in free space prevents scaling of that approach to larger distances.

So how much closer are we now to human teleportation since first understanding quantum entanglement nearly six years ago? It sounds like we're not that much closer. Scientists have been focusing more on transferring the atomic state of one atom to another in a different physical location. However, since the process of transmission destroys the original atom, multiple copies of the atom are not being created. That said, *Star Trek* style teleportation may not even require complete transmission of the quantum state. Charles Bennett, of IBM Research, believes that in principle, human teleportation would be possible by scanning the bio-molecular structure. He states that the "teleported person would end up slightly different, but not in a biologically important way."

The issue here is one of complexity. Teleporting an electron or an atom is one thing, but an average human body is made up of about 7,000 trillion atoms. How could the instantaneous quantum states of so many specks of matter be made to dematerialize and reappear perfectly in a different place? Another

major obstacle here is computing power. The American National Institute of Health estimates that it would take 1023 bits (yes, that's 24 zeros) to 'record' every detail of a human body down to 1mm precision. And with today's best optical fibers it would take a hundred million centuries to transmit this information.

It seems that human teleportation isn't going to happen tomorrow, or, barring some stupendous breakthrough, in the next few decades. However, that needn't stop us from thinking about the consequences if it ever does become possible. So, while theoretically possible, scientists are pessimistic about teleportation's realistic feasibility. For now, it looks like the only teleportation we'll be seeing is on television -- but then again, never underestimate the ingenuity of inventors and entrepreneurs.

Read more at: <http://phys.org/news/2013-04-physicists-quantum-teleportation-qubits.html#jCp>

**Appendix 2: Filler non-scientific article**

**The Growing Stone**

The automobile swung clumsily around the curve in the red sandstone trail, now a mass of mud. The headlights suddenly picked out in the night—first on one side of the road, then on the other—two wooden huts with sheet metal roofs. On the right near the second one, a tower of course beams could be made out in the light fog. From the top of the tower a metal cable, invisible at its starting-point, shone as it sloped down into the light from the car before disappearing behind the embankment that blocked the road. The car slowed down and stopped a few yards from the huts.

The man who emerged from the seat to the right of the driver labored to extricate himself from the car. As he stood up, his huge, broad frame lurched a little. In the shadow beside the car, solidly planted on the ground and weighed down by fatigue, he seemed to be listening to the idling motor. Then he walked in the direction of the embankment and entered the cone of light from the headlights. He stopped at the top of the slope, his broad back outlined against the darkness. After a moment he turned around. In the light from the dashboard he could see the chauffeur's black face, smiling. The man signaled and the chauffeur turned off the motor. At once a vast cool silence fell over the trail and the forest. Then the sound of the water could be heard.

The man looked at the river below him, visible solely as a broad dark motion flecked with occasional shimmers. A denser motionless darkness, far beyond, must be the other bank. By looking fixedly, however, one could see on that still bank a yellowish light like an oil lamp in the distance. The big man turned back toward the car and nodded. The chauffeur switched off the lights, turned them on again, then blinked them regularly. On the embankment the man appeared and disappeared, taller and more massive each time he came back to life. Suddenly, on the other bank of the river, a lantern held up by an invisible arm back and forth several times. At a final signal from the lookout, the man disappeared into the night. With the lights out, the river was shining intermittently. On each side of the road, the dark masses of forest foliage stood out against the sky and seemed very near. The fine rain that had soaked the trail an hour earlier was still hovering in the warm air, intensifying the silence and immobility of this broad clearing in the virgin forest. In the black sky misty stars flickered.



**Appendix 3: Filler questions regarding their liking of the articles framed as “Linguistic style”(see Appendix 2).**

**Linguistic style questions**

1) Are you communicating in two or more languages?

Yes (1)

No (2)

2) Please list all languages you know, regardless of how well you know them:

3) Do you consider yourself to be “good” at learning new languages?

4) Do you consider yourself to be a "verbal" person, that is, do you enjoy learning new vocabulary and “playing” with language?

Yes (1) Maybe (2) No (3)

5) Have you had formal instruction in music, such as choir or a particular musical instrument?

Yes (1)

No (2)

**Reading Questions about the readings**

1) Which of reading did you like more?

The scientific article (1)

The fictional passage (2)

2) Which reading did you think was better written?

The scientific article (1)

The fictional passage (2)

3) Regarding the scientific article, to what extent do you think the conclusions drawn in the article are factually correct?

Not at all correct (1) ..... Completely correct (9)

4) Regarding the passage from the short story, how do you feel about the overall descriptive qualities of the story?

Not at all descriptive (1)..... Extremely descriptive (9)

R5 5) Regarding the passage from the short story, how realistic were the descriptions in the, story ?

1) Not at all realistic (1)..... Extremely realistic (9)

**Appendix 4: Death thoughts accessibility measure**

**SAMPLE WORD COMPLETION TASK**

We are simply pre-testing this questionnaire for future studies. Please complete the following by filling letters in the blanks to create words. Please fill in the blanks with the first word that comes to mind. Write one letter per blank. Some words may be plural. Thank you.

- |             |            |
|-------------|------------|
| 1. BUR__D   | 14. CHA__  |
| 2. PLA__    | 15. KI__ED |
| 3. __OK     | 16. CL__K  |
| 4. WAT__    | 17. TAB__  |
| 5. DE__     | 18. W__DOW |
| 6. MU__     | 19. SK__L  |
| 7. __NG     | 20. TR__   |
| 8. B_T_LE   | 21. P_P_R  |
| 9. M_J_R    | 22. COFF__ |
| 10. P__TURE | 23. _O_SE  |
| 11. FL_W_R  | 24. POST__ |
| 12. GRA__   | 25. R_DI_  |
| 13. K__GS   |            |

## **Script and Debrief**

### **Study name: “Personality, reading preferences and linguistics”**

Hi my name is \_\_\_\_ I’m a research assistant here in the psychology department. In today’s study we are examining the relationship between different measures of personality, reading preferences and linguistic styles. Although research has showed that different linguistic styles are related to reading preferences, none of these studies examined how different personality characteristics affect may affect this relationship. To test this research question in our study today, we will first have you fill out some personality questionnaires. Next we will have you read two different kinds of reading material: a randomly selected short article about a scientific topic and a randomly selected passage from a fictional short story. After that we will have you fill out two short measures of linguistic styles. And finally you will answer some questions about the readings. Do you have any questions?

In just a minute, I’ll have each of you go into one of these cubicles where all of the materials will be presented to you on the computer. But before we get started, I just want to mention that on none of the materials are we going to ask you for your name, or any other identifying information. In other words, all your responses on the materials today will remain completely confidential, and they’ll never be associated with you in any way. So what this means is that you can feel free to answer openly and honestly on all the materials.

If there aren’t any initial questions I’m going to ask each of you to enter one of these cubicles for privacy. On the desk you will notice a consent form which outlines your rights as a participant. Please read it, sign when you are ready to participate, and then wait patiently and I’ll come by and get you started.

### **Cubicle Visit**

Okay, so everything will be presented to you on the computer. First you will fill out some personality questionnaires, for those, don’t spend too much time on any particular question and just go with your first gut-level responses. After that you will be presented with a randomly selected scientific article, and a fictional passage. Note that you cannot go back to the articles after you move past them. Then after you finish reading, you will be presented with the measures of linguistic styles. Finally, you will be presented with a few questions about the readings. As I said before, all your answers will remain confidential, so you can feel free to answer all the questions with your first, natural responses. When you’re done, crack open the door and I’ll come by and tell you what to do next.

(Debrief Life extension study 2)

**Okay, now what I would like to do is just ask you some questions about the study.**

- So, what did you think about the study?
- Were all the instructions clear?
- How about the personality questionnaires you completed, what did you think of those?
- Did you see any of these questionnaires before?
- Did any of the personality questionnaires seem odd or unusual?
- What did you think about the article that you've read?
- What did you think about the fictional passage that you've read?
- Did you have any thoughts about why we chose these particular readings?
- What did you think about the measure of linguistic style that you completed – the one with the word completion task?
- While you were doing the study, Did you see any connections between any of the materials in the study today?
- Okay, well, sometimes when people do these studies they think that maybe something else was going on behind the scenes, like something we didn't tell you about from the start, so while you were doing the study, did you think of anything like that?

The reason I'm asking you all these questions is that there was actually more going on than I initially told you. So what I'll do now is go quickly through the theory behind the research and then tell you exactly what we were doing here today.

Today's study is concerned with a theory called terror management theory. According to this theory, humans are distinct from other animals in many ways, but probably the most important being that we are aware of ourselves. The theory says that this is a mixed blessing because although we have sophisticated minds which allow us to think about far off future and past events, we're also the only animal smart enough to understand that we are mortal. According to the theory this realization poses a problem for us humans because by knowing in the back of our minds that we will eventually die, we always have the potential to be anxious worried or even terrified. What the theory says we do, then, in order not to be anxious all the time and function normally, is that we sustain faith in cultural beliefs that give our lives purpose and give each of us opportunities to feel like valuable individuals. Through our culture we come to believe that death is not the ultimate end, but that we can live on, maybe in an afterlife, or through our children, or through a book we write or picture we paint. Culture offers us ways to immortalize ourselves. This allows us to feel less vulnerable to death.

One new avenue for achieving immortality in need of further research is indefinite life extension through medical technology. In the past, thinking that one's body would live on forever wasn't plausible, and so symbolic forms of immortality, and literal immortality beliefs in the form of an afterlife have been more popular as terror management systems. As scientific discoveries make indefinite life extension more and more plausible, it becomes increasingly important to research the function of indefinite life extension from a terror management perspective.

That's generally what we were looking at today. In particular, we are interested in how indefinite life extension may function to protect against concerns about death, in a way similar to religion. Prior research has shown that if you remind an individual of death, and then allow them to affirm an important

aspect of their worldview, such as their religious beliefs, this affirmation negates the threat that thinking about death creates. Recent scientific discoveries are making indefinite life extension more and more plausible; in fact, people are living longer today than ever before and it is likely that through science this longevity will only continue to increase. As the possibility of extending life indefinitely becomes a reality, what is the impact that this has on concerns about death? Does thinking about indefinite life extension protect against concerns about death, or does it undermine important structures, like religion that we rely on to quell concerns about death?

To examine this, we first had *all of you* think about your own mortality. We did this by embedding a question that asked think about your own death in the questionnaire packet.

After that, you were all given one of 3 articles to read. One of the articles was about the possibility of consciousness after death, one of the articles was about the possibility of indefinite life extension, and one was a neutral control article about teleportation. Each of you received only one of these 3 articles, and which article you received was determined completely at random. All of these articles were actually made up in order to fit the purpose of this experiment- they are not real. Although all of these article are based on true things that are in development, as far as we know there is still no scientific evidence for consciousness after death, usable teleport technologies or feasible technologies that can extend human life indefinitely. So, please don't leave this study believing that all these technologies actually exist.

### **So this was in fact our independent variable.**

[Experimenter writes a 3 column table and labels the columns "*consciousness after death*", "*life extension*" and "*Control*"].

The reason that we used an article about evidence of consciousness after death is that prior research has shown that reading it can protect people from worrying about death. This way, we could see if learning about the possibility of indefinite life extension could protect people from worrying about death, as hearing about consciousness after death does. Additionally, we wanted to also compare these to neutral article, that is not concerned with death, such as the one about the feasibility of teleportation.

For our dependent measure, or the variable that we measure, we had you all complete the word completion task at the end (the linguistic measure). For this task, you were asked to complete partially formed words. Some of these words could be completed with a death related word. For example, the word fragment beginning with DE\_\_ could be completed as either DEED or DEAD. The number of death related words that you completed gives us an idea of whether or not death related thoughts or concerns were accessible in your consciousness. When death is a concern, death related words should "pop up" more easily. If the articles, either about consciousness after death or indefinite life extension help reaffirm a part of a person's worldview and protect against concerns about death, subjects in those conditions should then complete fewer of the words with death related words.

(E writes "*DV= number of death related words*").

We expect that those of you read about the possibility of life extension, or consciousness after death would have a lower level of death thought accessibility than those of you who read the control article. [E writes "*High DTA*" in the "*Control*" column, and "*low DTA*" in the "*consciousness after death*" and "*life extension*" columns].

So as you can see there was more going on that I initially told you. The reason we didn't tell you exactly what was going on was because if you knew what we were looking for it would most likely inhibit you from responding naturally. A study has what's called demand characteristics when people know what the study is about, and often, even if they're not aware of it, people will try to be good subjects and give us

the responses we are looking for. On the other hand, sometimes if subjects know what the study is about, they may react by doing the opposite of what we are looking for. Either way these responses invalidate and mess up our results. So that's why I didn't let you know exactly what was going on from the start. Does it make sense why we did that?

Well we don't just do these studies for fun, we think that they may have some important implications. In today's study we were interested in seeing whether learning about the feasibility of indefinite life extension could protect people from worrying about death. The study and development of indefinite life extension technologies could be very beneficial to human life. It could eventually promote human health in various ways, such as curing cancer cells or repairing other defected body organs. Yet for different reasons, many people are not so keen to support this line of research. For example, it could lead to overpopulation. One possibility is that when people think that indefinite life extension is not really possible, thinking about this topic makes them worry about death – and they don't want to hear about it anymore. If we find in this study that when people hear that indefinite life extension is feasible, they don't worry about death, we can better understand why some people do not support the development of indefinite life extension research. Furthermore, it is possible that in the future, indefinite life extension will be realistic possibility for people. This might actually change the way people feel about life and about death. These studies that we are doing could promote our understanding of the psychological factors that are related to the emergence of indefinite life extension technologies.

One last thing, I hope it's clear that we have invested a lot in this research and that we take it very seriously. And, as I mentioned before, if you come here knowing what the study is about, then your responses would be skewed and our results wouldn't be valid at all. This would mean that everyone has wasted a lot of time and money and resources. So it's very important that you don't tell any of your classmates what the study is about, or what we were looking at, least until the end of the semester. It's really critical that people don't know what this study is about when they come in here so we would appreciate your word that you won't discuss this experiment with anyone until the end of the semester, alright? (Get head nod). I know that it might be tempting if your roommate or your friend asks you what this study was about, but please just tell them what we told you in the beginning, that we're doing this short study about personality reading preferences and linguistics, OK? (Get head nod). Alright, thank you for your participation (give credit slip).

- Write remarks
- Clear board
- Number consents