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The innovation big picture: Including effectiveness dependencies, efficiency dependencies, and potential negative effects within the framing of new technologies

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ABSTRACT

Cycles of hype and disappointment are frequently observed in relation to new technologies. Hype draws attention to potential positive effects while excluding or under emphasizing a new technology's dependencies on other factors and its potential negative effects. Thus, hype presents a partial picture of technological innovation. In this paper, it is argued that dependencies and potential negative effects should be, and can be, included in the framing of new technologies. First, the limitations of hype are described with references to cases. Next, a template is provided to summarize big picture innovation framing. Dependencies for effectiveness and dependencies for efficient operation are included. This is because the potential of technological innovations to bring about positive effects is often dependent upon extraneous factors. Also, their efficient operation is often dependent upon many inter-related technological components. Potential negative effects are also included. Big picture framing is contrasted with the partial picture provided by hype. Then, examples of dependencies and potential negative effects are described for a range of technologies. Subsequently, a full example of big picture framing is provided for a hyped technology. In conclusion, it is argued that big picture framing can be a more informative starting point for understanding the potential of new technologies than vague hyperbole.

1. Introduction

Cycles of hype and disappointment are frequently observed in relation to new technologies. These cycles involve proponents of a new technology promoting their positive forecasts about the technology's potential effects. Promotion of positive forecasts leads to increasingly widespread enthusiastic expectations about the technology. Subsequently, expectations fall and disappointment rises as positive expectations cannot be met [1–4]. Hype draws attention to potential positive effects while excluding or under emphasising a new technology's dependencies on other factors and its potential negative effects. Thus, hype presents a partial frame of technological innovation, which leads to what has been described as blind or biased technology discourse [5].

The framing of new technology structures interactions among groups such as technology proponents and potential purchasers [6–8]. To frame is to draw attention to certain aspects of a topic, while excluding or under emphasising other aspects [9,10]. Basic framing research is carried out in psychology [11–13] and neuroscience [14–16]. Applied framing research has been carried out in the fields of organization management [17–19], mass media [20–22], political science [23–25], and social movements [26–28]. Common across these fields of research are findings indicating that how options are framed affects evaluations and decisions [29]. For example, positive evaluations are more likely when options are framed in positive terms [30], and an option is more likely to be chosen when described as an opportunity, rather than as a threat [31].

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Overall, framing research has revealed that human perceptions are remarkably susceptible to the manner in which new options are framed [32–34].

Hence, until the partial framing of new technologies is broadened to include dependencies and potential negative effects, as well as potential positive effects, it is likely that cycles of hype and disappointment will continue. Importantly, research findings indicate that framing bias, such as hype, can lead to suboptimal decisions throughout technology implementation projects. This is because the initial framing of a technology project provides lasting rationale for pursuing its implementation, and so can lead to continuing commitment to a failing course of action [35–38]. In this paper, it is argued that the framing bias of hype can be addressed by including dependencies and potential negative effects, as well as potential positive effects, in the framing of new technologies when they are presented to potential purchasers.

The findings reported in the paper are the result of survey research: in particular, literature review and semi-structured interviews. Literature review encompassed periodicals addressing framing studies and technological innovation. Interview participants were a purposive sample of nine with expertise relevant to an application of a hyped field of technological innovation: the Internet of Things [39]. The application is smart clothing that can, for example, automatically send messages about wearers' conditions to medical centres via the Internet [40]. A purposive sample of experts was used in order to determine the technological state-of-the-art in wearable automated messaging; and in market requirements for smart clothing. Purposive sampling of experts is appropriate when details are sought about an emerging field undergoing rapid development [41,42]. Face-to-face semi-structured interviews were used because the interview topic was well-defined before the interviews; but the specific issues within the topic were not certain before the interviews beyond broad categories [43,44], such as issues affecting technological performance and issues affecting customer requirements. The experts were four technology proponents and five potential purchasers. Of these proponents, one specialises in software, one in hardware, one in integration of software and hardware, and one in commercialization. The potential purchasers were representatives of companies that are interested in introducing smart clothing into their market offerings: via exclusive apparel retailing (three) and remote care for the elderly (two).

The remainder of the paper comprises four sections. In the next section, a template is provided to summarize big picture innovation framing. This big picture framing is contrasted with the current partial picture provided by hype. Then, individual examples are provided of dependencies and potential negative effects for a range of technologies. Subsequently, a full example is provided of big picture framing for the smart clothing case. In conclusion, it is argued that big picture framing can provide a more informative starting point for understanding the potential of new technologies than the vague slogans of innovation hype and/or the detailed reports of technical publications.

Framing is an on-going process, which can be informed by new insights over time. For example, early stage technology investors might require information about dependencies for technology development. Nonetheless, whatever the audience, the framing of technological innovations should be expanded beyond the partial picture provided by hype. The focus of this paper is framing for potential purchasers by proponents of new technologies.

2. Big picture framing

In this section, the partial framing of hype is compared to what is described as big picture framing. That is framing of new technologies that includes dependencies and potential negative effects, as well as potential positive effects.

2.1. Partial framing of hype

As outlined above, hype offers partial descriptions that present technological innovations as positive opportunities [1–5]. At the early stages of technologies' development, the partial framing of hype can arise from pressures on research institutions to seek research funding [45–47]. However, the focus of this paper is framing for potential purchasers by proponents of new technologies. It could be argued that dependencies and potential negative consequences may not be known to proponents. Conversely, as is shown in section three of this paper, proponents can be quite certain of dependencies and potential negative consequences – if they chose to think about them. Hence, it may be that the partial framing of hype arises from observational bias, confirmation bias, and publication bias in what proponents see, select, and report [48–51]. Such bias may arise from the need for proponents to sell new technologies in order to have employment and income [52,53].

Cycles of hype and disappointment fit well with the popular conceptualizations of innovation, such as creative destruction and disruptive change. Within these conceptualizations, disappointments with technologies are welcome opportunities to introduce further new technologies, which can destroy the old and create new markets, or at least disrupt existing markets [54–58]. This is a partial picture of innovation that is no longer sustainable because negative effects from new technologies can now be global and potentially irreversible; rather than local and manageable.

For example, technological improvements to horse drawn road vehicles in the 19th Century enabled more such vehicles to be put into use. This led to tons of horse dung being strewn across roadways, and the negative consequence of endangering public health. This was a local and manageable problem, which was addressed by dung being gathered from roadways and brought to local yards for conversion into a useful substance: manure. By contrast, negative effects of emissions from automotive vehicles, such as contributing to climate change, are global and potentially irreversible [59]. Such intractable negative effects are not limited to technological innovations in transportation. Rather, many new technologies offer as much peril as promise [60]. Consider, for example, the difficulty of addressing the deterioration in children's ability to