

Communication

Irresponsible Research and Innovation? Applying Findings from Neuroscience to Analysis of Unsustainable Hype Cycles

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Abstract: The introduction of technological innovations is often associated with suboptimal decisions and actions during cycles of inflated expectations, disappointment, and unintended negative consequences. For brevity, these can be referred to as hype cycles. Hitherto, studies have reported hype cycles for many different technologies, and studies have proposed different methods for improving the introduction of technological innovations. Yet hype cycles persist, despite suboptimal outcomes being widely reported and despite methods being available to improve outcomes. In this communication paper, findings from exploratory research are reported, which introduce new directions for addressing hype cycles. Through reference to neuroscience studies, it is explained that the behavior of some adults in hype cycles can be analogous to that of irresponsible behavior among adolescents. In particular, there is heightened responsiveness to peer presence and potential rewards. Accordingly, it is argued that methods applied successfully to reduce irresponsible behavior among adolescents are relevant to addressing hype cycles, and to facilitating more responsible research and innovation. The unsustainability of hype cycles is considered in relation to hype about artificial intelligence (AI). In particular, the potential for human-beneficial AI to have the unintended negative consequence of being fatally unbeneficial to everything else in the geosphere other than human beings.

Keywords: artificial intelligence (AI); hype cycles; informational conformity; normative conformity; outgroup derogation; reality distortion field; responsible research and innovation; sustainability; technological innovation; unintended consequences

1. Introduction

Adolescent years are characterized by suboptimal decisions and actions, which lead often to unintended negative consequences [1,2]. Multiple neuroimaging studies have revealed factors in brain development that contribute to irresponsible behavior being more common during adolescent years than during childhood and adulthood [3,4]. This not because adolescent brains are unable to understand the risks of the irresponsible behaviors. Rather, it is because adolescent brains are characterized by heightened responsiveness to peer presence and potential rewards [5–10]. In addition, multiple neuroimaging studies have revealed that adolescent behaviors can become entrenched in the brains of some people for the rest of their lives [11–14].

The introduction of technological innovations is often associated with suboptimal decisions and actions during cycles of inflated expectations, disappointment, and unintended consequences. For brevity, these can be referred to as hype cycles. Hitherto, studies have reported hype cycles for many different technologies [15–22], and studies have proposed different methods for improving the introduction of technological innovations [23–28].

Yet hype cycles persist, despite suboptimal outcomes being widely reported and despite methods being available to improve outcomes. Although many participants in hype cycles are adults in chronological age, it is explained in this paper that behavior in hype cycles can be analogous to that of irresponsible adolescents. In particular, behavior in the introduction of technological innovations can be characterized by chronic immaturity, rather than the responsible technology management needed to address the introduction of technologies—especially technologies that have the potential to bring far reaching negative unintended consequences for the entire planet [29,30]. Here, responsible technology management refers to technology management that is not characterized by irresponsible adolescent behaviors. Responsible technology management is essential for responsible research and innovation [31,32].

In this communication paper, findings from exploratory research are reported, which introduce new directions for addressing hype cycles. The research comprised abductive reasoning involving iterative cycles between observations and literature reviews. Irresponsible adolescent behavior among some adults in hype cycles is explored in the four remaining sections of this paper. Next, irresponsibility is related to a specific case: that is the widespread endorsement of the Asilomar AI Principles. Then, irresponsibility is related to a general case: that is the widespread adherence to the formal hype cycle. Subsequently, implications are discussed for education, for research, for practice, and for public debate. In conclusion, principal contributions are stated. It is important to note that this paper is concerned with patterns in hype cycles. Cases are referred to in order to illustrate patterns in hype cycles, not to define individual motivations in specific cases.

2. Case

As reported in the popular media, hundreds of well-known public figures and artificial intelligence (AI) experts have signed an open letter on “Research Priorities for Robust and Beneficial Artificial Intelligence” [33,34]. This open letter provides a basis for the article, Research Priorities for Robust and Beneficial Artificial Intelligence, published by the Association for the Advancement of Artificial Intelligence (AAAI) [35]. Following on from the letter and article, 23 principles for AI were formulated at the “Beneficial AI Conference” at Asilomar, California in January 2017. These principles have been signed up to by thousands of people including AI/robotics researchers and well-known public figures [36].

The principles comprise normative statements. For example, the second principle, Research Funding, is: Investments in AI should be accompanied by funding for research on ensuring its beneficial use [35]. A characteristic of normative statements is that they are emotion-based subjective statements that lack objective validity [37,38]. As shown in Figure 1, normative statements provide a basis for normative conformity. This is groupthink involving conforming to normative statements, even though they lack objective validity [39–42].

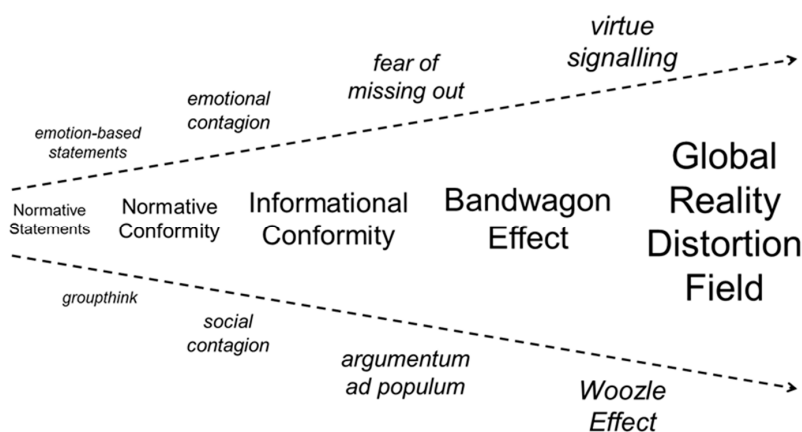


Figure 1. From normative statements to global reality distortion field.

Even though normative conformity can begin within a small social bubble [43,44], it can spread around the world rapidly via the Internet through social and emotional contagion [45,46]. This can involve fallacious argumentation from the supposed authority of majority positions (*argumentum ad populum*). Also, there can be the Woozle Effect, which involves statements being assumed to have objectivity validity just because they are referred to by an increasing number of people [47]. Thus, normative conformity among a small initial group can spread to informational conformity among a far larger group: for example, when people who do not have background knowledge in a topic “look up to” the initial group for guidance in a topic [48]. This can be more likely when the initial group presents as being prestigious—even if the initial group present no objective argumentation to support their statements. Rather, their statements are only the fallacy of “argument from prestige” [49]. Soon, the bandwagon effect can take place as more and more people want to believe in something—irrespective of whether there is underlying objective validity [50]. People can be drawn in by a growing fear of missing out (FoMO) together with a growing desire to signal to peers that they share the same virtues as they do: i.e., virtue signaling [51,52]. So it is that a reality distortion field can spread quickly across the world [53].

Alongside the rapid progression from normative statements to transcontinental reality distortion field, it was pointed out that the Asilomar AI Principles could appear comforting but lacked substance and accountability [54]. One aspect of their shallowness and hazard is their anthropocentrism. Overall, human life is the only form of life given consideration for beneficial outcomes. For example, the twenty-third principle, Common Good, is: Superintelligence should only be developed in the service of widely shared ethical ideals, and for the benefit of all humanity rather than one state or organization. Thus, the potential for human-beneficial AI to be fatally unbeneficial to everything else in the geosphere other than human beings is not considered. For example, fabricating more robots will involve further expansion of the technosphere at the expense of more extraction of finite natural resources from the lithosphere and more hazardous disruption to the biosphere. The dangerousness of the assumption that human beings need only be concerned with how AI directly affects human beings is illustrated by the development of aerial robots to carry out the pollination of plants needed by human beings [55]. Like replacing dead canaries in a mine with AI canaries, the development of AI pollinators to replace dying natural pollinators fails to address broader threats from relentless expansion of the technosphere [56].

However, in the absence of responsible technology management, it can be expected that many adults would act like irresponsible adolescents by making light of the risks that could arise from implementing the Asilomar AI Principles. In particular, it can be expected that many adults would demonstrate behavioral characteristics associated with the adolescent brain: heightened responsiveness to peer presence and potential rewards. For example, the website of the conference at which the Principles were formulated includes the assertion that its participants were an “amazing” group of researchers and thought leaders [57]. The online list of signatories headed by this group makes this “amazing” peer presence available globally. In doing so, it sends far and wide the potential reward of basking in reflected glory by signing up online to the list: as if engaged in upwardly-mobile friending in an online community [58,59]. Online friending by adolescents to boost their social self-esteem is common [60] as is their lack of impulse control in relation to Internet use [61]. Also, signing up online to the Asilomar AI Principles does not carry the risk of the negative social and emotional effects that can arise from being “unfriended” [62]. Accordingly, even though the normative statements of the Asilomar AI Principles are supported by only “argument from “amazing” prestige”, it can be expected that lack of responsible technology management will lead to adults going along with them. By contrast, responsible research and innovation takes into account effects and potential impacts on the environment [31,32].

It is important to note that hype has escalated from normative statements to international reality distortion fields before digital information and communication technologies (ICT). For example, there was hype about AI in earlier decades, and there has been hype about other technologies during

earlier centuries such as “railway mania” [63]. However, the increasing number and reach of digital channels can increase the number of technologies being hyped globally at the same time [64]. For example, autonomous vehicles are another topic of hype involving AI. Again, hype about autonomous vehicles is anthropocentric in focusing on benefits for humans, while understating related expansion of the technosphere and hazardous disruption to the biosphere. For example, the autonomy of many autonomous vehicles is dependent upon the construction of “cooperative infrastructures”. Hence, vehicle-infrastructure initiatives are being carried out that involve the manufacture and installation of millions of new electronic devices followed by the capture, processing, and storage of vast amounts of data [65–67]. In addition, hype about AI is applied to industrial production with slogans that reframe industrial production as a new paradigm [68–71], rather than as an old paradigm plus AI applied in conjunction with millions of new sensors, robots, and other physical equipment that require more extraction of finite natural resources from the lithosphere and more hazardous disruption to the biosphere.

Hype about the addition of AI to industrial production can spread rapidly from individuals, throughout organizations, and across continents. This is possible because humans everywhere tend to have a preference for the familiar: in this case, industrial production. Firstly, the human brain has a strong predisposition towards energy conservation. In particular, following old behaviors facilitates brain energy conservation through the employment of existing neural connections. By contrast, establishing new behaviors involves much greater energy expenditure during the creation of new neural connections [72–74]. Thus arises the “plasticity paradox” by which the brain changes itself through its plasticity to become more fixed, and hold strong preference for things that are familiar such as industrial production [75–78]. Apropos, multiple neuroimaging studies have revealed that what people learn in their teens and twenties can become entrenched in their brains for the rest of their lives. In other words, what they learn then can become “embrained”. Hence, people educated and trained in industrial thinking can become fixated with industrialization and have industrialization-on-the-brain for the rest of their lives [11–13,79]. Throughout organizations, fixation about what should be done can exist as groupthink [80,81]. Not conforming to groupthink can be a daunting challenge. This can be because there is the risk of hostile treatment due to outgroup derogation. This involves an ingroup perceiving individuals who do not join them, or who leave them, as an outgroup intent on hindering the goals of the ingroup [82,83]. Groupthink can span across separate organizations as institutional logics, which provide norms about how things should be and how things should be done [84,85]. Fixation can be refreshed, groupthink can be expanded, and institutional logic can be further entrenched through cycles of management fads and technology hype that are directed to a familiar old paradigm. For example, slogans such as Industry 4.0 involve assertions that industrialization is now a new paradigm: rather than a paradigm that is actually more than 250 years old [68–71]. Across continents, industrial fixation, groupthink, and institutional logics can be carried through international interdependencies. For example, rather than focusing upon more up-to-date alternatives than the 250 years old paradigm of industrial production, policy makers with industrialization-on-the-brain can focus upon international maneuvering in the industrial world. For example, international maneuvering can include so called “smart protectionism”, which involves the use of tariffs, subsidies, etc., that can be presented as being not directly trade-related and therefore not covered by the World Trade Organization [86]. At the same time, countries can be dependent upon the support of bodies such as the European Union, United Nations Industrial Development Organization, World Bank, etc., and may need to comply with the industrial fixation of these bodies in order to have access to their support. Such bodies can view countries with little, or no, existing industrial manufacturing as sites for setting up new industrial production, which can establish new markets for mass consumption and so drive up global industrial growth. This can be supported by greenwashing with slogans such as “green industrialization” [87,88].

A summary of differences between going along with hype that associates a new technology with a familiar old paradigm, and not going along with such hype, is provided in Figure 2. In particular,

going along with such hype involves brain energy conservation, ingroup affiliation, and international approval. By contrast, not going along with such hype can involve intense brain effort, outgroup derogation, and international disapproval. This example illustrates that the spread of new technology hype can be especially contagious when that hype is associated with an old paradigm that is already familiar to people all over the world. This is to be expected as there is more scope for argumentum ad populum and for the Woozle Effect. Hence, larger numbers of people can be drawn in by a growing fear of missing out (FoMO) together with a growing desire for virtue signaling [51,52].

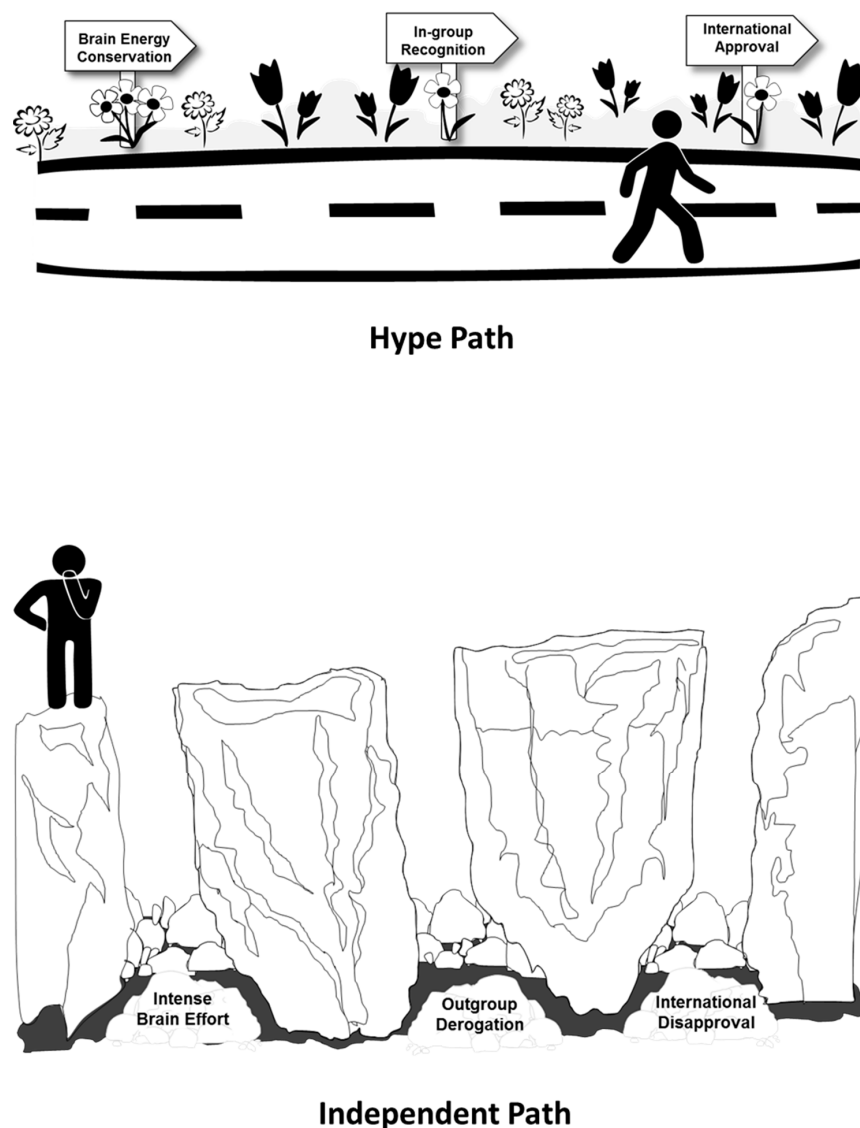


Figure 2. Hype path compared to independent path.

As artificial intelligence (AI) is a general-purpose technology (GPT), it can be associated with many familiar old paradigms. General-purpose technologies are technologies that can affect entire national and international economies. With the addition of the label “beneficial”, AI is framed as a general-panacea technology that can be applied to any familiar old paradigm to address its current limitations without any harm. Of course, it can be expected that proponents of human-beneficial AI would answer yes if asked whether they care about consequences of human-beneficial AI for the biosphere. One reason for such statements of concern for the biosphere can be courtesy bias, which involves people tending to give an opinion that is more socially correct than one’s true opinion in order to avoid causing offence. Another reason can be social desirability bias, which involves people

tending to answer questions in a manner that will be viewed favorably by others. A further reason can be acquiescence bias, which involves people tending to agree with what they are asked [89–91]. Nonetheless, the absence of statements of concern for the biosphere in the Asilomar AI Principles provides greater clarity about the priorities of advocates of anthropocentric AI initiatives.

3. Formal Hype Cycle

Rapid progression from normative statements to transcontinental reality distortion fields are not limited to a specific case. Rather, this progression is institutionalized in the first phases of the formal hype cycle. The formal hype cycle includes five phases as follows: technology trigger, peak of inflated expectations, trough of disillusionment, slope of enlightenment, and plateau of productivity. A line comprising two types of curves is used to represent the formal hype cycle [92]. The first curve resembles a bell. This bell shape describes the rise and fall of contagion. This begins with exponential growth followed by a more gradual tendency to reach a constant value (peak of inflated expectations) and concludes with exponential decrease of the growth rate (trough of disillusionment). The second curve is closer to an S shape. This describes the progress of technology introductions as technologies become better understood (slope of enlightenment) and are applied in practice (plateau of productivity). Previous analyses by others have indicated that although the formal hype cycle is very widely used, there is lack of empirical and theoretical justification for its use [93,94].

What has not been considered previously is that the bell curve phases of the formal hype cycle provide institutional logics for irresponsible adolescent behaviors among some adults during technology introductions. Institutional logics can have a determining influence in social systems that can span across many otherwise separate individuals and organizations. Institutional logics provide norms about how things should be done [84,85,95–97]. In particular, the institutional logics for inflated expectations and troughs of disillusionment are provided by the bell curve phases of formal hype cycle. Importantly, it is against these institutional logics to go straight from technology trigger to begin along the slope of enlightenment towards productivity. Rather, institutional logics dictate that it is first required to go up and go down the bell curve of inflated expectations.

Hype cycle reports from the consulting company that created the formal hype cycle contribute to the maintenance of these irresponsible institutional logics. These reports include claims such as: organizations which have introduced the full spectrum of Big Data issues (volume, complexity, variety, and velocity) into their information management strategies by 2015 will begin to outperform their unprepared competitors within their industry sectors by 20 per cent in every available financial metric [98]. This claim has two principal characteristics of hype: it is very vague and very positive. For example, increasing data volume, complexity, variety, and velocity are not new to organizations. Rather, they are challenges that organizations have been grappling with for decades [99]. Hence, introducing these issues into information management strategies is an indeterminate recommendation, which relies on subjective opinions about to what extent these issues have been already included in an organization's information management strategy.

However, ridiculously overblown vague claims are entirely appropriate within the institutional logics of the formal hype cycle, which rule that there should be inflated expectations and troughs of disillusionment. From the sociological perspective, institutions are recurring patterns of behavior, and institutional work involves the maintenance of institutions by those who create them [100]. Accordingly, it can be expected that the consulting company that created the formal hype cycle will maintain its creation with reports to push technologies up and down the bell curve of contagion. In this context of maintaining institutional logics, individuals may be motivated to make overblown claims for technological innovations by a sense of organizational duty, rather than by delusional optimism, Machiavellian deviousness, or a proclivity for bullshitting. Interestingly, Harry Frankfurt, Professor Emeritus of Philosophy at Princeton University has argued that the bullshitter either does not know the truth or does not care about it, and is most interested in showing off [101–105].

Within the institutionalization of irresponsible behaviors, the responsible behavior of progressing directly from technology trigger to the slope of enlightenment would be not normal. Just as it would be not normal for adolescents not to conform to irresponsible rites of passage—even though they are costly and hazardous. Also, there is the reassuring institutional logic that enlightenment and productivity will be reached in the future anyway. However, like adolescents who do not survive through irresponsible rites of passage [1,2], it can no longer be assumed that irresponsible behaviors in technology introductions will be survived [29,30].

Yet, making light of dangerous risks is a fundamental aspect of irresponsible adolescent behavior—even when adolescents fully understand that their decisions and actions will put them in grave danger, such as when they engage in reckless driving [3,10]. Furthermore, not participating in rites of passage can lead to being ostracized by peers. Thus, the prospect of not participating in irresponsible behavior carries fear of missing out (FoMO) and losing opportunities for virtue signaling to peers. In addition, not participating in irresponsible behavior can lead to hostile treatment [1,2,51,52]. This can arise because of outgroup derogation. This involves an ingroup perceiving individuals who do not join them, or who leave them, as an outgroup intent on hindering the goals of the ingroup. A summary of institutional logics for hype cycles is provided in Table 1.

Table 1. Institutional logics for hype cycles.

Hype Cycle Phase	Institutional Logic	Irresponsible Behavior
Technology trigger	Proof-of-concept tests of new technologies should be accompanied by hype stories	Acceptance of ridiculously overblown vague claims as being normal
Peak of inflated expectations	Inflated expectations are normal, inevitable, and not negative	Normative conformity and informational conformity, joining bandwagons, reality distortion fields, and outgroup derogation, while making light of risks
Trough of disillusionment	Troughs of disillusionment are normal, inevitable, and not negative	
Slope of enlightenment	Understanding the potential of new technology must be preceded by inflated expectations and troughs of disillusionment	Acceptance of inflated expectations and troughs of disillusionment as being normal, inevitable and not negative despite many previous of examples of fear of missing out (FoMO) and desire for virtue signaling not leading to successful outcomes
Plateau of productivity	Productive technology implementations much be preceded by inflated expectations and troughs of disillusionment	

In simple terms, people can match love of their ingroup (i.e., us) with hate for an outgroup (i.e., them), and conclude that either you are with us and our institutions or you are against us and our institutions [82,83]. Although individuals of all ages categorize ingroups and outgroups, adolescents are more sensitive to group affiliations than children and adults [106–108]. Hence, it can be particularly difficult for adolescents to depart from the institutions favored by their peers—even when they understand that the patterns of behavior set out by the institutions are irresponsible. Not complying with institutional logics can be particularly difficult when bullying among adolescents inflicts intense psychosocial pressure on those who dare to be different [109,110]. Thus, it takes some courage to defy the dominant institutional logics of peers. Accordingly, even when irresponsible behaviors in technology introductions may not be survived, it is to be expected that, without responsible technology management, people who chronologically are adults will continue to jump onto peer bandwagons to ride up and down the irresponsible peaks of inflated expectations and troughs of disillusionment.

4. Discussion

4.1. Implications for Education

Multiple neuroimaging studies have revealed that adolescent behaviors can become entrenched in the brains of some people for the rest of their lives due to synaptic pruning. This can carry on throughout adolescence into people's twenties, and is summarized with the phrase, "use it or lose it". Synaptic pruning involves the natural strengthening of those neural circuits that are actively engaged and the loss of those neural circuits that are not utilized. Thus arises the "plasticity paradox" by which the brain changes itself through its plasticity to become more fixed [11–13,111].

Accordingly, masters and doctoral studies that are funded by inflated claims for hype, and are focused on justifying the hype that brought in the funding, can lay down deep neural foundations for a lifetime of hype-on-the-brain. For example, masters and doctoral degrees can be awarded for carrying out studies of hyped technologies, rather than for demonstrating mastery of scientific principles, methodologies, and techniques through their rigorous application. Focus upon hype instead of upon developing scientific skills can lead to people with masters and doctoral degrees not having strong neural circuits for balanced objective scientific reasoning. Instead, people with scientific qualifications can develop strong neural circuits for constructing proposals and papers about whatever is hyped [43,112–114].

By 2017, the overwhelming of science with hype has become so extreme that "bullshit detection" is now being taught as a topic by at least one university and is a topic in papers [101]. With reference to Professor Frankfurt's exploration of bullshitters' behavior, it is possible that people who have lost capacity for balanced objective scientific reasoning may not be able to know the truth about hyped technologies. Also, it is possible that those who have been institutionalized into the logics of hype cycles may not care about the truth of hyped technologies [102]. If responsible technology management is to be established, technology management education needs to focus on scientific principles, methodologies, and techniques, while moving away from studies focused on justifying hype about technologies.

4.2. Implications for Research

Methods used to change irresponsible adolescent behaviors should be researched for application with adults who have completed their education and have hype-on-the-brain. One method that has been used widely to better understand and facilitate changes away from irresponsible adolescent behaviors is the Transtheoretical Model of Behavior Change. This model encompasses ten processes. First, increasing awareness about options that are not irresponsible. Second, paying attention to feelings about irresponsible and non-irresponsible options. Third, self-reevaluation of the personal importance of behavior that is not irresponsible. Fourth, environmental reevaluation of the importance to others of behavior that is not irresponsible. Fifth, recognizing that society tends to be more supportive of behavior that is not irresponsible. Sixth, making commitment to change. Seventh, identifying people who can support the change. Eighth, substituting irresponsible behaviors with responsible behaviors in order to achieve counter-conditioning. Ninth, reinforcement management that includes increasing rewards as a result of responsible behavior and reducing rewards arising from irresponsible behavior. Tenth, stimulus control by using reminders and cues that encourage responsible behavior as substitutes for reminders and cues that encourage irresponsible behavior. This model addresses the difficulty of changing irresponsible adolescent behavior by having seven steps before irresponsible behavior is substituted by non-irresponsible behavior [115–120].

Methods to improve technology management that have already been developed during previous research [22–27] could be implemented in the eighth step of this behavioral change model. New research could address the seven preceding steps, which need to be taken to facilitate use of these methods by adults who are institutionalized in the irresponsible adolescent behaviors of hype cycles. Recent initiatives in Responsible Research and Innovation (RRI) can provide support.

For example, RRI initiatives that take into account the networked nature of organizations' internal and outer environment [31] and provide key performance indicators for stakeholder management [32].

4.3. Implications for Practice

Some people are more prone than others to take up irresponsible behavior and persist with irresponsible behavior throughout their lives [79,121–123]. Thus, practical implementation of steps to reduce irresponsible behaviors should focus on identifying those individuals most prone to irresponsible behaviors. In particular, individuals who drive bandwagons up to peaks of inflated expectations and down into troughs of disillusionment. Here, studies of adolescent gangs are relevant: especially those that have identified different characteristics between gang leaders and gang members. For example, one characteristic of gang leaders is that they have grandiose-manipulative traits, which can involve using others to fulfil their own high opinions of themselves—even if doing so harms those who they manipulate [124,125].

Implementing steps away from irresponsible adolescent behavior in introductions of new technologies will be challenging in practice if the leaders of hype gangs are also organizational managers with grandiose-manipulative traits. This may be more likely if managers are promoted in accordance with competence inversion. This involves competent people doing work, while those without competence move into management. This can lead to a kakistocracy where management is carried out by grandiose-manipulative incompetents who focus their efforts on getting promoted and retaining power [126–129]. One option for such managers to work around their own lack of competence is to hire management consultancy companies to provide them with guidance supported by frameworks, such as the formal hype cycle [94,130,131].

Accordingly, implementation of behavioral change steps to reduce irresponsible adolescent behaviors in the introduction of technological innovations can face opposition from managers who have the grandiose-manipulative traits of adolescent gang leaders, and who are supported by consultancy companies that create and maintain the institutional logics of hype. It is important to note that grandiose-manipulative traits have been found to be common among senior managers [132]. Also, it is important to note that the reach of management consultancy companies extends from government organizations, which have control of public funding for introducing hyped technologies, to small firms that try to implement hyped technologies [133,134].

4.4. Implications for Public Debate

The spread of Internet, digital ICT, and associated social media has brought debate about new technologies more into the public domain. Education, research, and practice that aims to reduce irresponsible adolescent hype cycles may initially be regarded as amusingly quirky rather than threatening. However, if education, research, and practice begin to make inroads into the institutional logics of hype, it can be expected that management consultancy companies and grandiose-manipulative managers will invoke outgroup derogation towards those who challenge hype cycles. Furthermore, it can be expected that members of their ingroups will operationalize outgroup derogation through all means available—just like members of teenage gangs who obediently follow gang leaders no matter how irresponsible their instructions. In addition, hype gang members may operationalize outgroup derogation without explicit instructions in order to signal their virtue of strong ingroup loyalty.

Certainly, outgroup derogation will be a far easier cognitive option than applying scientific reasoning to the complexity of technology introductions. This is because outgroup derogation requires far less mental energy than applying scientific reasoning, and the human brain has a preference for energy conservation. This preference for brain energy conservation underlies the “plasticity paradox” by which the brain changes itself through its plasticity to become more fixed. The human brain preference for energy conservation is revealed through neuroscientific studies, and is well expressed in Henry Ford's phrase: thinking is the hardest work there is, which is probably the reason why so few

engage in it [135]. In addition, outgroup derogation will be a far easier social and emotional option than moving away from hype ingroups and their established institutional logics.

Hence, it can be expected that any progress towards responsible technology management will encounter hostility. This may involve discharge of the extensive arsenal of fallacious argumentation that is applied to support hype. This arsenal includes: argument from prestige; argument from the supposed authority of majority positions; and the false dilemma fallacy that either there is hype or there is no uptake of technological innovations. Also, those who advocate more responsible technology management can expect to be assailed by name calling from those who are most committed to brain energy conservation. For example, those who advocate more responsible technology management can expect to be called Luddites, closed-minded, resistant to change, etc. However, those assailed by fallacious argumentation and name calling when they raise well-reasoned questions about hyped technologies can find rejoinders in the findings reported in this paper. For example, those who raise well-reasoned question about hyped technologies are not covered by outgroup derogation [82,83]; are not constrained by Fear of Missing Out [52]; are not swayed by bullshit [101,102]; are not limited by the human tendency towards brain energy conservation [72–79]; and so on. Yet, the converse conditions may be characteristics of those who direct fallacious argumentation and name calling against well-reasoned questions about hyped technologies.

5. Conclusions

More than 200 hundred years ago, the sleep of reason producing monsters was drawn with great artistry by Francisco Goya. Today, the more minimalist descriptions of normative statements and simple curves are preferred in the expression of irresponsibleness brought about by the sleep of reason. Previous studies have reported hype cycles of inflated expectations, disappointment, and unintended consequences; and have proposed methods for improving the introduction of new technologies. Yet, hype cycles persist. In this paper, it is explained that the behavior of some chronological adults in hype cycles can be analogous to the behavior of irresponsible adolescents.

Analysis of one specific case, endorsement of the Asilomar AI Principles illustrates how there can be rapid progression from formulation of normative statements in a small social bubble to a transcontinental reality distortion field. In particular, social and emotional contagion can spread around the world by argument from prestige, rather than objective reasoning, via the Internet. Analysis of the general case of the formal hype cycle illustrates how overblown claims, inflated expectations, and troughs of disillusionment are made normal by institutional logics. In both the specific and the general case, the irresponsible behavior of adolescents is apparent; heighten responsiveness to peer presence and potential rewards.

Adolescent behavior among adults during hype cycles can be addressed through education, research, and practice. Education that focuses on the development of scientific reasoning skills, instead of focusing on justifying technology hype, is important to prevent synaptic pruning that could lead to a lifetime of hype-on-the-brain. Research related to methodologies that have been successfully applied to reduce irresponsible adolescent behaviors is important to determine how best to alleviate hype-on-the-brain among adults who have completed their education. Practice should focus upon those adults who are most prone to irresponsible adolescent behaviors during hype cycles. This, however, can be challenging when those adults have grandiose-manipulative traits, which characterize both the leaders of adolescent gangs and managers promoted through competence inversion.

The overall contribution of this communication paper is to relate the behavior of some adults in hype cycles to the irresponsibleness of adolescent behavior as investigated by neuroscience studies, and so draw attention to the need for behavioral change in the introduction of technological innovations—this being necessary to bring about responsible technology management. For example, responsible technology management that addresses the potential of human-beneficial AI to be fatally unbeneficial to everything else in the geosphere other than human beings. One potentially fatal unbeneficial outcome being the fabrication of more robots leading to further expansion of the

technosphere at the expense of more extraction of finite natural resources from the lithosphere and increased hazardous disruption to the biosphere. More responsible technology management is needed for more responsible research and innovation.

The analogy introduced here relates the behavior of some adults amidst hype cycles to foolish adolescent behavior. This is intended to introduce new directions for addressing hype cycles. In doing so, it is important to recognize that there can be hype on both sides of a debate of about the consequences of new technology. For example, some proponents of genetically modified crops claim that genetically modified crops are essential for human survival, but proponents may not take into account all potential unintended negative consequences [136]. By contrast, some opponents claim that genetically modified crops threaten the survival of soil, animals, and people [137]. Yet, they may do so without taking into account that there could be some potential benefits from genetically modified crops and that alternatives could have their own limitations [138]. Similarly, some envisage that robots could pay taxes to help humans [139], while others envisage that robots could harm humans [140]. Thus, even reasoned debate concerning technology, which has been hyped-up by others, can take place at opposite ends of a continuum. Such debate can overlook that whatever end prevails, there could be environmental degradation. Hence, more consideration for human/environmental balance can be needed from both sides of polarized positions.

Overall, in this paper, an analogy has been drawn between the behavior of some adults in hype cycles and irresponsible adolescent behavior. As stated in the Introduction section, cases are referred to in order to illustrate patterns in hype cycles, not to define individual motivations in specific cases. Additionally, it is important to note that there may be other potential analogies in the broader literature concerned with predictably irrational decision making [141].

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