Persuasive Data Storytelling with a Data Video during Covid-19 Infodemic: Affective Pathway to Influence the Users' Perception about Contact Tracing Apps in less than 6 Minutes

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ABSTRACT

The current pandemic showed us the importance of swiftly disseminating data-based information to the masses of people. This study explores an affect-centered narrative to convey data-driven messages regarding contact tracing apps (CTAs) using video as a medium (i.e., data video). A between-subjects online study compared the effect of three storytelling approaches on viewers' perception. A video developed by Google was selected as the baseline video (Control Condition; 2min 23s) due to its high quality and relevance to CTAs. The central messages of this baseline video were; a) how CTAs work, and b) how safe and effective CTAs are. Infographics supporting these messages were then added to the baseline video (the second condition; 3min 19s); this was a simple data video (DV), and it did not intend to induce specific emotional experiences in participants (i.e., cognition-centered video). Finally, an affect-focused DV (AFDV) was also created by emphasizing the emotion-based narrative aspect of the message (the third condition; 4min 6s). In this video, three cute human-like cartoon characters were introduced. Viewers in this condition needed to process both cognitive and affective information. Note all three videos (i.e., control video, DV, and AFDV) conveyed identical messages. Participants watched one of these three videos only once, and we explored the video effect on their perception. Our results repeatedly indicated the potential benefits of including affect in data storytelling.

1 INTRODUCTION

There are countless rumours/misinformation associated with Covid-19 prevention during the current pandemic (i.e., infodemic). Sometimes such misinformation is dangerous and even life-threatening (e.g., "Drinking bleach may kill the virus" [1]). Islam and his colleagues recommend that *credible organizations* such as "governments and international health agencies continue publishing correct and context-appropriate information supported by scientific evidence about COVID-19 on their websites" [1]. The *ways* those organizations deliver information is an important factor which still requires close investigation, however. Storytelling is an effective strategy in sending out data-driven messages/insights, and during this pandemic, many organizations chose video as a medium for data storytelling as videos have become readily accessible through the internet, circulated via Social Networking System (or SNS). Moreover, while some information might be hard to follow in text, videos are often brief and easier to follow. One of the greatest advantages of data storytelling with video is that videos can introduce their contents in an organized sequence. This organized sequencing enables the viewers to process the data in a logical order along with the interpretations of data [2]. Such videos with infographics are called data videos (DVs) and are often very brief (usually shorter than 6 mins; [3]), and are becoming increasingly popular [4]. With narratives that can induce *emotional reactions*, we can further enhance the potential of such videos so we can influence their viewers' perception adequately to motivate healthy behaviours. However, the potential power of data video via inducing emotional reactions has not been explored empirically yet. Thus, this paper focuses on videos as a medium for communicating data driven messages.

While data storytelling is an effective way to deliver messages, influencing individuals' perceptions via storytelling is challenging particularly when they commit their attention only briefly, which is often the case in the current fast-paced lifestyle in our society; how do we convey the insights from such enormous data to the users swiftly? Indeed, exploration of data might be somewhat intimidating and therefore, time-consuming for many people. Some might feel they are lost in data, and hence, they may avoid exploring data even when they contain very important information [5]. While data storytelling should be beneficial [5–7], presenting the data in a way that can be readily interpreted by laypeople with diverse backgrounds remains a challenge. In this paper, our exploration focuses on more than the cognitive aspect: With DVs, we explore *the role of emotional responses in influencing the viewers' perception*.

2 LITERATURE REVIEW

Data videos (DVs) are short animated graphics that tell stories that are based on factual data [4]. Given their brevity, ideally no longer than 6 minutes [3], and their entertaining and engaging nature, data videos are becoming very popular recently on platforms such as YouTube, TickTock and Snapchat [4]. For some people, data videos are becoming a primary source to get information on various topics. This high interest from the viewers' side was aided by an even higher supply from the designers' side and it started to take a more formal direction as we see data videos published by educational [3, 8], journalism [7, 9], environmental, as well as health organizations and institutions. Recently, we have witnessed a massive corpus of data videos developed by governments and health organizations such as WHO and CDC, on issues related to Covid-19 such as mask wearing, sanitizing and hand washing, social distancing [10–12], contact tracing apps [13] or vaccination [14]. Those videos aim at advocating certain precautionary behaviours by showing, with data, how effective they are or how dangerous it could be if we do not adopt them. The power of data videos comes from combining both a strong cognitive argument through the data they incorporate, as well as an emotional edge that they exhibit through their narrative component. Although recent research has started to turn an eye to exploring data videos in terms of how to create them [4] and the

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best practices for presenting the data [15], very few efforts focus on measuring the efficacy of such videos on the viewers' perceptions or their tendencies to be influenced by watching DVs. This research aims at exploring the efficacy of DVs on influencing viewers' perceptions about using contact tracing apps or CTAs, a potentially life-saving technology, via data storytelling. We specifically explore the persuasive power data videos exhibit through their cognitive content (i.e., data and logical arguments), as well as the emotions they trigger in their viewers. The elaboration likelihood model of persuasion (ELM) is a dual process model that suggests two routes that can lead to persuasion (i.e., attitude and/or behavioural changes): central and peripheral routes [16]. When the receiver of a persuasive message is highly motivated about the topic, they are more likely to process the message through their cognition, using the mental clues in the message, while less motivated individuals would process the message based on their emotions (i.e., the feelings triggered by the message viewing) [17, 18]. We explore the possibility of providing both types of information in one DV for powerful data storytelling.

To support the cognitive arguments in the video, Amini et al., suggest using simple and well-known data visualizations such as bar charts, pictographs, and maps to present the facts [4]. As for the emotional aspect of data videos, specifically those focused on motivating healthy behaviours, there are no clear empirical guidelines in the literature regarding the strategies or types of emotions that would be effective. Normally, campaigns that aim at promoting healthy behaviours would adopt one of two strategies; either a loss-framed or gain-framed strategy [19]. A loss-framed messaging strategy would focus on negative emotions such as fear, guilt, or worry by emphasizing on the negative consequences of not following a healthy behaviour. Gain-framed messages, on the other hand, focus on the gains or the positive consequences of following a healthy behaviour. The Prospect Theory argues that the way the same information is framed can have different effect on people's decisions [20]. People are more prone to take a risky option in order to avoid potential losses, than they are to attain potential gains [19, 20], suggesting that the loss-framed strategy is preferred in the context of healthy behaviour motivation. Accordingly, in this study when we introduce the affect-based condition we focused our story to induce negative emotions such as 'empathy' with the characters as they suffer due to Covid-19. [1]

Stikeleather notes that "Data visualization lends itself well to being a communication medium for storytelling, in particular when the story also contains a lot of data" [21]. Thus, data storytelling has been explored widely in the field of data visualization. Citing [22], Ojo and colleagues state that "stories are fundamental components of human experience [23]". They further note how crucial the "mechanisms" of stories are for human communication because storytelling regularly has a strong format for inducing psychological effects. While data storytelling has captured much attention, narratives in the context of visual data storytelling are often different from regular stories (e.g., films and books). While all the events are delivered in a "linear sequence" in films and books, visual data stories regularly offer interactive functions to verify the users' own discoveries, which could generate further inquires [24]. In this study, we aim to expand the arena of data storytelling by utilizing video as a medium (i.e., data video). Specifically, *we aim to influence the viewers' perception via data storytelling*. Unlike other forms of data storytelling (e.g., interactive figures on a tablet or a smartphone), the narratives used in data videos can resemble to the ones used in films and books (i.e., events are presented in linear sequences [24]). To fully benefit from the nature of the video, which allows us to utilize common forms of storytelling, *we focus on the roles of affect (or emotional experiences) in the data video context.*

[1] Additionally, while consideration of positive affect is theoretically desirable, negative emotions fit in our videos more naturally as data we presented reflected the reality we were facing at the moment of writing (i.e., pandemic).

3 STUDY

The goal of this study was to explore the potential effect of narratives in influencing participants' perception in data storytelling using a video format. Specifically, *we explore the potential advantages of adding emotional components to data video (DV) in influencing its viewers' perception.* We applied psychological principles to induce emotional reactions [2]. Additionally, we explored how viewers' comprehension level could be impacted when we add emotional experiences while they are processing cognitive information. Further, as DVs are brief, and participants were exposed to the video only once, we focused on those participants who had rather neutral or positive attitudes toward CTAs when we explored the effect of video on the participants' perception. Finally, our exploration focused on negative affect. This is because we examined the data storytelling approaches during the pandemic, and loss-framed messages were mores suitable than gain-framed messages.

3.1 Study Design

There were three conditions; 1) Baseline Video condition, 2) Data Video condition (DV), and 3) Affect Focused DV condition (AFDV); please see supplementary materials. A Qualtrics survey was distributed via MTurk, and the study was a between-subjects design. To avoid the potential confound effect of cultural differences as well as accessibility to publicly developed CTAs, all the participants were recruited from Canada and were randomly assigned to one of the three conditions. The study was conducted between May 26th and June 14th, 2021. Note the media's attention had shifted at this time: The media was heavily focusing on vaccine rollout and CTAs were not discussed during this time. Participants in all the conditions completed a survey that contained three sections. The first section (Section 1) assessed participants' background and attitude towards CTAs, followed by watching one of the three videos (Section 2). Finally, participants' perceptions of CTAs were assessed after the video viewing (Section 3).

3.2 Videos

We adopted and modified a video produced by Google as a baseline video (2min 23s see [25] for the original video). The video explains the functions of CTAs, and how useful and safe they are [3]. A data video or DV (3min 19s) was created by adding infographics to deliver data-based evidence to augment the messages present in the baseline video. In the affect focused data video or AFDV (4min 6s), three cartoon characters were introduced; Little Emma, her Grandpa, and Mom, to actively induce affect (see Figure 1). To prevent any potential confound effect associated with the race of the characters, these characters were *human-like characters*, but no race can be inferred from them. Further, we designed the characters to be cute to avoid the viewers' indifference towards the characters. At the beginning of the video, these characters were introduced: "Here is Emma. Like any child, she loves her parents, and especially her grandpa" then the narrator continues "It's not just Emma who is suffering. Think about someone you care about." This was added to boost the **applicability**[4] of information so the viewers could personalize the video content (i.e., they are cartoon characters but people are actually going through situations like this). Then the voice over says "If there is anything we can do to help, we should do it, shouldn't we?" This question along with a pause was added to

[2] Empathy, cognitive dissonance, heightened applicability/relevance are applied as they are all relevant in influencing viewers' perception.

[3] Sixty-four videos focusing on Covid-19 related health behaviours were selected at first. Based on our coding on the video quality, message relevance, source credibility, and length, five videos were selected. Then three researchers unanimously ranked the video created by Google as the best video.

[4] We aimed at inducing an effect akin to identifiable victim effect to induce empathy.

trigger **cognitive dissonance**, a psychological phenomenon whereby individuals try to maintain equilibrium between their attitude and beliefs (see [26]). Specifically, the question part "shouldn't we?" was embedded to lead the viewers to *think* "Yes, we should." Once they feel "they should do something to help others," then their perception change should be inducted more readily. Then the narrator says "While we are waiting for everyone to get vaccinated, what can we do to slow down or even stop the spread of Covid-19, and new variants?" After all facts and arguments are presented, the **summary** section lists all potential benefits of using CTAs in bullet points form. The reason behind providing the summary was to link the cognitive aspect and make a smooth transition to the affective components of the video to conclude the video: The summary was provided, then Emma (the little girl cartoon character) came back for the conclusion of the video. Finally, the video goes back to Emma's story by saying "Sure, Emma is just a cartoon character, but this is actually happening to families around the world, including people you know and care about." This section was added to **boost the personal relevance** of video contents to each viewer. Thus, we used various forms of *manipulation* to increase information relevance and empathy (see Figure 2).

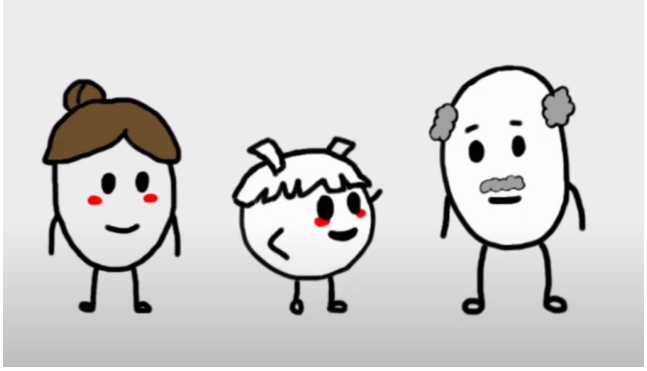

Figure 1: The three human-like cartoon characters introduced in AFDV to induce affective responses.

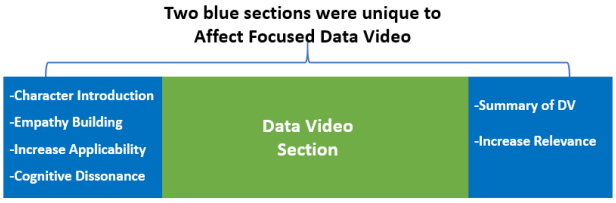

Figure 2: DV and AFDV Structures.

3.3 Participants

One hundred and twenty-five participants were recruited using MTurk. Three participants failed to answer our readily verifiable multiple choice or Gotcya question; "For this question, we would like you to select 'I did not pay attention at all (the third option)' with five options[5]." Further, 119 participants completed the study within one hour while three participants took longer than four hours (the longest it took was approximately 88 hours and they were considered as outliers). Since the study was designed to be completed in one hour, their data were removed from the analyses listwise. Thus, analyses were conducted with $N = 119$ (52 Females, 65 Males, one wrote down X and another one wrote down Heterosexual). Thirty nine participants viewed the baseline video, 39 viewed DV, and 41 viewed AFDV. One hundred and ten participants responded to a question asking their age. Their age ranged between 18 and 67 ($M = 34.04$, $SD = 10.30$). One question asked their perceived technology proficiency "I feel that I am good with technologies (i.e., tech savvy)" using a 7-point Likert Scale (1 = Strongly Disagree and 7 = Strongly Agree). Participants generally felt that they had relatively higher experience with technologies ($M = 5.71$, $SD = .92$). Each participant received $2.47 US for their participation in accordance with the ethics guidelines at a local university.

[5] 1) I paid attention throughout the study; 2) I paid attention to questions most of the time; 3) I did not pay attention at all; 4) I enjoyed this survey.

4 Results

All the analyses were selected after checking the assumptions.

4.1 Personal Tendency Towards Persuasion

We explored whether participants in each condition had comparable levels of **susceptibility towards persuasion** using Kukkonen's question items [27] (e.g., "When I hear others talking about something, I often re-evaluate my attitude toward it.") Since Cronbach's α was lower than our cutoff (.70, see [28]), we examined each question individually to see whether the levels of individual susceptibility tendency toward persuasive messages varied based on the condition. Kruskal-Wallis tests were conducted with Bonferroni adjustments ($p = .017$); none of the comparison yielded significant difference, indicating the individuals in each condition had comparable levels of vulnerability towards persuasive messages.

4.2 Video Comprehension

We explored how well participants thought they understood the content of the video ("How much of the video content was understandable to you?" using a slider ranging from 0 to 100), reflecting perceived difficulty. In particular, since our AFDV contains both cognitive as well as emotional information, it was important to ensure that the comprehension level was comparable across the conditions. A oneway ANOVA yielded no condition effect (Baseline; $M = 93.42\%$, $SD = 10.88$, DV; $M = 92.88\%$, $SD = 8.29$, AFDV; $M = 94.38$, $SD = 10.69$, $\eta^2 = .045$). Regardless the type of video, participants felt they understood the video contents almost fully, and this tendency was held across the conditions.

4.3 Affect

Three questions explored participants' emotional reactions to the video they watched. Note all the videos dealt with the same topic (CTAs during the Covid-19 pandemic), and due to the nature of topic, we focused on negative affect of being sad, sorry, and emotional (e.g., "The video made me sad" on a 7-point Likert scale) as opposed to positive affect (e.g., happiness and excitement). Cronbach's alpha for these three items was .89 (see [28]). Thus, the aggregate of the three items was used as an affect index.

4.3.1 General Functions of Affect

We explored whether AFDV actually induced the highest affect among the three conditions. A oneway ANOVA revealed a significant effect; $F(2, 116) = 5.57$, $p = .005$. Thus, pairwise comparisons were conducted with Bonferroni adjustment. Indeed, AFDV induced significantly higher levels of **negative affect** ($M = 2.92$, $SD = 1.68$) than the baseline video ($M = 1.98$, $SD = 1.56$; $p = .02$) and DV ($M = 1.94$, $SD = 1.14$, $p = .01$). No significant difference between the baseline video and DV was found. This implies that our psychological manipulation was successful. We then explored the general role of affect in improving participants' perception towards CTAs. Regardless the video type, our affect index predicted **how much the participants enjoyed the video** (i.e., "I enjoyed watching the video"

on a 7-point Likert scale); F (1, 117) = 22.91, $p < .001$, $_{adj}R^2 = .16$, $\beta = .41$. One unit increase in negative affect corresponded to .41 point increase in participants enjoying the experience of watching their respective video. Further, interestingly affect predicted **general persuasive potential** of the video ("e.g., The video would make me change my behaviour regarding using Contact Tracing apps" on a 7-point Likert scale where 7 indicated the highest persuasive potential, taken from [6] and adjusted for our study purposes to reflect the users' own perception), F (1, 117) = 20.34, $p < .001$, $_{adj}R^2 = .141$, $\beta = .39$, indicating that generally, an increase of one point in emotional experience corresponded to .39 point increase in users' perception about the video's persuasive potential. Affect also predicted how **convincing** the information in the video was, F (1, 117) = 21.901, p =.004, $_{adj}R^2 = .06$, $\beta = .26$. One unit increase in negative affect corresponded to .26 unit increase in how convincing the information was ("I found the information in the video convincing"). The level of affect further predicted participants' **likelihood of downloading a CTA** for those who have never used any CTAs, F (1, 60) = 9.42, p =.003, $_{adj}R^2 = .12$, $\beta = .37$. Affect level tapped onto the direct assessment of participants' **change in perception toward CTA** (i.e.,"The video changed my perception of Contact Tracing apps" assessed with 7-point Likert scale), F (1, 117) = 18.40, p <.001, $_{adj}R^2 = .13$, $\beta = .37$. Altogether, in our study, increasing negative affect (sadness, sorry, emotional) while watching a video influenced participants' perception towards CTAs positively.

4.4 Participants with Neutral to Positive Pre-attitude

It is valuable to explore collected data based on participants' pre-attitude (i.e., prior to the video viewing) so we can understand the importance of the target viewers' readiness. Thus, we examined our data based on the response to the question "I feel Contact Tracing apps can help contain the spread of COVID-19." Note a 7-point Likert Scale was used for the assessment. We created two categories based on the participants' responses (the low scores 1 and 2 are categorized as negative, while the rest were considered as neutral to positive range). Since this part of the analysis focuses on the effect of video on the change of participants' perception, participants were included in the analysis as long as their pre-attitude score was equal to or greater than 3 (i.e., relatively neutral to positive range). Eighty-nine participants remained in the analyses.

4.4.1 Effect of Video Type on Perceptual Shift

We explored the effects of video type with those who had relatively neutral to positive attitude. A Kruskal Wallis test explored whether the type of the video participants watched had any effect on their perception change regarding their **perceived safety of CTA use** ("I would feel safe using a Contact Tracing app" was subtracted from "After watching the video, I would feel safe using a Contact Tracing app.") A significant effect was found (p = .023). Thus we further examined where the differences are located (i.e., AFDV vs. Baseline; AFDV vs. DV; Baseline vs. DV). A Mann-Whitney U test with Bonferroni adjustment identified that AFDV induced greater improvement (Mdn = .500) than the baseline video did (Mdn = .00; U = 305.50, Z = -2.70, p = .007) with a moderate effect r = .34 [29]. No other pairwise comparisons yielded significant effects. Next, a oneway ANOVA found a video effect on participants' perception change regarding **how comfortable they would feel about using a CTA** ("I would feel comfortable using a Contact Tracing app" was subtracted from "After watching the video, I would feel comfortable using a Contact Tracing app"). A significant condition effect was found, F (2, 86) = 3.15, p = .048 with a moderate effect (η^2 = .07). Posthoc pairwise comparisons with Bonferroni adjustments revealed that the condition effect was driven by the difference between the effect between the baseline video (M = .00, SD = 1.23) and AFDV(M = .84, SD = 1.40), p = .048. Note parallel analyses for negative attitude group were also conducted (n = 30). However, no effects were found. [6]

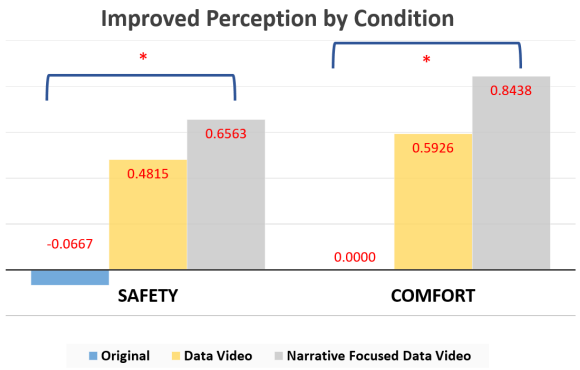

Figure 3: Means of improved perceived safety and comfort in using CTAs. Participants with negative pre-attitude were excluded. * denotes a statistically significant difference.

5 Discussion

Our focus on digital communication for data-driven messages amid infodemic naturally guided us to explore negative affect (e.g., sadness) as opposed to positive ones (e.g., happiness), and our study revealed that *affect driven data video has great potential in improving viewers' perception about the topic*, especially when viewers do not have negative prejudgement about the video topic, in particular. Additionally, we were able to merge cognitive and emotional components in a video while maintaining the levels of content comprehensibility. That is, affective information did not interfere with the cognitive information for the viewers to understand the video contents. Instead, merging these two types of information/clues augmented the impact of video communication on the viewers' perception. Furthermore, experienced affect predicted how much viewers enjoy the video, perceive it as convincing, and are likely to download a CTA after the study. Thus, our empirical exploration revealed a variety of potential benefits that affect can offer in data videos. Finally, we discovered that the AFDV was more powerful than regular information video (i.e., without data) on guiding viewers' perception changes *when the viewers had a neutral to a positive attitude*. This "targeting neutral to positive pre-attitude group" strategy should be applied for data video distribution specifically because data videos are generally brief (shorter than 6 mins, in general [3]): We have only brief attention from the viewers. Thus, influencing viewers' perception when they already have a neutral to positive attitude (before the video viewing) might be more suitable than targeting those who have a negative attitude towards the video topic. In fact, while those participants who had negative pre-attitude towards CTAs viewed one of our videos as they were in a study, it might be plausible that they might choose not to watch such videos in real life. Then AFDV should be used as a tool to encourage people to act a certain way; not to change their attitude. Although it was beyond the scope of this study, future investigation of ways to convince/influence people with negative attitudes with data videos, would be fruitful. While we found various benefits associated with negative affect in AFDV as our investigation centred around digital communication during infodemic, the level of negativity in comparison to other types of videos (e.g., documentary based DV), was not explored. If we had used actual human characters instead, the level of negative affect could have been higher; when the narratives induce excessive fear, then viewers might not finish watching a video or experience *"denial"* which might not lead them to any perceptual changes. Thus,

[6] While this could be due to their negative pre-attitude toward CTAs, it is possible this null effect is reflecting small sample size (i.e., Type II error).

examination of levels of negative affect induced by *different types of data video* might be important.

6 Conclusion

We empirically explored the role of affect in a data video to convey data-driven messages, and our results indicated that inducing affect could lead to a variety of positive outcomes. Especially when the viewers have a neutral to a positive attitude towards the video topic, affective focused data video became significantly more powerful than a regular video (i.e., no data). While we acknowledge that there are some limitations in current study, we conclude that, affect driven data video has great potential in guiding masses of people during the infodemic so they can adjust their perception.

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