

Fostering safe behaviors via metaphor-based nudging technologies

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Abstract. The goal of this research is to study the role of metaphor on the effectiveness of technologies that are designed to nudge people towards more healthy or socially appropriate behaviors. Towards this goal, we focus on the problem of motivating and encouraging appropriate social behaviors in the context of the ongoing COVID-19 pandemic, such as maintaining mandated social distance, wearing masks, washing hands. In the last few months, many countries have developed different approaches to promoting and enforcing the mandated behaviors. In this research, we explore metaphor-based solutions to this problem by studying the following research questions: (1) How is it possible for artificial agents to recognize inappropriate behavior (mobile systems, robots)? (2) How to design metaphor-based interfaces of artificial agents that relevantly and effectively influenced human decisions and choices in the event of improper behavior? Our approach is implemented in three steps: (1) Identifying inappropriate behaviors in the context of maintaining social distance; (2) Designing a persuasive metaphor-based interface to nudge people towards appropriate behaviors. (3) Designing a user study by deploying technologies that incorporate the interface. This research is interdisciplinary and concerns cognitive linguistics, IT, human-computer interactions, cognitive science, media ethics, and legal issues.

Keywords: Metaphor, Nudging technologies, Healthy behaviors.

1 Introduction

In recent years, a number of persuasive technologies have been developed that are designed to nudge people towards more healthy or socially appropriate behaviors. As new technologies are introduced, such as mobile phones, computers, GPS systems, and self-trackers, they make possible a range of new behaviors, and new norms have to be established for these behaviors to determine what is appropriate and what is not in any given situation (Gunia & Indurkha 2017; Colley et al. 2017). This might be of crucial importance in the context of sanitary emergencies, where appropriate collective behaviors, such as social distance, wearing masks, washing hands, could be nudged to reach a solution for the sanitary emergency itself. Past research has shown that metaphors can be very persuasive in nudging people towards this behavior rather than

that. Our goal is to explore this possibility by studying use cases, developing metaphor-based prototypes, and conducting preliminary user studies. Based on the results of these studies, we will propose some guidelines for designing metaphor-based interfaces to persuade people towards healthy and safe behaviors.

From the COVID-19 pandemic outbreak onward, the development of advanced mobile and internet technologies has massively made our activities take on a new dimension, including business meetings through video conferencing, e-learning, and numerous deliveries of food ordered online. However, the impact of technology on human behavior can be even greater in correcting human behavior. The role of metaphors in persuading people to follow certain behavior patterns has been known for some time (Thibodeau et al. 2017, 2019), but it is still underinvestigated why some metaphors can be more persuasive than others in the context of sanitary emergencies. In this paper, we study and design use cases, focusing on the problem of motivating and encouraging appropriate and safe social distance in the context of the ongoing COVID-19 pandemic. In the last several months, many countries have developed different approaches to promoting and enforcing this mandated behavior. We explore the role of an interface based on the fire metaphor for COVID-19 to address this problem: COVID-19 is implicitly compared to a spreading fire and people are “matches” that need to be far from the fire to stop the fire spreading. Metaphor has indeed been recently studied and discussed as a persuasive conceptual tool to let lay people understand the need for social cooperation in preventing COVID-19 spread (see Semino 2020 for a critical analysis of different metaphors for COVID-19 prevention). In particular, our research is guided by the following research questions:

- (1) Can we design artificial agents to recognize inappropriate and unsafe behaviors?
- (2) How to design a metaphor-based interface of artificial agents that relevantly and effectively influence human decisions and choices in the event of improper behavior?

In what follows we provide a framework to address each question. Based on this framework, we will explore some challenges to testing nudging technology prototypes based on the fire metaphor.

2 **How artificial agents recognize appropriate social distance**

This research adopts a conceptual perspective of the influence of artificial agents on human behavior in the context of sanitary emergencies. For artificial agents we mean mobile or web applications and/or social robots that can recognize the behavior, i.e., an architecture of sensors that can collect data from the environment to recognize some relevant events for the mandated behavior, also having a nudging interface. First, we argue that “social distance” should be better understood by the artificial agent (but also by laypeople) in terms of “spatial distance”, but social closeness (Abel & McQueen 2020). Second, we underpin the idea that psychology and economics methods about decision making can be used to influence human behavior and especially correct it, also in the case of social distance.

2.1 Social distance as spatial distance and social closeness

During the COVID-19 pandemic, social distancing has been one of the crucial measures taken by many countries to slow down the spread of the virus. As per WHO recommendation on physical distancing¹, it consists of a spatial distance, i.e., at least 1m, people were suggested to stay away from each other, in order to be safe and reduce the transmission. The human distance perception, which refers to a process in which an observer perceives an interval between two points in space (Yamamoto 2017), is difficult to accurately estimate. The spatial distance can be quite easily measured and maintained by an artificial agent, while it has proved to be difficult for humans, who had to be explicitly instructed to do so during the pandemic and also provided with explicit reminders (written and visual normative rules). However, despite the abundance of both linguistic and visual instructions and reminders, this restriction was (and still is) most often not properly respected. As it has been pointed out, social distancing “pushes against human beings’ fundamental need for connection with one another” (Zaki 2020), especially in most difficult and stressful times. The lack of social closeness can indeed be at the roots of serious mental health problems: while affective and social support can help people during the pandemic in this respect, loneliness can rather bring anxiety and depression (Abel & McQueen 2020). Thus, if spatial distancing is a safe behavior to prevent the COVID-19 transmission, the idea of social distance is rather an unsafe behavior and social closeness should rather be fostered to prevent unsafe mental health behaviors. To foster safe behavior for humans, effective technology should promote both spatial distance and social closeness.

The latest Information Technologies (ITs) not only facilitate the performance of certain “spatial” tasks, such as keeping spatial distancing, (sometimes also by providing entertainment), but also strongly influence our social behavior in everyday life. Previous research has studied how computer games can trigger emotions, including moral emotions (guilt, pride, compassion, gratitude, contempt, indignation, see e.g., Tangney, Stuewig & Mashek 2007). Authors of these studies suggest that moral emotions are triggered when players perform especially immoral behavior in the game (primarily guilt) (Hartmann, Toz & Brandon 2010). On this basis, they conclude that even playing anti-social games, some prosocial effects may appear (Grizzard et al. 2014), such as civic engagement, establishing new social interactions, easier contacting of closed and shy people, the need for making new contacts in the real world (Ferguson 2010). The results of current research show how certain behaviors in the virtual world translate into behaviors in subsequent social interactions. In particular, cognitive technologies can change the body schema/image and influence emotions, thereby affecting immersion and cyborgization (Gunia 2019).

Systems based on the idea of quantified self (or self-tracking) are a special group of mobile and wearable cognitive technologies that particularly affect our behavior. Using IT tools, it is possible to measure different aspects of our behavior, including spatial distance from other people. The ‘quantified self’ is the idea of measuring human behavior, biological signals, mood, or geographical location in order to optimize our life in various aspects, e.g., in order to increase our emotional and social intelligence,

¹ The WHO recommendation on physical distancing is available at <https://www.who.int/westernpacific/emergencies/covid-19/information/physical-distancing> (last accessed 2021/12/1).

optimal sleep, prolong life, maintain health, track our preferences, habits, social and material practices. Optimization in these systems is associated with the detection of various correlations, anomalies, and high frequencies in our behavior. In turn, embedded decision support systems may dictate what should be done to achieve optimization in a given field (Swan 2012). It is also strictly connected with monitoring, controlling, and pressure to improve ourselves (Neff & Nafus 2016).

These tools can be regarded as an element of motivational cognitive enhancement for supporting self-motivation, understood as goal orientation consisting in motivating oneself to achieve the goals set. Motivational enhancement is to provide a better perception of needs, and then to optimize and control one's capabilities in order to realize one's own needs. The goal is also to stimulate and supplement cognitive processes and emotional feelings for better performance of motivated tasks (Gunia 2019). For example, apps for mobile phones for measuring physical activity, such as MapMyFintessor or Runkeeper, can monitor physical and physiological activity. These solutions are based on the optimization of basic physiological processes. The second group of applications aims at self-improvement, based on scheduling and self-control, and finally self-awareness.

2.2 Nudging the appropriate behavior

Persuasive technology can positively influence social agency and modulate the way people connect to the environment, making sense of their relationships with the world and the others. Many people think that they have high multi-tasking skills, but our attention, as well as our abilities for epistemic vigilance, are limited and biased in specific ways both by environment and social relationships (see e.g., Sperber et al. 2010). In the Nudge Theory proposed by Thaler & Sunstein (2009, 2021), indirect reinforcement and suggestions are proposed as ways to influence the behavior and decision-making of groups or individuals (Berger 2020; Matsumura et al. 2015). The term "nudge" suggests that, instead of coercing a person, one may (only) "push" him/her (in a gentle manner), by taking advantage of certain human cognitive biases. Nudge is the modification of what Thaler and Sunstein call architecture, that is, the structure of the physical world (for example the arrangement of sweets in a canteen), to make it simpler, easier to determine the socially desired action.

Thaler & Sunstein (2009) focus on "pushing" someone in some direction, and mainly by exploiting his/her cognitive biases. However, defining "nudging" (as manipulation of choices) independently from "regulation" implies accepting as nudging *any* attempt to influence someone else's behavior, even by merely granting information (see Lorini & Moroni 2020 for a critical perspective). Also, nudging effects are short-lived (Kelly et al. 2013) and their effectiveness depends on the correct identification of 1) the mechanisms through which information influences behavior; 2) the motivations for specific (in)appropriate behavior; 3) the specific context in which the target behavior occurs (Bicchieri & Dimant 2019). More importantly for our research, language (and visual format) of the conveyed messages matters for nudging (Schultz et al. 2007), thus different (metaphorical) framings of the messages can bring to the failure of the nudging itself.

3 A metaphor-based interface to promote social distance

In our view, metaphorical representations, providing people with useful models of the (social) world (Thibodeau & Boroditsky 2011, 2013) can be the basis of persuasive strategies used to build conceptual models of how artificial agents influence human behavior. Metaphor has been described as a cognitive process that leads people to grasp an unknown (often abstract) conceptual domain in terms of a better known (and often more concrete) conceptual domain (Black 1954; Lakoff & Johnson 1980; Bowdle & Gentner 2005). Metaphor is thus a useful conceptual tool not only to design interfaces in human-computer interaction (Colburn & Shute 2008), but also to represent messages from artificial agents that can be easily understood by laypeople (Klingen 2018). The analysis carried out in this way will allow us to develop an architecture of representation of messages from artificial agents that would reach people in their everyday life, thus more effectively influencing the mandated behavior in the case of social distance.

3.1 Metaphorical framing as a reasoning device

Metaphor has been considered as a reasoning device that implicitly accompanies the audience along a path of inferences from a source conceptual domain to a target conceptual domain. In the process, as widely pointed out (Entman 1993; Semino 2008; Burgers et al. 2016), metaphor is never “neutral”, because it provides a figurative frame that makes the audience ignore some properties of the source and select other properties, which become prominent. Thus, metaphor as a reasoning device has an “ignorance-preserving trait” (Arfini et al. 2018; Ervas 2019): it gently “pushes” the audience to select the relevant properties of the source to understand the target, while other properties of the source remain ignored or underrated.

In a very famous series of experiments, Thibodeau & Boroditsky (2011, 2013) showed that when metaphorically framing a target, i.e., an important societal problem (e.g., crime) via different metaphors (virus vs. beast), participants consistently adopted different behaviors (enacting respectively social reforms vs. harsher enforcement laws). As the authors argued, metaphor is a framing strategy that presents people with an implicit evaluation of the target, i.e., the societal problem, thus influencing the way people interpret and reason about it. In a similar framework, Scherer and colleagues (2014) described a disease (the flu) literally vs. metaphorically (as a beast, riot, army, or weed) and showed that participants are more prone to get vaccinated when the flu is described metaphorically rather than literally. The authors concluded that “describing the flu virus metaphorically in decision aids or information campaigns could be a simple, cost-effective way to increase vaccinations against the flu” (Scherer et al. 2014: 37).

However, other follow-up studies showed that the metaphorical framing effect on reasoning and decision-making on the same societal issues was below the significance threshold. Steen and colleagues (2014) found effects neither of the metaphorical frame for crime nor of the metaphorical textual support on reasoning. They concluded that increased media attention and/or a simple text exposure to the issue as a relevant social problem finally influenced the policy preferences. They finally suggested that novelty, artfulness, or deliberateness of a metaphor might play a major role in enhancing the metaphorical processing as well as the communicative effects of the text. In the same

vein, the more recent study by Panzeri and colleagues (2021) showed that describing COVID-19 as a war entailed no metaphorical framing effect on reasoning and decision making in the participants, but rather that the acceptance of metaphorical-consistent behavior was modulated by participants' previous political views. In other words, reasoning about COVID-19 in terms of war just confirmed and reinforced right-wing oriented participants' previous beliefs.

Interestingly, an experimental study (Robyns & Mayer 2000) on the use of metaphor for the solution of everyday dilemmas showed that the framing effect also depends on reasoning conditions. The authors proposed the *metaphor processing termination hypothesis*, suggesting that when a metaphor is unnecessary, not consistent with the reasoner's understanding process, or increases ambiguity, the metaphorical framing effect decreases: "reasoners were less likely to make decisions consistent with the metaphor, were less likely to rate the metaphor as apt, and were less likely to choose metaphor-consistent responses on a subsequent verbal analogy test" (Robyns & Mayer 2000: 57). More recent empirical studies (Ervas et al. 2018; Ervas et al. 2021) have shown that conventional metaphors can lead people to revise the premises of the reasoning processes to hold their (already believed) conclusions while creative metaphors can help them in finding alternative solutions, but this might crucially depend on the *affective coherence* of the metaphorical source with the target. Thus, the metaphorical framing might influence people's reasoning, also entailing a shift in implicit attitudes toward the target, but this depends on the social context addressed by the metaphor, the reasoning aptness of the metaphor, and its affective coherence in light of a specific conclusion.

3.2 The fire metaphor for spatial distance and social closeness

In the theory of conceptual metaphor (Lakoff & Johnson 1980), metaphors can modify people's behavior because they are not just "linguistic", but rather constitute cognitive models for conceptualization. However, as we are mostly unaware of metaphorical framing, we might not be able to identify its effects on behaviors either. This is very striking in the case of the latest crisis in our society during the COVID-19 pandemic where the metaphor of COVID-19 as war was widespread in political discourse, aiming at influencing people's views about it and required action against it. In the field of health communication, the WAR metaphor has been largely applied in discourse to describe illness and therapy management, especially in oncology (Ervas et al. 2016; Semino et al. 2018), and thus making it easier to conceptualize a phenomenon that is difficult to express in literal terms in people's life.

As the WAR metaphor is highly conventional and frequent in health communication, it is easier to understand when compared to new and creative metaphors. However, scholars highlighted the negative entailments of the metaphor (Sontag 1978; Semino et al. 2018): people reported feelings of anger or sadness in perceiving them as losers in a war that was not in their control. More recently, the WAR metaphor has been applied to the COVID-19 pandemic, thus moving to the individual health context to the collective health context of entire communities threatened by COVID-19, where new key features of the WAR metaphor emerged (Marron et al. 2020). Indeed, the war against COVID-19 expressed the urgency for masks and social distance as weapons against COVID-19, but was highly criticized in public debates for

its negative implications, especially from an affective point of view. Politicians used motivating language against COVID-19, targeting emotions to call for joined action (Schnell & Ervas 2021): by frightening people and making them be afraid of the unknown, social distancing has been imposed as physical isolation without connection with social spaces. Thus, as remarked by Schnell & Ervas (2021: 11), “new metaphors have been proposed in a variety of discourse genres (from social campaigns to political cartoons) to challenge the shortcomings of the WAR metaphor for COVID-19 and find alternative and more suitable metaphors to talk about the social crisis engendered by the pandemic” (see the #ReframeCovid Initiative², for a collection of COVID-19 metaphors, in both verbal and visual shapes).

The WAR metaphor not only promotes a particular view of society but also includes specific feelings and attitudes toward the pandemic, which might influence reasoning on the measure to be taken and/or be passively accepted by the society, especially when confirming beliefs already held as true by its members. However, metaphor can also have a perspective-changing function (Steen 2008): especially when novel and creative, metaphors can help us in focusing on the target from a completely new perspective, questioning previous beliefs held as true or reframing them, thus providing a new conceptualization that can change our view of the social world. As pointed out (Semino 2020, 2021), the fire metaphor for COVID-19 could be more effective in communication and reasoning about health emergencies. In particular, the metaphorical frame of fire can highlight “different aspects of the pandemic, including contagion and different public health measures aimed at reducing it” (Semino 2020: 50). Indeed, beyond evoking vivid and rich images, fire metaphors can convey danger and urgency, but also help in explaining the different phases of the pandemic, how transmission happens, and the role of individuals within that, how the pandemic connects with health inequalities, and other problems. Most importantly for our research, while the war metaphor cannot explain measures for reducing contagion, in the fire metaphors people are “trees” and “fuel”, thus exploiting “the forest fire scenario to convey the effectiveness of quarantines and social distancing” (Semino 2020). These might be the basic elements to build a metaphor-based interface to promote social distancing as “spatial distancing”, which can suggest how to avoid the spreading of the fire.

What is missing in Semino’s analysis is that fire is also used as a metaphorical frame to entail affective “warmth” and “enlightenment”. Indeed, other studies (Frankfort 2021; Schnell & Ervas 2021) showed that COVID-19 as enlightenment entails a call to change and find a new direction in life: quarantine and spatial distance were also times and places where to think of and reflect on our (pre-pandemic) life, making sense of the new situation and finding creative ways to socially connect to others. From this perspective, the fire metaphor for COVID-19 entails an opportunity (rather than a tragedy) to find creative ways of sharing our lives with the relevant others, rather than social isolation. These might rather be the basic elements of a metaphor-based interface to promote social closeness, besides “spatial distancing”.

² The #ReframeCovid Initiative and the collection of COVID-19 metaphors is available at <https://sites.google.com/view/reframecovid/home> (last accessed 2021/12/1).

4 Design challenges for visual metaphor-based prototypes

The fire metaphorical frame for COVID-19 has been proposed not only in verbal messages to promote social distance but also in the visual mode (images and video) to let people understand, think or remind about the right thing to do to avoid contagion. An example of visual metaphor in a short video is provided by the graphic designer Juan Delcan³, who depicted COVID-19 as a fire spreading via matches, alias people, who need the “right” distance to stop the spreading itself. As in any metaphor, also this example can be criticized for missing analogies with the real-world situation, but in our perspective, it can be an effective way to gather people’s attention on the (social) problem and nudge their behavior in the desired direction. The visual metaphor attracts people’s attention precisely because it “creates” a (social) problem that urgently needs a solution.

As previously argued (Indurkha & Ojha 2013; Perez-Sobrinó 2016), a visual metaphor is inconsistent with our familiar conceptualization of the (social) world. A visual metaphor is “based on a disruption of existing familiar conceptualizations of objects and/or actions” (Ervás 2019: 17). Nudging technologies could therefore exploit the unfamiliar or changed “architecture of the world” presented via visual metaphor. To nudge the desired behavior and promote social distance, the change in architecture can be proposed via 1) homospatiality (i.e., the physical co-impossibility of the two discrete entities occupying the same space); 2) suspension of functionality (regarding objects or spaces); 3) unexpected affordances. The visual version of the fire metaphor can thus be realized in different ways in the interface: in the example provided by Delcan, it is realized via suspension of functionality (of the match), alias the suspension of functionality of a person as a vehicle for COVID-19 contagion.

In previous research (Ojha & Indurkha 2020), a system to generate visual metaphors based on algorithmic perceptual similarity has been proposed. In this research, a visual version of the fire metaphor can be exploited to create and test a persuasive interface for social distancing. The project first adopts some technical methods for identifying inappropriate behavior in spatial distancing, covering the use of relevant sensors in mobile devices and social robots. The project thus aims to use open access data from GPS transmitters, Bluetooth communication channels, gyroscopes. A recognition and explanation system could be designed with the usage of advanced machine and deep learning methods.

5 Conclusion

In this paper we explore the idea of a metaphor-based interface for technologies designed to nudge social distance. Developing such tools required guidelines, also for the privacy of data processed by artificial agents. The recognition of (appropriate) human behavior is associated with the collection of large amounts of data about the user and the user’s environment, which can lead to the following problems: 1) legal issues related to methods of data management; 2) surveillance issues (for instance, the user of these technologies may have the feeling of being observed, which will reduce the effectiveness of such a solution). In the development of the research, it will also be

³ The video is available at <https://www.youtube.com/watch?v=8Hi9-5F2zW4> (last accessed 2021/12/1).

important to consider, from an ethical point of view, if the metaphor can entail negative connotations, especially in relation to different cultures.

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