Personalized Persuasive Holograms:
Use Case Scenario – Running with Arnold

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Abstract. Next generation broadband cellular networks, e.g. 5G, will enable technological advancements. Ultra-low latency, less packet loss and high data rates should be able to fill the requirements for disruptive technologies such as augmented reality and ubiquitous services. One possible concept for using new 5G enabled disruptive technology in persuasion could be real-time holograms, for instance, using social roles as models for virtual avatars that could act as personal trainers for increasing physical activity. Just imagine celebrities such as Arnold Schwarzenegger. Running and exercising with Arnold while getting encouragement might be motivating for some, whereas those open to instructive authority could pump iron with Arnold's hologram. Through holographic simulation of oneself, one could perceive the link between the cause e.g. exercising and effect e.g. getting fit or losing weight.

Keywords: Persuasive technology, 5G, Hologram, Physical activity, Disruptive technology, Future technologies, Personalization

1 Introduction

Information and communications technology has changed the way we think and perceive the world. People all around the world can contact others over vast distances or share their music, art, et cetera for others to enjoy or criticize. Up to four generations of broadband cellular networks have enabled enhanced mobile services. Now the fifth generation (5G) seeks to offer higher bandwidth, lower delays (latency) and fewer packet losses than the previous generation(s). Therefore, one might ask, what technological advances do 5G enable in terms of designing persuasive technologies (PTs) when compared to fourth generation (4G) for example.

For one, a system for continuous patient monitoring of not only few individuals, but also even thousands at the same time [1]. Moreover, the long hyped Internet-of-Things (IoT) could finally be more than just refrigerators ordering refills of milk and cheese. Ubiquitous 5G IoT environment could for example support active and healthy ageing with the help of persuasive technology by true personalized medicine, even though predicting future technology can be a long shot [2]. Virtual reality (VR) and augmented reality (AR) can instantly benefit from 5G through the bandwidth and ultra-low latency, because both technologies already exist up to a limit; 5G can be considered serving as enabling infrastructure also for other technological advances e.g. autonomous vehicles [3]. According to Yu et al. [4], "*to achieve realistic services for users, hologram generation and delivery is the most desirable feature of 5G technology*". While high-speed broadband connections do exist, they are inevitably wired, thus hardly usable in real-life environments e.g. jogging in random outside location. Thus, portable holograms could only be enabled through cellular broadband networks, in other words 5G.

Truly ubiquitous environment with functioning real-time holograms could make current computers, smartphones and wearable devices seem like horse carriages; legacy technology that was surpassed by a disruptive invention called automobiles. In the wave of the becoming next generation cellular broadband networks, we decided to create a scenario for a branch of technological advancement that 5G could enable via future technology: *Running with Arnold*.

The next chapter introduces the background regarding 5G and holograms, whereas the chapter after that presents a persuasive technology concept. Discussion will be followed by conclusions.

2　Background

Holograms have long been one cherished concept of science fiction, for example in TV-series (e.g. Star Trek), movies (e.g. Star Wars) and video games (e.g. Halo Combat Evolved). Science fiction stories portray holograms as realistic moving images composed from light. Holograms should not be confused with Pepper's ghost, a technique to create optical illusions [5], even though the latter can seem quite realistic with modern technology; and has been applied for example in live music shows for "*bringing back*" dead musicians (e.g. 2Pac Shakur) to "*perform on stage*" [6].

2.1　Holography

Holography is a method of photography that makes use of laser beam rather than lens to produce images [7], while having a wide application domain including medicine [8], arts [9], storage of data [10], security (e.g. labels of government currency, passport and credit cards) [11].

Pepper's ghost. Pepper's ghost is considered a holographic projection, which is not a true hologram. Pepper's ghost, as a holographic projection, has been used to enhance the sleep of cohabiting partners. Holographic candles were utilized to offer calming

notifications and ambient feedback, thus nudging the users to go to sleep at optimal self-set times. [12]

Holographic displays. Holographic displays could be used for helping people to adopt healthy lifestyles. For example, in a study by Ramli et al. [13], users explored and imitated workout sessions by following three-dimensional (3D) animations projected through a holographic display. Nevertheless, holographic displays and holographic projection do exist, but true animated holography, in other words 3D picture or 3D video without the need for special glasses, requires further research and future development [14].

Holograms. Hologram, the end product of holography, can be described as "*a special type of photograph or image made with a laser in which the objects shown look solid, as if they are real, rather than flat*" [15]. Holograms can be seen with the naked eyes, they enable telepresence, and they can enhance the interaction between human and computers by making it more natural and real [14]; thus may have the potential to influence or persuade people. For example, del Valle and Opalach [16], as well as Chittaro and Zangrando [17] have addressed AR and VR in their research for changing peoples' behaviors. One path of research is near-eye displays that use holography for virtual and augmented reality [18].

2.2   5G

Holograms portrayed by science fiction (e.g. Star Wars) may very well be reality in the becoming years, for science fiction seems to function as an inspiration for inventors, rather than as precise prediction of the future [19, 20]. In the end, it all comes down to technology and the ultra-low latency is one of the requirements for 3D images and holograms, and 5G should support this requirement [21]. Another requirement is high data rates, which 5G should also be able to support [22].

The rapid developments of mobile and telecommunications network seems to have opened new affordances and opportunities for research and industry. The fifth-generation network spokespersons tend to promise high speed, high capacity, larger data broadcasting, and bigger phone memory for audio and streaming activities.

Although the theoretical side of 5G networks is known, its true potential is yet to be explored regarding practice. Nevertheless, the potential can already be predicted, given that it is built on 4G, thus assumptions of its power can be made. For example, 1) the role of 5G in solving the challenges that previous generations of mobile networks faced e.g. the limitations of 4G such as bandwidth for cellular communication of healthcare systems based on IoT; 2) as well as new approaches that 5G will enable. [23]

With vendors implementing 5G fixed mobile access and test networks, use case scenarios have been proposed; these include but are not limited to: smart pharmacy, precision medicine, personalized medicine, remote care, surgical robots, social robots, smart packaging of medical products, artificial organs, telemedicine, wound management, wellness and fitness [24], drones, virtual and augmented reality, and holograms [4]. 5G and subsequent mobile networks should enable the development of media-rich mobile applications that support telepresence and 3D holography, including large and fast data rates.

In essence, 5G could provide opportunities for personalized healthcare delivery via mobile, wearables and all sorts of electronic applications [25]. These could also enable self-management of diseases caused by lifestyle choices [26] and non-behavioral factors [27]. As such, the need to integrate theories underpins human computer interaction, behavior change and persuasion strategies into the design and development of such health applications.

However, it should be noted that 5G might not be enough for truly multiple-view holographic experience, which may instead require much higher data rates that would require yet another generation of broadband cellular networks, which is actually already on its way [28].

2.3 Holograms and Persuasion

Persuasive strategies can be embedded implicitly or explicitly into technologies as authoritative or non-authoritative agents [29]. These strategies can be used to support the user to perform tasks that lead to behavior change, interaction between the user and technology, the credibility of the system, and communication with other users of the technology [30]. Holograms can be used as substitutes for persuasive agents such as instructors, friends, state of human organs, and animated characters using direct, emergent, or virtual or augmented reality [31].

Persuasive effects of presence. Presence provides direct experiences, which have been found to be more persuasive; it has an impact on the cognitive and emotional perception of a person [32]. There is evidence that presence has an impact on attitude change [32, 33]. The extent of presence afforded by persuasive technologies affects the perceived persuasiveness of the technology.

Virtual presence technologies (e.g. VR and AR) provide affordances of real environment compared to text, audio, video and hence are more persuasive [32]. Social influence, presence and persuasion are also closely connected [33]. Presence in augmented and virtual reality could "*take*" the user into another environment, while holograms could interact with the user in their real authentic environment. This unique attribute should have the tendency to persuade the user.

Social actors. Computers are persuasive social actors [34], and holograms could be seen as an analogy for computers. As such, the affordances of computers as social actors could be leveraged for holograms, and thus holograms could persuade and influence users. Holograms as social actors could provide social support, and model a target behavior, among others.

Persuasive potential of holograms. To persuade a user to adopt a healthy lifestyle e.g., quit smoking, lose weight, or self-manage a health issue, to name a few, there is a need to understand the goals of the user, context dependent features, and the medium to support behavior change [30]. Holograms as social actors could support the user to commit to changing a health behavior for example by motivating, persuading and providing helpful information.

We suggest a few ways in which holograms could persuade users to change their behavior given visual, interactive, engaging, and immersive appeal.

- *Reduction*: e.g. a hologram that provides and demonstrates simple tasks and instructions for exercising
- *Simulation*: e.g. a holographic recording that demonstrates the cause and effect before they take an action;3D hologram to display an obese reflection of individual - resulting from poor eating habits
- *Personalization*: e.g. a 3D holographic personal coach
- *Rehearsal*: e.g. a hologram that enables users to rehearse new behaviors
- *Reminder*: e.g. a hologram that pops up to discourage children from going close to cooking tools
- *Social role*: e.g. a hologram that support virtual (tele)presence of celebrity or friend who provides some form of motivation or social support
- *Cooperation*: e.g. a hologram that collaborates with the user to perform target behavior
- *Competition*: e.g. a hologram that competes with the user to perform a behavior (as in scrabble or chess competition between a computer and a human)

To demonstrate the concept of personalized persuasive holograms, a scenario, which we call "*Running with Arnold*" will be presented. In this scenario, a hologram of Arnold Schwarzenegger is the medium for persuasion.

We present a case, in which individuals need to adopt the fitness lifestyle to manage health condition or change health behaviors. Arnold is called into the rescue to motivate, persuade, and assist the users to reach their goals. Arnold Schwarzenegger is a recognized celebrity in the fitness industry, idol to many, and as such could play the role of a coach, an (un)authoritative instructor, or simply support the user with praises and/or suggestions.

With 'running' as one of his many talents, we present some in the hologram of Arnold, which could persuade users to change behavior(s) or adopt new behavior(s).

- Instructing users to run, giving helpful information about good postures for running, demonstrating how to run, *rehearsing*, etc. based on the performance of the user.
- Providing feedback to users via *praise*, *reward* (e.g. handshake), *reminding* the users about their goals, *suggesting* ways in which running can be improved based on the performance of the user.
- Leveraging his *credibility* as a fit person to influence users. The hologram could be decorated with awards that he has earned from the fitness industry, which could be used to increase the *trustworthiness* and hence persuade the users (although in the case of Arnold, most people would know his accomplishments anyway).
- Providing social support by *competing* or *cooperating* with the users in running tasks such as a marathon.

With social features, one could imagine that the hologram of Arnold would be instructing, competing or cooperating to perform a task with a group of people who are Arnold's fans. Arnold's hologram could be customized, thus personalized for an individual user with or without other users regarding social features.

Personalization potential of holograms. Personalization, for example providing personalized content or services, can increase persuasive potential of systems [30]. However, the personalization context of systems may often be left *weak* e.g. targeting groups not individuals, or even *fake* e.g. using one's name without further personalization features [35]. Similarly, if persuasive holograms would be produced as "*bulk*", e.g. only using the appearance and voice of a celebrity with pre-defined phrases, it should not be counted as *strong* or *true* personalization, even if the said celebrity would be users' idol. As regards strong personalization, in-depth user modeling, based on the actions and reactions of the targeted user, would be required; and would likely request high computing power [35] as well as low latency (for responses from the hologram). With cloud computing seemingly being the trend manufacturers are moving towards, enabling lightweight terminal devices with significant computation capacity, high data rates would be needed between hologram terminal and cloud, which 5G should enable. As users may change their behavior, similarly systems should adapt to the change to provide true personalization [35]

3 Concept and Scenario

For the sake of concept and scenario regarding this paper, we assume that engineers and scientists will eventually figure out all the details when it comes to functioning real-time holographic images. Therefore, the point of this paper is not to solve the technical problems, but instead examine the possible use of a becoming potentially disruptive technology as regards to persuasion: *persuasive holograms*.

3.1 Concept

Stepping away from traditional persuasive technology, holograms could be the next step after computers, thus truly disruptive technology for the next generation of personalized persuasion via technology. For this paper, we drafted a concept of how holograms could be utilized in persuasion.

Personal trainers have long been popular with people, for either instructing gymgoers with proper exercise moves or pushing them to the limit [36]. Similarly, one can perceive for example friends training together, whether it be jogging, guided gymnastic exercises or lifting weights at gym. It seems that depending on their self-concordance, the optimal mode of goal-striving, people enjoy challenges, or may need social interaction to persuade them to be more active physically [37].

For example, it may be more difficult to stay at home, when you have booked an appointment with a personal trainer to the gym or settled a competitive exercise date e.g. tennis with a friend. Thus, the motivation for being physically active may be derived from both intrinsic, e.g. enjoying challenges and extrinsic e.g. social interaction complemented with positive feedback.

Given the possibility in technological advancements, what if one could train with someone s/he looks up to; and could receive encouragement and positive feedback from

that person in first-hand experience. What would happen, if one could go jogging together with Arnold Schwarzenegger, the original running man? Could one be persuaded for example to be more physically active together with holograms of other, perhaps famous or well-known, people; or in the case of children, with one's favorite cartoon character? Furthermore, the interaction of the hologram should be truly personalized by utilizing user modeling as regards to the preferences of the user to avoid personalization myopia [35].

3.2 Scenario

On a bright sunny day, one is ready to go for a run, but lacks motivation. Arnold Schwarzenegger, idol of the user, enters as a hologram and encourages the user to get up, go out and start jogging "*with him*". User can start running together with Arnold, being personally encouraged all the way and feel good afterwards. Thus, holograms could act as personal trainers, or in other words, the system adopts a *social role* and serves as truly *virtual avatar* to support and motivate users [30].

If the user wants to go to the gym later on, once again, Arnold can appear there as a hologram to instruct and encourage the user in pumping iron. Some people might benefit from *authoritative* instruction style [29], and it is difficult to image a stricter personal trainer than seven-times Mr. Olympia.

The use of holograms for increasing physically active lifestyle could include other styles of persuasion, as well. For example, *simulation*, where the user can observe the link between cause and effect regarding exercising, could be very persuasive [30]. If the user could see a hologram of oneself from different angles and from a certain periods of time, while having access to previous *self-monitoring* data regarding exercising, one could reflect on the link between the cause (exercising) and effect (losing weight, better physical condition, more muscles et cetera).

How about *cooperation* [30], if new technology could provide for example for friends to jog together, even if they are in different continents? It would seem quite persuasive, if you would not have to stop exercising with friends, even though they should happen to move elsewhere. If both could see each other as real-time holograms while jogging, it could feel like they are still running together.

As for *competition* [30], there would not be any reasonable obstacles for friends to have a friendly competition regarding who runs faster, even if they are physically elsewhere. Once again, hologram could fit in; or why not compete with someone famous, maybe not Usain Bolt, but perhaps Arnold Schwarzenegger for one. Even if his hologram "*loses*", you would still know that he would be back for another round.

In the case of children, would it be efficient if their most favorite cartoon character would nudge them towards positive behaviors, for example anti-bullying, instead of authorities. Through *liking* [30], the hologram of SpongeBob SquarePants for one could encourage children to take better care of their pets e.g. goldfish in a bowl.

4 Discussion

The possibilities of uses for new technological advances in persuasion could be some of the previous presented, or none of them. Only time will tell, whether we can run with Arnold, or not. One should not shy away from thinking or imagining uses for potential technological breakthrough, in this case possibly enabled by next generation broadband cellular networks. As the past has shown us, science fiction prototypes could very well become reality in the future technology by some means or another [19].

However, regarding persuasion, models, theories and frameworks, some of the previous ones could be adapted or modified to support new disruptive technologies, but it can be difficult or in some cases somewhat impossible. Transforming previous theories directly into platforms e.g. IoT, AR, VR, ubiquitous environments, or holograms that differ radically from the previous ones (e.g. computer and smartphones), may not be the right way to deal with disruptive technologies. New inventions will surely surpass old legacy technologies eventually; therefore, there should be a need for starting to consider the aspects that new frameworks and theories for persuasion could end up having.

Technological features such as *reduction* in the form of simple tasks and instructions, or *simulation*, *rehearsal* et cetera are certainly not new ideas or groundbreaking aspects as regards PT. The same could be said about virtual avatars e.g. hologram of Arnold Schwarzenegger. The ideas about aforementioned persuasive features per se are not new, but in the case of technological break-through, true virtual 3D real-time holograms would be something new that should have an influence on how the research community perceives persuasion.

While high-speed broadband connections do exist, they are inevitably wired, thus hardly usable in real-life environments e.g. jogging in random outside location. Thus, portable holograms could only be enabled through cellular broadband networks, in other words 5G.

As regards virtual environments, immersion can be considered as a belief that one is present in the virtual word, and presence (being in the virtual world) is consequence of immersion [38]. As regards holograms, it could be considered that holograms could turn the initial setting the other way around; virtual world being present in the real one, which could make holograms unique as truly immersive experience when compared to other persuasive technological solutions e.g. mobile or web apps, 3D virtual glasses et cetera. Thus, holograms could most certainly be an example of disruptive technology that could change how we perceive persuasion in the future – bringing the virtual world into the real one. As for the concept and user scenario we have presented, it could up to some point tried out with the technologies we have now. However, would a smartphone's screen with an image of Arnold Schwarzenegger or clumsy VR equipment be as immersive and present, as a moving hologram of him present in real-world environment?

How then, could we consider persuasion with the help of new technology, if we still lack the actual functioning technology? We may start by looking up what becoming technologies may enable, as well as how that technology has been presented in previous mediums, for example science fiction. Fiction may have been something that has

brought us from near-river campfires into cozy modern houses with indoor fireplaces and running water, because the power of human imagination may very well forge the reality: with courage to dream that the world could be a better place; we ourselves may be persuaded to work towards that goal.

5 Conclusions and Future Work

The aim of this paper is not advertisement or marketing new cool and hype technologies, quite the opposite. What we were trying to do was taking into account the emergence of 5G, what it could enable in the future and through a concept scenario show what one direction of the future for persuasive technology could be.

Predicting future is more like threading on thin ice in the middle of a frozen lake while hoping of not getting one's feet wet, than paving the road into a set location. While it may be true that predicting the future is uncertain at its best, science fiction for example has inspired inventors in the past to change the future. Without the courage to dream, the future could end up being more like a dystopia, rather than a utopia.

The things we have presented in this paper are derived from sources that have been applied for technology that exists today, but still could be "*transformed*" to apply into potential new disruptive technologies. Thus, our findings, concept and scenario could be seen as stepping stones for considering what the future of PTs could be like. Furthermore, without anyone trying to imagine what the future could be like and without others inventing those disruptive technologies, our present time could have ended up being dull, but at least our legacy technologies such as horse carriages would be superb.

With currently ongoing advancement of information technologies because of next generation broadband cellular networks, the future world could seem like one from science fiction novel for the people of present age. Similarly, as the present age would seem for someone from the beginning of the new millennia.

Therefore, the contribution of this paper is to open the minds and thoughts of the research community to research possibilities for disruptive technologies and imagining what the future could be like. We propose that as soon as suitable technology is available, a working prototype should be built. We would be more than willing to participate in the process and research effort and we would want to invite other researchers to join in this endeavor.

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