Eliciting altruism in a video intervention to increase COVID-19 vaccination intentions amongst younger adults

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Abstract

Since the discovery of the SARS-CoV-2 virus in 2020, the COVID-19 pandemic has infected over 500 million people and caused 6.1 million deaths worldwide. Through rapid financing and collaborative research from scientists worldwide, safe and effective COVID-19 vaccines were developed in record time. However, vaccine hesitancy, particularly amongst younger adults, has posed a significant threat to reducing virus spread and mitigating the pandemic. Previous studies have shown that appealing to altruistic messaging may be effective in increasing vaccine acceptance. The present study evaluated the efficacy of a brief video eliciting altruism to increase vaccine acceptance amongst younger Canadians. In a web-based survey using a pre-to-post, randomized control trial design, we randomized Canadians aged 20-39 in a 1:1 ratio to the video-based intervention arm or an active control arm consisting of text information regarding COVID-19 preventive behaviours not related to vaccination. We found a significant within-group change in the video intervention arm, while the between-group difference was not significant. In addition, in the video intervention arm, we found that those who had not yet thought about vaccination and those who were undecided about receiving a COVID-19 vaccine were more amenable to change to accepting a vaccine than those who decided not to vaccinate. These results demonstrate that messages eliciting altruism could be used to increase vaccine uptake amongst younger Canadians, particularly those who are not already completely resistant to vaccination. This study can inform public health authorities in creating targeted messaging and can be adapted to the current context of the COVID-19 pandemic or other vaccine-preventable diseases.

Résumé

Depuis la découverte du virus SARS-CoV-2 en 2020, la pandémie de COVID-19 a infecté plus de 500 millions de personnes et causé 6,1 millions de décès dans le monde. Grâce à un financement rapide et à la recherche collaborative de scientifiques du monde entier, des vaccins sûrs et efficaces contre la COVID-19 ont été mis au point en un temps record. Cependant, l'hésitation à la vaccination, en particulier chez les jeunes adultes, a constitué une menace importante à la réduction de la propagation du virus et au décroissement de la pandémie. Des études antérieures ont montré que faire appel à des messages altruistes peut être efficace pour augmenter l'acceptation des vaccins. La présente étude a évalué l'efficacité d'une brève vidéo suscitant l'altruisme pour accroître l'acceptation du vaccin chez les jeunes Canadiens. Dans le cadre d'un sondage en ligne utilisant un modèle d'essai contrôlé randomisé pré-à-post, nous avons randomisé des Canadiens âgés de 20 à 39 ans dans un rapport de 1:1 par rapport au groupe d'intervention vidéo ou à un groupe témoin actif composé d'informations textuelles concernant des comportements préventifs liés à la COVID-19 autres que la vaccination. Nous avons constaté un changement significatif au sein du groupe d'intervention vidéo, tandis que la différence entre les deux groupes n'était pas significative. De plus, dans le groupe d'intervention vidéo, nous avons constaté que ceux qui n'avaient pas encore pensé à la vaccination et ceux qui étaient indécis quant au vaccin contre la COVID-19 étaient plus enclins à accepter un vaccin que ceux qui avaient décidé de ne pas recevoir le vaccin. Ces résultats démontrent que les messages suscitant l'altruisme pourraient être utilisés pour accroître l'adoption du vaccin chez les jeunes Canadiens, en particulier ceux qui ne sont pas déjà complètement résistants à la vaccination. Cette étude peut informer les autorités de santé publique dans la création de messages ciblés et

peut être adaptée au contexte actuel de la pandémie de COVID-19 ou d'autres maladies évitables par la vaccination.

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Contribution of Authors

As the co-first author of this manuscript, I contributed to the design of the study. I helped with data cleaning, performed statistical analyses, and interpreted the data. I wrote the first draft of the manuscript. Ovidiu Tatar, the other co-first author, conceived and designed the study, cleaned the data, performed statistical analyses, interpreted the data, and helped in drafting parts of the manuscript. Gabrielle Griffin-Mathieu and Samara Perez participated in study design and provided critical feedback on manuscript revisions. Ben Haward assisted in data cleaning and provided critical feedback on manuscript revisions. Gregory Zimet, Matthew Tunis, and Ève Dubé provided critical feedback on manuscript revisions. Zeev Rosberger conceived and designed the study, assisted in data interpretation, and provided critical feedback on manuscript revisions.

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List of Abbreviations

Abbreviation	Explanation
CIHR	Canadian Institutes of Health Research
CONSORT	Consolidated Standards of Reporting Trials
COVID-19	Coronavirus Disease 2019
HPV	Human papillomavirus
K6	6-item Kessler Psychological Distress Scale
MERS-COV	Middle East respiratory syndrome-coronavirus
MI4	McGill Interdisciplinary Initiative in Infection and Immunity
MRNA	Messenger ribonucleic acid
NACI	National Advisory Committee on Immunization
OR	Odds ratio
PAPM	Precaution Adoption Process Model
PHAC	Public Health Agency of Canada
PTM	Prosocial Tendencies Measure
RCT	Randomized controlled trial

Introduction

In December of 2019, the first known case of Coronavirus Disease 2019 (COVID-19) caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), was identified in Wuhan, China. Like the influenza (flu), COVID-19 transmission occurs when droplets containing the virus are expelled from an infected individual through speaking, coughing, or sneezing, and are inhaled by another person. It is also possible to become infected through touching an infected person or an object that has the virus on it, and then touching one's own mouth, nose, or eyes. Many COVID-19 symptoms are similar to those of flu, including fever, muscle aches, and fatigue. Unlike the flu, however, COVID-19 causes more serious illness in many people and can result in hospitalizations and deaths of healthy individuals (Centres for Disease Control and Prevention, 2021b). A systematic review by Lopez-Leon et al. (2021) found that over 80% of infected patients developed one or more long-term symptoms, and that there were more than 50 long-term effects (14-110 days post viral-infection) of COVID-19 ranging from fatigue and headaches to symptoms related to lung, cardiovascular, and neurological diseases (Lopez-Leon et al., 2021). Furthermore, COVID-19 infections have been associated with changes in brain structure that could lead to the "degenerative spread of the disease via olfactory pathways, of neuroinflammatory events, or of the loss of sensory input due to anosmia", and cognitive decline (Douaud et al., 2022). Perhaps the most critical distinction from the flu is that COVID-19 is more easily spread. Within a few months of the first case of COVID-19, the disease reached pandemic status on March 11, 2020. As of April 2022, the virus has infected over 500 million people and officially resulted in over 6.1 million deaths worldwide (John Hopkins University and Medicine, 2022), although the actual death toll has been estimated to be nearly 15 million (World Health Organization, 2022a). The COVID-19 pandemic has become one of the deadliest pandemics in history (LePan, 2020).

The Impact of COVID-19

To limit the spread of the virus, governments around the world mandated preventive health behaviours such as quarantining and physical distancing. Work, school, entertainment, and most aspects of our daily lives have transitioned online. In Canada, the federal government invoked the *Quarantine Act*, requiring a mandatory 14-day quarantine for travelers entering Canada. Provincial governments have also implemented regional travel restrictions, restrictions for indoor and outdoor gatherings, mask mandates, and even curfews. Not abiding by these provincial and federal legislations could result in heavy fines, imprisonment, or both (Government of British Columbia, 2021; Government of Canada, 2021e). Importantly, these measures have been instrumental in reducing transmission of the virus (Bo et al., 2021; Girum et al., 2020).

Despite this, these preventive health mandates have also had severe impacts on the economy, culture and religion, and individuals' mental health. One in six Canadian businesses may close permanently (Canadian Federation of Independent Business, 2021). Panic buying and increasing demand of goods, coupled with manufacturer closures, and decreasing employment staff have resulted in stress on supply chains (CBC News, 2020; Ontario Chamber of Commerce, 2021; Russel & Jarvis, 2020). In May 2020, the unemployment rate in Canada reached 13.7%, the highest it had been since 1982 (Tencer, 2020). In January 2021, 27% of unemployed individuals in Canada were experiencing long-term unemployment, an increase of more than 10% compared to before the pandemic (Government of Canada, 2021c). Cultural and religious events have also been canceled, postponed, or hosted virtually; for example, many weddings and funerals were postponed or held online, and many film and music festivals were canceled altogether. As the country remained in "lockdown", with continued stay-at-home orders, quarantine mandates, and other preventive health measures that limit social interactions, Canadians experienced a deterioration of their mental health (Jenkins et al., 2021). A nationally representative survey found that 38% of Canadians indicated having worsened mental health since the pandemic; 14% indicated that they were not coping very well or not well at all; and 19.5% indicated that their alcohol consumption had increased as a result of the pandemic (Jenkins et al., 2021). Amongst Canadian adults, social isolation had increased levels of anxiety and depression, and contributed to projected increases in suicide (Dozois, 2021; McIntyre & Lee, 2020). Additionally, over 70% of college and university students reported increased levels of stress and anxiety due to the COVID-19 pandemic (Son et al., 2020; Wang et al., 2020), with increased concerns for academic performance, difficulty concentrating, and worries about their health and that of their loved ones (Kecojevic et al., 2020; Son et al., 2020). Overall, the COVID-19 pandemic has caused much distress and mental health burdens, with these effects particularly salient amongst young adults (Gill et al., 2022; Glowacz & Schmits, 2020; Hawes et al., 2021; Varma et al., 2021) .

COVID-19 vaccines

As vaccination is one of the most effective methods to limit the spread of, and eliminate, many infectious diseases (Centres for Disease Control and Prevention, 2016; World Health Organization, 2022b), developing a COVID-19 vaccine became a top priority. The vaccine production process includes six stages: research, pre-clinical preparation, clinical trials, approval, manufacturing, and distribution (Felter, 2021). From the research stage to getting the vaccine into the hands of healthcare workers, this process normally requires 8-15 years to complete. The first COVID-19 vaccine (developed by Pfizer-BioNTech) underwent one of the largest vaccine clinical trials in history with over 43,000 participants (Polack et al., 2020). It was approved in record time – less than one year from the beginning of the pandemic. Since then, Moderna, AstraZeneca, Janssen, and Novavax have also developed COVID-19 vaccines that have gone through large clinical trials with 15,000 to 40,000 participants (Baden et al., 2021; Heath et al., 2021; Sadoff et al., 2021; Voysey et al., 2021). The messenger ribonucleic acid (mRNA) vaccines (Pfizer-BioNTech and Moderna) have shown approximately 95% efficacy in preventing COVID-19 illness (Baden et al., 2021; Polack et al., 2020), while the viral vector vaccines (AstraZeneca and Janssen) have shown 62-67% efficacy against symptomatic COVID-19 disease (Sadoff et al., 2021; Voysey et al., 2021), and the protein-based vaccine (Novavax) has shown 90% protection. All five vaccines have demonstrated prevention of severe illness and hospitalization, ultimately leading to their approval by the Public Health Agency of Canada (PHAC) (Government of Canada, 2022d). Nevertheless, side effects are common following vaccination, including redness, soreness, and swelling at the injection site; chills; fatigue; fever; joint pain; headache; and muscle aches. Serious adverse events (e.g., anaphylaxis, thrombosis with thrombocytopenia syndrome, myocarditis, and pericarditis) may also occur, although they are much rarer. Out of over 80 million doses of COVID-19 vaccines administered in Canada, there were only 7999 reported serious adverse events (0.01% of all administered doses) (Government of Canada, 2022c).

Several factors facilitated COVID-19 vaccine rapid development while still assuring their safety and efficacy. SARS-CoV-2 is part of the coronavirus family, which includes severe acute respiratory syndrome-coronavirus (SARS-CoV) and Middle East respiratory syndrome-coronavirus (MERS-CoV) that were responsible for the SARS epidemic of 2003 and MERS outbreaks since 2012, respectively (Zhu et al., 2020). Researchers have been studying these coronaviruses for decades and already had existing data and knowledge to aid in developing a COVID-19 vaccine. Furthermore, as the COVID-19 pandemic plagued all countries, scientists worldwide collaborated and shared their data and technology with each other, thus enabling efficient research and development. Lastly, and arguably most importantly, governments, private institutions, and other funding bodies pledged over $8 billion for vaccine research (Stevis-Gridneff & Jakes, 2020). Funding for the research and development of vaccines using mRNA technology allowed for a more rapid production process compared to traditional viral-vector vaccines, as mRNA vaccines can be developed using readily available materials in a laboratory (Centres for Disease Control and Prevention, 2021c).

Currently, the National Advisory Committee on Immunization (NACI) recommends two doses of the Pfizer-BioNTech vaccine for individuals aged 5-29 for their primary series as well as a booster dose, while either mRNA vaccine may be used for a booster dose for adults aged 30 or older (Columbia, 2022). Canada delayed the second dose for up to four months so more Canadians could be vaccinated sooner and was also the first country to introduce vaccine mixing (i.e., offering a different vaccine for one's second dose). These decisions saved lives; a recent study from British Columbia found that any combination of vaccines had an efficacy of 95% against hospitalization (BC Centre for Disease Control, 2021). Ultimately, COVID-19 vaccination is the most critical and effective method to end the pandemic and to return society back to normalcy.

Vaccine hesitancy

Vaccine hesitancy is defined as delaying or refusing vaccination despite its availability (MacDonald, 2015) . It has been listed as one of the top ten threats to global health by the World

Health Organization (WHO) (World Health Organization, 2019). Over the past few decades, public confidence in vaccines has been decreasing, and anti-vaccination sentiments have been intensifying (Badur et al., 2020; Dubé et al., 2016; Hussain et al., 2018). This has led to a resurgence of previously largely eradicated diseases (Dubé et al., 2015; Hotez et al., 2020; Kubin, 2019; Ryan & Malinga, 2021). In Canada and the US, the number of children who are unvaccinated against measles have quadrupled since 2001 (Sanyaolu et al., 2022). These anti-vaccination movements were significantly influenced by a debunked and retracted article published in *The Lancet* by former doctor Andrew Wakefield who claimed that the measles, mumps, and rubella vaccine was linked to the development of autism in children (Motta & Stecula, 2021). Furthermore, the increasing use of social media has provided a platform for fear-inducing messages (e.g., personal stories) regarding vaccination to become widespread (Benecke & DeYoung, 2019). A content-analysis of tweets from Canadians found several reasons for vaccine hesitancy, including: concerns about the safety of the vaccine; beliefs that the vaccine was distributed despite a lack of scientific testing because of political and economic pressures to reopen the economy; lack of knowledge about the benefits of vaccination; and lack of trust in pharmaceutical institutions and public health authorities (Griffith et al., 2021). During the COVID-19 pandemic, there have been many anti-vaccination protests and conspiracy theories that rapidly spread (Cecco, 2022; Douglas, 2021; Dubé & MacDonald, 2020; Mettler et al., 2022; Verger & Dubé, 2020). On the extreme, some people believed that the coronavirus was purposely leaked to be used as a bioweapon by China to wage war against the US or vice versa, or that 5G phones caused the COVID-19 pandemic (Ahmed et al., 2020; Imhoff & Lamberty, 2020). As well, with identity politics becoming increasingly divisive (Chua, 2018; Hepburn, 2021), economic, social, and political movements may have also contributed to the rise of vaccine hesitancy (Benecke & DeYoung, 2019; Lam, 2021).

Considering that a vaccine normally takes 10 years to develop and that the previous fastest-developed vaccine (for mumps) still took four years to develop (Piccirillo & Ledger, 2020), many were also apprehensive about the safety and efficacy of the COVID-19 vaccines (Baack et al., 2021; Benham, Atabati, et al., 2021; Biswas et al., 2021; Griffith et al., 2021; Sherman et al., 2021; Wang et al., 2021). Further, mixed messaging regarding recommendations for COVID-19 vaccines from public health authorities have exacerbated vaccine mistrust. For example, in Canada, NACI had initially not recommended the AstraZeneca vaccine for adults aged 65 years or older due to insufficient evidence of vaccine efficacy in this age group, although it was later recommended when the vaccine was deemed safe and effective (Jackson & D'Amore, 2021). However, due to concerns related to blood clots, NACI revised its guidelines once again and recommended against the use of the AstraZeneca vaccine for adults under 55 years old (Connolly & Jackson, 2021). In Sweden, Denmark, and Finland, health agencies paused the use of the Moderna vaccine for younger age groups (under 18 or 30 years old) over the potential increased risk of heart inflammation (Paterlini, 2021). Similarly, Canada, Germany, and France recommend the Pfizer-BioNTech vaccine for individuals under 30 years of age (Columbia, 2022; Tenn, 2021), while Norway, South Africa, and the United Kingdom recommend only one dose (instead of the typical two doses) of the Pfizer-BioNTech vaccine for children and teenagers (Tenn, 2021). Although based in science, the ever-changing COVID-19 vaccination guidelines have caused confusion, increased hesitancy, and decreased trust in public health officials (Goldfarb et al., 2021; Griffith et al., 2021; The Canadian Press, 2021).

Age has been found to be a key distinguishing factor for COVID-19 vaccine acceptance. Several large-scale population-based studies have found that older age is associated with vaccine acceptance (Burke et al., 2021; Ogilvie et al., 2021; Sherman et al., 2021), and younger age is more likely to be associated with vaccine hesitancy (Afifi et al., 2021; Lazarus et al., 2021; Shih et al., 2021). Younger adults perceive COVID-19 to be a lower threat compared to older adults (Niño et al., 2021), yet they have the highest infection rate and are increasingly suffering severe complications (e.g., hospitalization, prolonged illness) (Centres for Disease Control and Prevention, 2021a; Government of Canada, 2022a; Neustaeter, 2021; Pan American Health Organization, 2021). Younger adults have also been identified as significant spreaders of the virus as they have more social contacts and commonly hold jobs that require frequent interactions with others (e.g., retail and customer service) (Aziz, 2021; Monod et al., 2021). Moreover, they often experience asymptomatic infections and may fail to limit their social interactions (Boehmer et al., 2020; Sah et al., 2021), increasing the risk of transmission, including vulnerable populations (Rabin, 2020). In Canada, although COVID-19 vaccines have been available for younger adults since April/May 2021 depending on the province, vaccine coverage in this age group has consistently lagged behind older age groups, requiring over seven months to reach 80% vaccine uptake (Government of Canada, 2022b). At the time of writing, additional booster doses are recommended and available for all Canadians. However, only 30-40% of Canadians aged 18-39 have received a booster dose, compared to 70-80% of Canadians aged 60 or older (Government of Canada, 2022b). As the pandemic progresses and evolves, it is critical to understand and address vaccine hesitancy amongst younger Canadians to protect Canadians of all age groups.

In addition to age, other factors have been associated with vaccine hesitancy, including: lower education (Benham, Atabati, et al., 2021; de Vries et al., 2022; Yousuf et al., 2021); lower income (Murphy et al., 2021; Yousuf et al., 2021); being female (Cordina et al., 2021; Guillon & Kergall, 2021; Murphy et al., 2021; Yousuf et al., 2021); being a healthcare provider (Murphy et al., 2021; Tatar et al., 2022; Toth-Manikowski et al., 2022); not previously vaccinated for the flu (Cordina et al., 2021; Sherman et al., 2021). Therefore, it would be important to examine these factors as possible correlates of vaccine intentions.

Mitigating vaccine hesitancy

While widespread public education about vaccines is important, correcting myths about vaccines is often ineffective in increasing vaccine confidence (Hornsey et al., 2018; Nyhan & Reifler, 2015). This may be a result of confirmation bias in which those who hold vaccine-hesitant beliefs may ignore or discount any information that does not align with their beliefs to avoid cognitive dissonance (Nyhan & Reifler, 2015; Pluviano et al., 2019). However, in addition to the personal benefits of being vaccinated (e.g., being protected against the disease), there are also social benefits to vaccination (e.g., providing indirect protection to others, especially those who cannot receive the vaccine). Therefore, highlighting altruism may be a promising approach to increasing vaccine acceptance. Altruism is commonly defined as “pursu[ing] the ultimate goal of increasing another’s welfare” (Pfattheicher et al., 2022).

Many studies have found prosocial/altruistic motives to be associated with vaccine acceptance for non-COVID-19 related vaccines (e.g., Human Papillomavirus (HPV), influenza) (Böhm & Betsch, 2021; Brewer et al., 2017; Cucciniello et al., 2021; Goss et al., 2020; Lacombe-Duncan et al., 2018; Li et al., 2016; Luong & Moyer-Gusé, 2021; Tatar et al., 2019; Zhu et al., 2022). With regards to COVID-19, research has shown that prosocial or altruistic motives were associated with engagement in preventive health behaviours (e.g., social distancing, mask wearing) (Coroiu et al., 2020; Heffner et al., 2021; Jordan et al., 2021; Pfattheicher et al., 2020). Higher levels of altruism have also been shown to be associated with COVID-19 vaccine acceptance (Burke et al., 2021; Head et al., 2020; Rieger, 2020), while lower levels of altruism were associated with COVID-19 vaccine hesitancy (Latkin et al., 2021; Murphy et al., 2021). Thus far, only two studies have empirically tested the effect of an altruism-based intervention on vaccine intentions (Li et al., 2016; Rieger, 2020), with both interventions using text-based messages and neither using a Canadian sample. Importantly, both studies found that altruistic messaging increased vaccination intentions.

The Precaution Adoption Process Model

Health behaviour interventions grounded in theory are more effective in changing behaviour than those that are not (Glanz & Bishop, 2010; Michie et al., 2008). The Precaution Adoption Process Model (PAPM) attempts to capture the stages of health decision-making allowing researchers to more clearly identify the factors that might affect movement between stages (Weinstein et al., 2008). This model has been previously used to assess health behaviours such as cancer screening (Carter-Harris et al., 2020; Jin et al., 2021; Marlow et al., 2017), smoking cessation (Mahabee-Gittens et al., 2017; Park et al., 2018), and other vaccinations (e.g., HPV, meningococcal, pertussis) (Dempsey et al., 2018; Oostdijk et al., 2021; Tatar et al., 2019; van Zoonen et al., 2021). The PAPM consists of seven distinct stages of decision-making: (1) *unaware* of the issue, (2) *unengaged* with the issue, (3) *undecided* about acting, (4) *decided not* to act, (5) *decided to* act, (6) *acting.* By differentiating individuals in different decision-making stages, the PAPM provides a more nuanced understanding of how individuals make decisions regarding vaccination. Although PAPM is a stage theory, it does not assume that individuals must move through each stage in order. For example, receiving a doctor's recommendation could result in the person receiving the vaccine without further hesitancy, even if they were previously unaware that the vaccine existed. As highlighted by Tatar et al. (2019), those who have *decided not* to vaccinate were likely to remain unchanged about their decision ("rigid hesitant"), whereas individuals who were *unaware*, *unengaged*, or *undecided* were more likely to become vaccine acceptors over time ("flexible hesitant"). Thus, tailored interventions are necessary for people in different decision-making stages. In the present study, we use PAPM to measure vaccination intentions and estimate how altruism can affect individuals in different stages of vaccine decision-making.

The present study

COVID-19 vaccination is crucial for minimizing infections, hospitalizations, and death. However, vaccine hesitancy, particularly amongst younger adults, remains a threat to overcoming the COVID-19 pandemic and returning to normalcy. To our knowledge, only two studies have experimentally tested the effect of altruistic messaging on vaccine acceptance, and neither used a video-based intervention. This thesis evaluates the efficacy of a brief altruism-eliciting video in increasing COVID-19 vaccine intentions amongst younger Canadian adults. Achieving high vaccine uptake amongst younger adult Canadians will not only protect others in their age group, but also the population at large.

Manuscript

The Efficacy of a Brief, Altruism-Eliciting Video Intervention in Enhancing COVID-19 Vaccination Intentions Among a Population-Based Sample of Younger Adults: Randomized Controlled Trial

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Abstract

Background

High COVID-19 vaccine uptake is crucial to containing the pandemic and reducing hospitalizations and deaths. Younger adults (aged 20-39 years) have demonstrated lower levels of vaccine uptake compared to older adults, while being more likely to transmit the virus due to a higher number of social contacts. Consequently, this age group has been identified by public health authorities as a key target for vaccine uptake. Previous research has demonstrated that altruistic messaging and motivation is associated with vaccine acceptance.

Objectives

This study had 2 objectives: (1) to evaluate the within-group efficacy of an altruism-eliciting short, animated video intervention in increasing COVID-19 vaccination intentions amongst unvaccinated Canadian younger adults and (2) to examine the video's efficacy compared to a text-based intervention focused exclusively on non-vaccine-related COVID-19 preventive health measures.

Methods

Using a web-based survey in a pre-post randomized control trial (RCT) design, we recruited Canadians aged 20-39 years who were not yet vaccinated against COVID-19 and randomized them in a 1:1 ratio to receive either the video intervention or an active text control. The video intervention was developed by our team in collaboration with a digital media company. The measurement of COVID-19 vaccination intentions before and after completing their assigned intervention was informed by the multistage Precaution Adoption Process Model (PAPM). The McNemar chi-square test was performed to evaluate within-group changes of vaccine intentions. Exact tests of symmetry using pairwise McNemar tests were applied to evaluate changes in multistaged intentions. Between-group vaccine intentions were assessed using the Pearson chi-square test postintervention.

Results

Analyses were performed on 1373 participants (n=686, 50%, in the video arm, n=687, 50%, in the text arm). Within-group results for the video intervention arm showed that there was a significant change in the intention to receive the vaccine (χ^2_1=20.55, P<.001). The between-group difference in postintervention intentions (χ^2_3=1.70, P=.64) was not significant. When administered the video intervention, we found that participants who had not thought about or were undecided about receiving a COVID-19 vaccine were more amenable to change than participants who had already decided not to vaccinate.

Conclusions

Although the video intervention was limited in its effect on those who had firmly decided not to vaccinate, our study demonstrates that prosocial and altruistic messages could increase COVID-19 vaccine uptake, especially when targeted to younger adults who are undecided or unengaged regarding vaccination. This might indicate that altruistic messaging provides a "push" for those who are tentative toward, or removed from, the decision to receive the vaccine. The results of our study could also be applied to more current COVID-19 vaccination recommendations (eg, booster shots) and for other vaccine-preventable diseases.

Trial Registration

This study was registered on ClinicalTrials.gov (NCT04960228); https://clinicaltrials.gov/ct2/show/NCT04960228

Keywords: COVID-19; Vaccination; Vaccine hesitancy; Altruism; Video Intervention; Younger adults.

Introduction

SARS-CoV-2 has caused the greatest pandemic of our lifetime. At the time of writing, the virus had infected 251 million people and killed over 5 million worldwide (John Hopkins University and Medicine, 2021). To contain the COVID-19 pandemic, governments have recommended and mandated preventive health measures, such as physical distancing, mask wearing, and restrictions on indoor and outdoor gatherings. Although these measures have been instrumental in reducing virus transmission and the burden on the health care system, they have also had severe impacts on the economy and individual well-being (McKinsey & Company, 2021; Torales et al., 2020; Xiong et al., 2020).

Following a rapid mobilization and development process, COVID-19 vaccination was introduced in late 2020, and widespread vaccination has since been encouraged for the general population. In Canada, vaccinating against COVID-19 has likely saved 476,000 lives (Zuber, 2021). Compared to those who are vaccinated, unvaccinated individuals make up a disproportionally higher percentage of infection cases (61.9% vs 38.1%), hospitalizations (77.3% vs 22.7%), and deaths (74.6% vs 25.4%) (Government of Canada, 2021b). Further, there is evidence that vaccination has helped reduce virus transmission (Shah et al., 2021).

Vaccine hesitancy, which refers to a set of attitudes and beliefs which may lead to delay or refusal of 1 or more vaccines despite their availability (Dube et al., 2013; World Health Organization, 2014), poses a significant threat to achieving sufficient COVID-19 vaccination rates to mitigate the pandemic. Younger age has been associated with vaccine hesitancy (Afifi et al., 2021; Benham, Atabati, et al., 2021; Burke et al., 2021; Lazarus et al., 2021; Shih et al., 2021). Additionally, younger adults often experience mild or asymptomatic infections (Gao et al., 2021; Kronbichler et al., 2020) and are more socially active. In Canada, this age group also demonstrates lower adherence to other preventive health measures (eg, social distancing) (Benham, Lang, et al., 2021; Brankston et al., 2021). Thus, younger adults play an important role in virus transmission. To protect the Canadian population at large, it is important to ensure adequate vaccine uptake amongst younger adults.

Although providing basic vaccine education to the population is critical, research has shown that correcting vaccine misinformation and refuting vaccine myths is largely ineffective in enhancing vaccine intentions (Nyhan & Reifler, 2015). This resistance may be attributable in part to confirmation bias. Studies have shown that vaccine hesitant individuals are less receptive to new information that disconfirms their beliefs (Azarpanah et al., 2021; Nyhan & Reifler, 2015). Additionally, vaccine hesitancy cannot be understood as a total refusal or acceptance of vaccination but rather as a continuum. Individuals in different stages of vaccine decision-making have different attitudes and beliefs towards vaccination (Perez et al., 2017; Tatar et al., 2019). Therefore, the efficacy of interventions designed to address vaccine hesitancy might be moderated by the set of attitudes, beliefs, and cognitions a specific individual has towards vaccination.

A novel and promising approach is to develop interventions that elicit altruism, that is, intentional and voluntary action in which the primary goal is to increase the welfare of another person (Feigin et al., 2014; Pfattheicher et al., 2022). Previous hypothetical and laboratory game studies have found that altruistic messages can increase vaccination intentions (Chapman et al., 2012; Cucciniello et al., 2021; Shim et al., 2012) or demonstrated that altruistic motives were related to self-reports of actual vaccine intentions and/or behaviors. However, few studies have experimentally elicited altruism to examine its impact on vaccine intentions (Li et al., 2016; Rieger, 2020), and none have used a video-based intervention. Younger adults have lower concerns of hospitalization and mortality than older adults (Bechard et al., 2021) and thus may perceive receiving a COVID-19 vaccine as less personally beneficial. To increase vaccination intentions and uptake amongst this age group, it could be more effective to highlight messages of altruism and the protection of others rather than oneself (Badr et al., 2021; Burke et al., 2021).

Considering the need to address hesitancy towards COVID-19 vaccination amongst younger adults, the aim of this study was to evaluate the efficacy of a short video intervention eliciting altruistic motives for vaccination. Understanding the effectiveness of altruism-based messaging could inform public health communications targeting COVID-19 vaccine uptake in this age group. The specific objectives were to estimate (1) pre- to postintervention change of COVID-19 vaccine intentions and (2) between-group COVID-19 vaccine intentions postintervention.

Methods

Trial design

We used a 2-arm parallel randomized pre-post design. Participants in a web-based survey were randomly allocated in a 1:1 ratio to the video-based intervention or the active control arm consisting of a text-based intervention. The study was designed to detect a significant pre-post increase in COVID-19 vaccine intentions in the video intervention group and the superiority of the video intervention compared to the text intervention in eliciting pro-COVID-19 vaccine intentions. We used the Consolidated Standards of Reporting Trials (CONSORT) statement to report the results (Moher et al., 2010).

Participants and study setting

Participants from all Canadian provinces or territories who met following eligibility criteria were enrolled in the study: (1) not vaccinated for COVID-19, (2) age range of 20-39 years, (3) Canadian resident, and (4) willing to complete the survey in either English or French. To ensure a balanced participation in the study and informed by the Canadian Census data, we used quota sampling for the primary language spoken at home (80% Anglophones, 20% Francophones); biological sex (50% males, 50% females), annual total income before taxes of all members of the household before the pandemic (50% more than CA $75,000 [US $58,563.80], 50% less than CA $75,000), and population density (80% urban, 20% rural). During data collection (July 30-September 13, 2021), the daily incidence of COVID-19 was rising, signaling the emergence of the fourth pandemic wave in Canada that reached its peak mid-September, when about 4300 new daily cases were reported nationwide. In this period, about one-third of daily cases were reported in Canadians aged 20-39 years and the estimated daily COVID-19 incidence in this age group reached 1500 (35% of total daily cases) (35% of total daily cases) (Government of Canada, 2022a). In Canada, our target population became eligible for COVID-19 vaccination in April-May 2021, although provincial rollout varied widely. Therefore, as of April 17, 2021, the national cumulative percentage of individuals aged 20-39 years who received at least 1 COVID-19 vaccine dose was only about 9%. Vaccine uptake increased sharply in the upcoming months and the cumulative percentage of individuals in this age group who received at least one dose reached about 62% by June 5th, 2021. During data collection, the estimated national vaccine coverage (at least 1 dose) in individuals aged 20-39 years increased from about 72% at the start to 78% (Government of Canada, 2022b). In this period that corresponded with the beginning of the academic year, extensive public health interventions (eg, messages distributed through media) aiming at increasing vaccine uptake were ongoing and vaccination mandates were beginning to be implemented in some jurisdictions (eg, Quebec).

Study procedures

Data collection was carried out by Dynata, an international online market research company with experience in programing surveys and collecting data for universities and companies in various fields (eg, public health, politics). Dynata used a combination of recruitment methods (eg, its own website, direct emails, ads on social media) to recruit participants. At the beginning of the survey, we checked whether participants' electronic device (the survey could be completed on a smartphone, computer, or tablet) had adequate video and sound capabilities to complete the survey. After providing electronic consent, participants deemed eligible to participate were randomly allocated to 1 of the 16 strata based on the 4 quota sampling criteria (ie, primary language, biological sex, income, and population density; see Multimedia Appendix 1 for details). Within each stratum, a random concept picker approach was used to ensure a 1:1 allocation. Correspondingly, the first participant of a pair was randomly allocated to the intervention or the control arm and the second participant to the opposite arm. If a participant did not finish the survey (incomplete data), that place in the pair was allocated to the next participant. Thus, the quota in each stratum was filled in pairs and ensured a balanced group allocation throughout the data collection period.

After randomization, participants completed the remaining baseline sociodemographic questionnaire and provided their intentions to receive a COVID-19 vaccine. Then, they participated in the intervention (watched a short video eliciting altruism motives) or read a text related to general hygiene and preventive measures (active control group). All participants were prompted that attention check questions would follow. Those who did not correctly identify the names of the video characters were offered the possibility to watch the video a second time. Those who decided to watch the video again but still answered incorrectly were terminated. The video could be paused but not skipped or muted. Participants could not continue the survey until the video had been played entirely. In the active control arm, the sequence of information sections was randomized (to control for bias attributable to presentation order) and participants could neither skip sections nor progress to the next section until 10 seconds had elapsed to encourage careful reading. After each section, participants answered an attention check question asking them to identify a measure that was not mentioned in the section they had just read. Participants who answered all 3 attention check questions incorrectly were terminated.

Immediately after completing the intervention, we reassessed their intentions to receive a COVID-19 vaccine. Subsequently, participants answered additional questions (offered after the second assessment of vaccine intentions to avoid response bias), which included flu vaccination status, health care professional status, smoking history, and measures of altruism, empathy, and psychological distress. Only participants who provided complete survey data were retained in the final database. Participants were compensated by Dynata according to the reward system in which points are earned that can be later redeemed for company rewards (eg, Amazon, Starbucks).

Interventions

Video intervention. Because mobile streaming is highly popular in our target age-group (Statista, 2022), we decided to use a video-based intervention to maximize its acceptability and minimize study attrition. The development of the intervention was informed by a literature review conducted by our team showing that eliciting prosocial motives (altruism) can increase vaccine intentions. Accordingly, the messaging was framed around the concept of social benefit of vaccination by emphasizing the importance of indirectly protecting the health of vulnerable individuals who either cannot receive the vaccine (eg, children under the age of 5 years) or might develop an insufficient immune response (eg elderly, immunocompromised) (Betsch et al., 2013;

Betsch et al., 2017; Bohm et al., 2016; Böhm et al., 2019; Korn et al., 2020; Polonijo et al., 2016). Moreover, protecting children and the elderly and providing details about negative health outcomes caused by infection were found to elicit empathy and altruism and increase vaccine acceptability in young adults(Brewer et al., 2017; Li et al., 2016; Seanehia et al., 2017). Because narratives represent an essential component of human communication and their use has been recommended for health behavior change interventions (Hinyard & Kreuter, 2007), we used this approach to emphasize the importance of receiving the vaccine for protecting others. Finally, we drew a parallel between the collective benefits of having a public health system and the social benefits of being adequately vaccinated.

The development of the intervention unfolded in following phases: First, we developed the script to focus on 3 characters with different COVID-19 vulnerability profiles (ie, John, 82 years old, vaccinated but at risk because of his age; Simon, 4 years old, not eligible for vaccination at the time of the study; and Marie, 32 years old, at risk of infection because of the immunosuppressive effects of chemotherapy). Subsequently, an initial storyboard was created by Akufen (a Montreal-based media design company), which was further refined and produced in video format. Adjustments were made based on the feedback received from 5 young adults (aged 20-39 years who had not yet received the COVID-19 vaccine) who viewed the video and participated in a focus group in June 2021. The final animated character video was 2 minutes 47 seconds in length. Click to view the videos in English (*Vaccination Video (EN)* 2021) or French (*Vaccination Video (FR)*, 2021). All narration was completed by an experienced, fully bilingual professional narrator.

Text intervention. Consistent with the widespread use of public health messaging campaigns during the pandemic focusing on promoting preventive health behaviors, we decided to include an active instead of a placebo control group. We developed the text-based intervention by selecting non-vaccine-related preventive health behavior recommendations disseminated through the Public Health Agency of Canada's website (Government of Canada, 2021a). The text-based intervention was limited to about 450 words to ensure a reading time similar to the duration of the video-based intervention. Recommendations were divided into 3 sections: travel restrictions (eg, mandatory COVID-19 testing, mandatory isolation), general hygiene (eg, handwashing, mask wearing), and physical distancing (eg, avoiding closed spaces, maintaining a physical distance of 2 m from people outside of your household). See Multimedia Appendix 2 for the text intervention and attention check questions.

Measures

Baseline socio-demographics. Baseline sociodemographics included continuous (ie, age) and categorical (province or territory, ethnicity, self-perceived visible minority [yes/no], gender identity, identification as a parent [yes/no], language spoken at home [English, French, other], postsecondary education attainment [yes/no], and income [CA $10,000 increments]) variables. Variables with a small cell count for some categories were recategorized. Provinces or territories were recategorized into Western, Central, and Eastern Canada. The 9 categories used by Statistics Canada to measure self-reported ethnic origins (Statistics Canada, 2016) were recategorized into North American Aboriginal, other North American (eg, Canadian, American), European, Asian, and other (ie, Caribbean, Latin, Central and South American, African, dual/mixed ethnicities, and uninterpretable open-ended responses). We used multiple validated categories (National LGBT Health Education Center, 2016) to measure gender identity that captures men and women's socially constructed roles, identities, and behaviors and retained for analyses 3 categories: male, female, and gender diverse (ie, transgender male/trans man/female-to-male, transgender female/trans woman/male-to-female, genderqueer, neither exclusively male nor female, other [open ended], and prefer not to answer).

Main outcome. Based on the World Health Organization (WHO) Strategic Advisory Group of Experts on Immunization (SAGE) Working Group definition, vaccine hesitancy is considered on a continuum, which implies that using a binary (yes/no) would not allow for a precise, nuanced understanding of where individuals are in their vaccination decision-making process. Therefore, to measure COVID-19 vaccine intentions, we used a stage-based model of health decision-making, the Precaution Adoption Process Model (PAPM) (Weinstein et al., 2008). Informed by the PAPM, we asked participants, "Which of the following best describes your thoughts about a COVID-19 vaccine?" and allowed participants to place themselves in 1 of 4 nominal intention stages: (1) *unengaged* ("At this moment, I have not thought about receiving the COVID-19 vaccine."), (2) *undecided* ("At this moment, I am undecided about receiving the COVID-19 vaccine."), (3) *decided not* ("At this moment, I do NOT want to receive the COVID-19 vaccine."), and (4) *decided to* ("At this moment, I do want to receive the COVID-19 vaccine.").

Additional measures. Additional measures included following dichotomous (yes/no) variables: identification as a caregiver for an elderly person; identification as a healthcare professional; receiving a COVID-19 test; influence of religion on health decisions; and seasonal influenza vaccine uptake in the last 12 months. Smoking history was captured by 3 categories: *never smoked*, *smoked in the past but not anymore*, and *currently a smoker*. Vaccination uptake of all recommended vaccines since birth was captured by 3 categories: *all vaccines*, *some vaccines*, and *no vaccines*. The validated 6-point-item (*excellent* to *very poor*) measure of self-perceived health status (Bowling, 2005) was dichotomized into "excellent or very good" and “good or less”. Empathy was assessed using the validated 16-item Toronto Empathy Questionnaire (TEQ) (36). Psychological distress was assessed using the validated 6-item Kessler Psychological Distress Scale (K6) (37). Altruism was assessed using the validated 5-item altruism subscale from the Prosocial Tendencies Measure (PTM) (38).

Sample size

To calculate the required sample size for the within-participant change in vaccine hesitancy (ie, pre- to postintervention), we used survey data that showed that in January/February 2021, approximately 40% of Canadians aged 20-39 years were hesitant toward a COVID-19 vaccine (ie, don’t know yet or would refuse vaccination) (Angus Reid Institute, 2021; Impact Canada, 2021). Estimating a 5% decrease in hesitancy in the intervention group and a correlation of about 0.4 between paired observations, the intervention group required a sample size of 907 pairs for detecting a 5% change in marginal proportions at a power of 80% and 2-sided significance of 5% (Dhand & Khatkar MS, 2014). To detect a 5% superiority of the video intervention in increasing vaccine intentions compared to the active control group at a power of 80%, we estimated a required sample per group of about 1300 participants. Considering a 1:1 allocation, the total sample required for this study was approximately 2600 participants (2×1300=2600).

Data analysis

Data cleaning

Using data cleaning techniques to identify careless responses is recommended for internet-based surveys as inattentive responses represent a threat to data validity (Meade & Craig, 2012). We used 2 methods to identify careless responses using the database received from Dynata. First, amongst both the video and text groups, we excluded participants who spent less than 273 seconds or more than 2401 seconds on the survey (lowest and highest 5% of time spent on the survey compared to the mean, 699 seconds). Next, we used responses to the TEQ to identify straight-liners (ie, exhibited no variance in their responses across scale items) and excluded them from subsequent analyses. We chose this scale because it included reverse-coded items, thereby making it highly unlikely that a participant would provide the same response for all items.

Statistical analyses

For baseline sociodemographics, we calculated proportions and means (and SD) and used the Pearson chi-square test and the Welch 2-sample t test to evaluate whether the 2 study groups differed significantly. At baseline and postintervention and for each of the study groups, we calculated the proportion of participants in each of the 4 PAPM intention stages (ie, unengaged, undecided, decided not, and decided to). For each study group, we calculated the pre- to posttransitions in intentions to receive the COVID-19 vaccine. To estimate the pre- to postintervention change in vaccine intentions, we used a binary outcome (ie, "intenders" corresponding to the stage decided to and "nonintenders" that included stages unengaged, undecided, and decided not) and the McNemar chi-square test. To estimate pre-post changes in PAPM intention stages, we conducted exact tests of symmetry (4×4 contingency tables) that comprise pairwise McNemar tests (using the nominalSymmetryTest function available in the R package rcompanion) (Mangiafico, 2022). We reported adjusted *P* values for multiple comparisons (Benjamini and Hochberg method), odds ratios (ORs), and the Cohen g effect size that was interpreted as small (0.05 to <0.15), medium (0.15 to <0.25), or large (≥0.25). For each study group, we used the significant transitions between vaccine intention stage pairs for calculating the total number of participants who changed toward increased vaccination intentions (eg, from *undecided* to *decided to*) and estimated the between-group difference using the chi-square 2-sample test for equality of proportions. To estimate the between-group difference in vaccine intentions, the Pearson chi-square Test was conducted on postintervention vaccine intentions using the 4-stage PAPM outcome.

Additional analyses

Using the same analysis approach, we performed 2 subgroup analyses that included (1) all participants who answered the postintervention COVID-19 vaccine intentions question and participants who were initially removed during data cleaning (N=1654) and (2) all participants who were randomly allocated to the study groups and who answered the preintervention COVID-19 vaccine intentions question (N=2089, intention-to-treat approach). In addition, for both subgroups, we performed exploratory between-group analyses and operationalized the vaccine intention outcome in 2 different ways: (1) baseline (preintervention) vaccine intentions in the text group and postintervention intentions in the video group and (2) postintervention vaccine intentions in the text group and baseline intentions in the video group.

All statistical analyses were conducted using R v. 4.0.5 (R Core Team) (R Development Core Team, 2005).

Ethical considerations

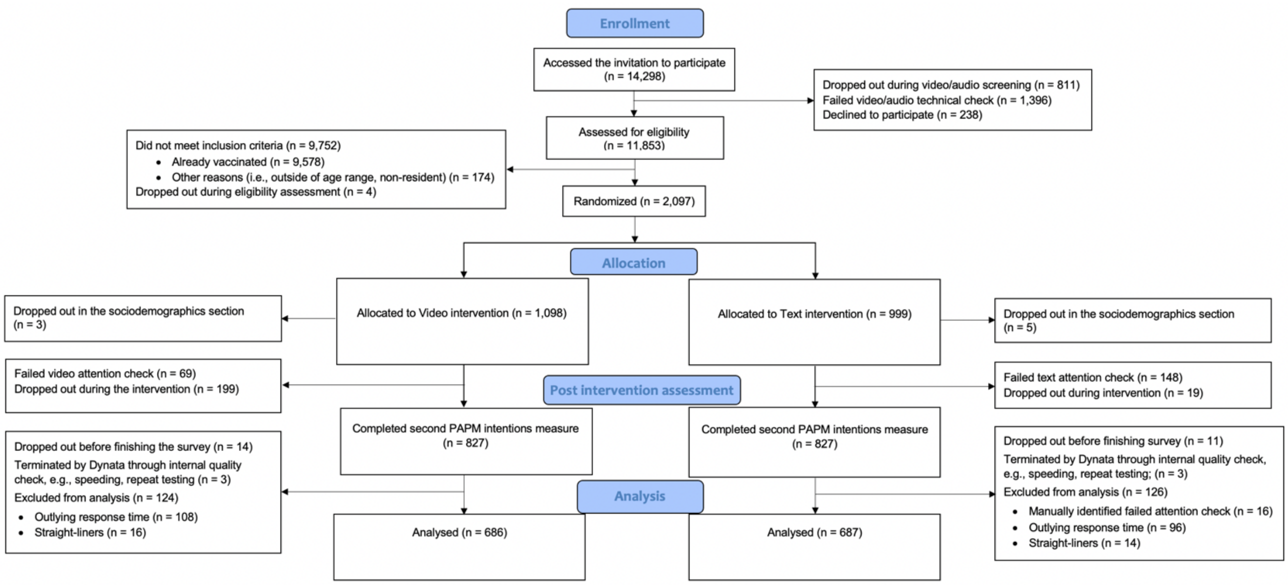
The study was approved by the Research Ethics Board of the Integrated Health and Social Services University Network for West-Central Montreal (CIUSSS West-Central Montreal; Project ID #2021-2732).

Results

Participant flow

Of 14,298 participants in the target age group who accessed the invitation to participate, 11,853 (82.9%) were assessed for eligibility, of whom 2097 (17.7%) were eligible (n=9578, 80.8%, were excluded because they were already vaccinated against COVID-19; n=174, 1.5%, did not meet other inclusion criteria; and n=4, 0.03%, dropped out) and were randomly allocated to the study arms: 1654 (78.9%) completed the postintervention assessment, and 1373 (65.5%; ie, 686, 50%, and 687, 50%, in the video and text intervention arms, respectively) were included in the analyses. See Figure 1.

Figure 1. CONSORT diagram. CONSORT: (Consolidated Standards of Reporting Trials); PAPM: Precaution Adoption Process Model



Recruitment dates and reasons for stopping the trial

Data collection took place from July 30 to September 13, 2021. At about 5 weeks into data collection, daily recruitment significantly declined. The main barrier was the relative low proportion (about 22%) of eligible participants (ie, unvaccinated in the age group of 20-39 years). We conducted preliminary analyses using a total sample of 1346 participants (673, 50%, per group) and found that the number of observations ensured 80% power to detect a 5% pre-post change in vaccine intentions. Preliminary analyses showed a difference of about 2% as opposed to the expected between-group difference of 5% in vaccine intentions that we had anticipated. To reach a similar level of power would have required about 5500 participants per group (ie, an increase of 4200 from our initial sample calculations) to detect a statistically significant superiority of the video intervention. Reaching the new sample size target would not have been feasible due to time and budget considerations, and we decided to stop data collection.

Baseline data

The sample consisted of slightly more females (n=740, 53.9%), the mean age was 30.7 years, the majority used English as the primary language at home (n=1122, 81.7%), most reported a total gross household income in the year preceding the pandemic of less than CA $75,000 (US $58563.80, n=848, 61.8%), and most resided in an urban area (n=1067, 77.7%). None of the sociodemographic characteristics differed significantly between the study groups (see Table 1 and Multimedia Appendix 3 for additional subgroup analyses). In the video group, 86 (12.5%) intended to receive the vaccine, 292 (42.6%) were decided against vaccination, 234 (34.1%) were undecided, and 74 (10.8%) had not thought about receiving the COVID-19 vaccine (ie, *unengaged*). Participants allocated to the active control group (text intervention) reported similar vaccine intentions, and the difference between groups was not statistically significant: χ^2_3=1.62, P=.65; see Table 2.

Table 1. Socio-demographic variables

Characteristics		Total (N=1373)	Video group (N=686)	Text group (N=687)	Between group difference[a]
Age, mean (SD)		30.7 (5.3)	30.7 (5.4)	30.7 (5.3)	*P* = .94
Sex, n (%)					*P* = .98
	Male	633 (46.1)	316 (46.1)	317 (46.1)	–[b]
	Female	740 (53.9)	370 (53.9)	370 (53.9)	–
Gender, n (%)					*P* = .98
	Man	626 (45.6)	311 (45.3)	315 (45.9)	–
	Woman	721 (52.5)	362 (52.8)	359 (52.3)	–
	Gender diverse	26 (1.9)	13 (1.9)	13 (0.4)	–
Canadian region, n (%)					*P* = .08
	Western	451 (32.8)	225 (32.8)	226 (32.9)	–
	East	105 (7.7)	40 (5.8)	65 (9.5)	–
	Central	813 (59.2)	419 (61.1)	394 (57.3)	–
	Territories	4 (0.3)	2 (0.3)	2 (0.3)	–
Place of residence, n (%)					*P* = .43
	Rural	306 (22.3)	159 (23.2)	147 (21.4)	–
	Urban	1067 (77.7)	527 (76.8)	540 (78.6)	–
Self-perceived visible minority, n (%)					*P* = .05
	Yes	401 (29.2)	217 (31.6)	184 (26.8)	–
	No	972 (70.8)	469 (68.4)	503 (73.2)	–
Language spoken at home					*P* = .46
	English	1122 (81.7)	561 (81.8)	561 (81.7)	–
	French	203 (14.8)	105 (15.3)	98 (14.2)	–
	Other	48 (3.5)	20 (2.9)	28 (4.1)	–
Education (any post-secondary)					*P* = .63
	Yes	858 (62.5)	433 (63.1)	425 (61.9)	–
	No	515 (37.5)	253 (36.9)	262 (38.1)	–
Income (CAD $)[c], n (%)					*P* = .56
	<19999 (US $15,616.20)[d]	149 (10.9)	72 (10.5)	77 (11.2)	–
	20000-39999 (US $15,617-$31,233.20)	253 (18.4)	136 (19.8)	117 (17.0)	–
	40000-59999 (US $31,224-$46,850.20)	227 (16.5)	113 (16.5)	114 (16.6)	–
	60000-79999 (US $46,851-$62,467.20)	217 (15.8)	109 (15.9)	108 (15.7)	–
	80000-99999 (US $62,468-$78,084.20)	188 (13.7)	82 (12.0)	106 (15.5)	–
	>100000 (US $78,085)	288 (21.0)	148 (21.5)	140 (20.4)	–
	Prefer not to answer	51 (3.7)	26 (3.8)	25 (3.6)	–
Ethnicity, n (%)					*P* = .31
	North American Aboriginal	107 (7.8)	62 (9.0)	45 (6.6)	–

	Other North American	637 (46.4)	303 (44.2)	334 (48.6)	–
	European	320 (23.3)	160 (23.3)	160 (23.3)	–
	Asian	98 (7.1)	51 (7.4)	47 (6.8)	–
	Other	211 (15.4)	110 (16.0)	101 (14.7)	–
	Identification as a parent, n (%)				*P* = .89
	Yes	697 (50.8)	347 (50.6)	350 (50.9)	–
	No	676 (49.2)	339 (49.4)	337 (49.1)	–

[a]Chi-square or *t* test.

[b]-: not applicable.

[c]Of 1373 participants, 848 (61.8%) and 525 (38.2%) reported an annual income before taxes of all members of the household before the pandemic of <CA $75,000 and ≥CA $75,000, respectively. The between-group difference in proportions was not significant (P=.48).
[d]An exchange rate of CA $1=US $0.78 has been applied.

Table 2. Number of participants by PAPM[a] vaccine intention stage and intervention group at baseline and post intervention (N=1373)

Group	Unengaged	Undecided	Decided not	Decided to	Total	Between group difference[b]
Baseline, n (%)						*P* = .65
Video	74 (10.8)	234 (34.1)	292 (42.6)	86 (12.5)	686 (50.0)	–[c]
Text	73 (10.6)	255 (37.1)	272 (39.6)	87 (12.7)	687 (50.0)	–
Postintervention, n (%)						*P* = .64
Video	54 (7.9)	236 (34.4)	277 (40.4)	119 (17.3)	686 (50.0)	–
Text	47 (6.8)	249 (36.2)	285 (41.5)	106 (15.4)	687 (50.0)	–

[a]PAPM: Precaution Adoption Process Model.

[b]Chi-square test.

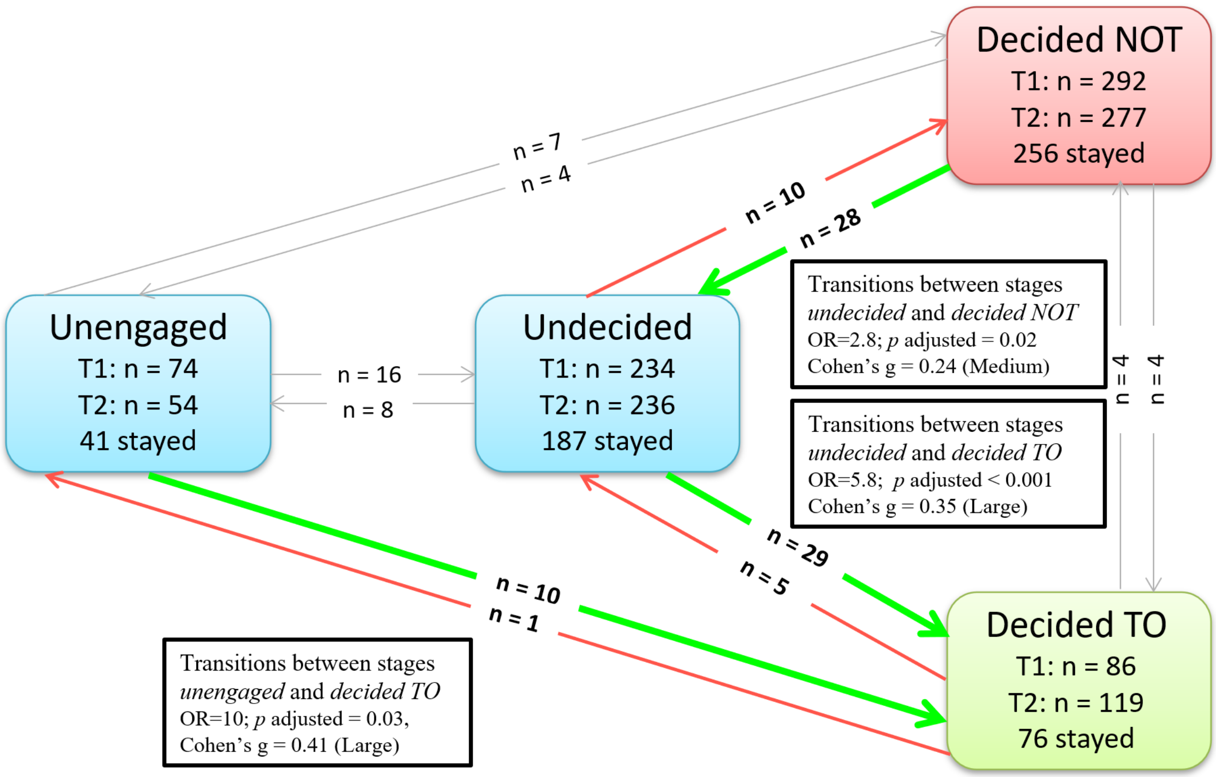
[c]–: not applicable.

Outcomes

In the video group, 43 (6.3%) participants changed from nonintenders at baseline (ie, *unengaged*, *undecided*, or *decided not*) to vaccine intenders (ie, *decided to*) postintervention and 10 (1.5%) participants changed from vaccine intenders at baseline to nonintenders postintervention. The McNemar test was significant (χ^2_1=20.55, *P*<.001). In the active control (text) group, 24 (3.5%) participants changed from nonintenders at baseline to vaccine intenders postintervention and 5 (0.7%) participants changed from vaccine intenders at baseline to nonintenders postintervention. Unexpectedly, the McNemar test was also significant (χ^2_1=12.45, *P*<.001).

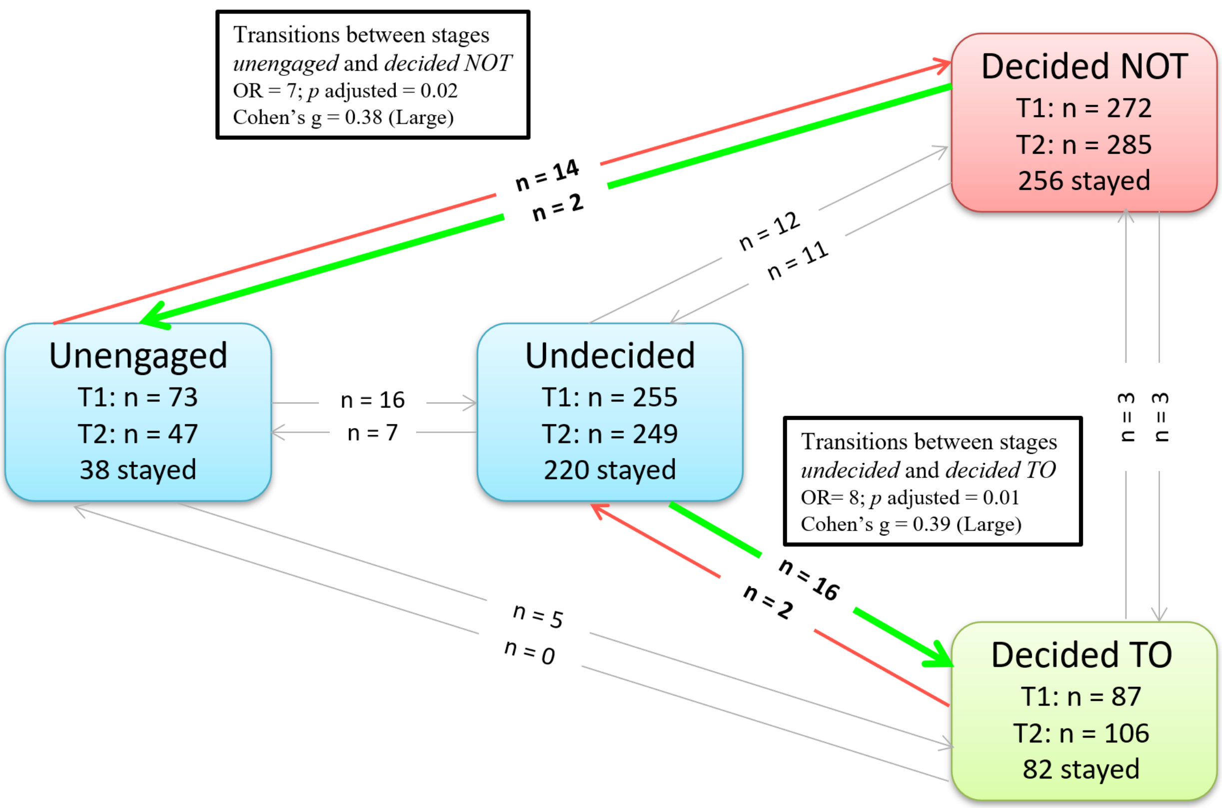
In the video group, we found a statistically significant change from decided not at baseline to undecided postintervention (n=28, 4.1%; P=.02, OR 2.8, Cohen g=.24), from undecided to decided to (n=29, 4.2%; P<.001, OR 5.8, Cohen g=.35), and from unengaged to decided to (n=10, 1.5%; P=.03, OR 10, Cohen g=.41). In total, in the video group, 67 significant changes toward increased vaccination intentions were observed (see Figure 2 for a visual representation of PAPM stage transitions from baseline to postintervention in the video group and Table 1 and Table 2 in Multimedia Appendix 4).

Figure 2. PAPM stage transitions from T1 (baseline) to T2 (postintervention) in the video group (N=686). OR: odds ratio; PAPM: Precaution Adoption Process Model. Green arrows show significant transitions toward increased and red arrows toward decreased vaccination intentions. Gray arrows show nonsignificant transitions between stages.



In the text group, we found a statistically significant change from *unengaged* at baseline to *decided not* postintervention (denoting a change toward decreased vaccine intentions; n=14, 2%; *P*=.02, OR 7, Cohen g=.38) and from *undecided* to *decided to* (n=16, 2.3%; *P*=.01, OR 8, Cohen g=.39). In other words, in the text group, 14 (2%) participants moved toward decreased intentions and 16 (2.3%) participants moved toward increased vaccination intentions (see Figure 3 for a visual representation of PAPM stage transitions from baseline to postintervention in the text group and Tables S1 and Table S3 in Multimedia Appendix 4). We found a significant difference between those who changed toward increased vaccine intentions in the video group (n=67, 9.77%) compared to the text group (n=16, 2.33%): χ^2_1=33.43, *P*<.001.

Figure 3. PAPM stage transitions from T1 (baseline) to T2 (postintervention) in the text group (N=687). OR: odds ratio; PAPM: Precaution Adoption Process Model. Green arrows show significant transitions toward increased and red arrows toward decreased vaccination intentions. Gray arrows show nonsignificant transitions between stages.



Postintervention, in the video group, 119 (17.3%) intended to receive the vaccine, 277 (40.4%) were decided against vaccination, 236 (34.4%) were undecided, and 54 (7.9%) reported being unengaged. In the text group, 106 (15.4%) intended to receive the vaccine, 285 (41.5%) were decided against vaccination, 249 (36.2%) were undecided, and 47 (6.8%) reported being unengaged. The between-group difference in vaccine intentions was not significant: χ^2_3=1.70, *P*=.64.

Results of additional subgroup analyses did not significantly differ from per protocol analyses (see Multimedia Appendix 5). The only difference consisted in the loss of statistical significance of the transition from *unengaged* to *decided to* in the video group (see Table S2 in Multimedia Appendix 5) that could be explained by 2 additional participants who transitioned from *decided to* at baseline to *unengaged* postintervention. Since one cannot change from *decided to* get the vaccine to *unengaged*, this was an artifact introduced by careless responding.

Results of exploratory analyses provided a signal that the video intervention was superior to the text intervention as the between-group difference in vaccine intentions was significant when using preintervention intentions in the text group and postintervention intentions in the video group (χ^2_1=5.90, *P*=.02) and not significant when using preintervention intentions in the video group and postintervention intentions in the text group (χ^2_1=2.39, *P*=.12); see Tables S10 and S11 in Multimedia Appendix 5. The same results were obtained using samples comprising 1654 (all completers of the second vaccination intention assessment; see Tables S5 and S6 in Multimedia Appendix 5, Tables 5 and 6) and n = 2089 (intention-to-treat) participants (see see Tables S8 and S9 in Multimedia Appendix 5.

Discussion

Principal findings

To the best of our knowledge, this is the first population-based study that examined the effect of a video-based intervention eliciting prosocial (altruistic) motives on intentions to receive the COVID-19 vaccine in younger Canadian adults. We used a pre-post and randomized control trial (RCT) study design and recruited a national sample of unvaccinated 20-39-year-old Canadians who participated in a web-based survey between July and September 2021 in the context of the fourth COVID-19 pandemic wave. Our study had 2 specific objectives: (1) to estimate pre- to postintervention vaccine intention changes in participants who were randomly allocated to the video intervention or the text-based intervention that provided non-vaccine-related preventive health measures and (2) to estimate between-group vaccine intentions postintervention.

Comparison with prior work

First, we found that the video intervention was effective in changing vaccine intentions and that 4.8% more participants intended to receive the vaccine postintervention. The size of the effect is consistent with results of the experimental study conducted by Li et al. (2016) who studied 3952 participants (median age range 31 to 40 years) from 8 countries (China, France, Japan, United Kingdom, United States, Israel, Brazil, and South Africa) who participated in an internet survey in 2013 before the start of the flu season at the time. They reported a 6% absolute increase in intentions to receive the influenza vaccine in participants who were exposed to prosocial (altruism) messages (Li et al., 2016). Understanding the evolving context in which our study was conducted could explain the modest (4.8%) increase in vaccine intentions. At the time of data collection (July 30-September 13, 2021), about 3 months had elapsed since adults 20-39 years old became eligible to receive the COVID-19 vaccine in Canada. Three-quarters of them had received at least 1 dose (Government of Canada, 2022b). In surveys conducted before the start of vaccination, approximately 40% of our target population was vaccine hesitant compared to 87% who reported vaccine hesitancy in our analyzed sample who are more resistant to vaccination. Therefore, it is possible that had this study been conducted 2 months earlier, our results would have shown a higher increase in pre- to postintervention vaccine intentions. Surprisingly, vaccine intentions also significantly increased in the group that received information about nonvaccine preventive measures in text format, although the effect was smaller than that in the video group, as only 2.7% reported higher vaccine intentions postintervention. Because we used a vaccine-neutral intervention in the active control group, it is possible that the increase represents social desirability. Since we did not measure social desirability, it is possible this bias was also present in the video intervention group as the video depicted vaccination as a social benefit.

Using the theoretical PAPM to inform the measurement of vaccine intentions, we found a more nuanced understanding of pre- to postintervention change in vaccine intentions. Our results show that significantly more participants who watched the video changed toward a more advanced vaccine decision stage than participants in the text group. In both groups, we found that individuals who had not thought about receiving the vaccine (unengaged) and those who were undecided were more likely to change their intentions to decided to vaccinate compared to those who reported being decided not at baseline, and this effect was more pronounced in the video group. This pattern of decision-making changes aligns with our previous findings from a longitudinal study evaluating human papillomavirus (HPV) vaccine intention change over a 9-month period in parents of 9-16-year-old boys and girls (Tatar et al., 2019). In that study, we demonstrated that parents who were unengaged or undecided at baseline were more likely to increase their HPV vaccine acceptability over time and deemed "flexible hesitant" (ie, changed to decided to vaccinate or vaccinated their child). This was in contradistinction with parents who were initially in the decided not stage and remained decided not over time, whom we deemed as "rigid hesitant" (Tatar et al., 2019). Therefore, investigating vaccine hesitancy as a binary outcome does not convey the nuances of movement in vaccine intention stages. For individuals who are “flexible hesitant,” viewing messages that highlight altruism may provide the necessary “push” to move toward adoption stages of accepting the vaccine. This could reflect behavioral nudging, in which promoting the positive impacts of a behavior without changing incentives or forbidding negative options can have a substantial impact on the behavior (Dai et al., 2021; Thaler & Sunstein, 2009). A recent systematic review by Reñosa et al. (2021) found that nudging messages that invoked emotional affect, such as storytelling and dramatic narratives, can improve vaccine confidence and uptake. In addition, Wood and Schulman (2021) suggested that apathy toward vaccination, a characteristic that might contribute to someone being unengaged, could be addressed with peripheral, emotional messaging to motivate behavior change. Interestingly, in the video group, significantly more people moved from decided not to undecided, suggesting that the evocation of concern for others (altruism) may prompt even “rigid” hesitant individuals to reflect and rethink their decision.

Although pre-post analyses showed that the video intervention was effective in increasing vaccine intentions, between-group analyses did not confirm our hypothesis that watching the video would result in statistically significant higher intentions compared to reading non-vaccine-related information. Two factors may have contributed to this outcome: (1) The unexpected 2.7% increase in vaccine intentions in the active control group that reduced the hypothesized 5% between-group difference, and (2) the higher-than-expected vaccine hesitancy in our sample (which comprised ~40% “rigid hesitant” compared to ~10% found in 2 population-based studies conducted by our team that investigated HPV vaccine hesitancy (Perez et al., 2017; Shapiro et al., 2018) that could have attenuated the effect of the video on vaccine intentions because “rigid hesitant” are less amenable to changes in intentions.

Although achieving statistical significance for the between-group difference would have sent a strong signal related to the efficacy of the video intervention, we believe that our study can inform future research using interventions that elicit prosocial motives to increase COVID-19 vaccine intentions. For example, interventions could be adapted to include other forms of prosocial motivations, such as collectivism (the practice of prioritizing a group over individuals within the group) (Batson et al., 2011). Previous research has shown that collectivism is associated with COVID-19 vaccine acceptance (Burke et al., 2021; Mo et al., 2021), while individualism (ie, emphasis on the autonomous individual) is associated with COVID-19 vaccine hesitancy (Yu et al., 2021). Therefore, to override feelings of personal invulnerability to COVID-19 in countries that are more individualistic than collectivistic (eg, Canada, the United States), messages that promote community well-being, highlight shared goals, and induce feelings of interdependence should be used to encourage COVID-19 vaccination (Leonhardt et al., 2021). Importantly, the design of our intervention aligns well with the recommendations for animated, video-based health communication interventions published by Adam et al. (2021) in 2021. Our intervention used a narrative approach, was well adapted to the Canadian cultural context as it was available in English and French, used characters of different ages and ethnic backgrounds, used appealing colors that ensured an optimal contrast independent of the size of the screen, included the voice of a narrator with experience in media communications, and had a length aligned with the recommend optimal length of around 2.5 minutes (Adam et al., 2021).

Limitations

The main limitations derive from the premature termination of the study dictated by barriers in participant recruitment and by lower-than-anticipated COVID-19 vaccine hesitancy in the population of interest. As the target sample size was not reached, the sampling quotas used to match Canadian Census data deviated from the planned quotas and we included 3.9% more females, 2.3% more participants residing in rural areas, 5.2% less Francophones, and 11.8% less participants with annual total income before taxes of all members of the household before the pandemic of CA $75,000 (US $58,563.80). Although between-group differences were not significant, these differences in sociodemographics could impede the generalizability of the results to the Canadian population. The high proportion of participants who were in the decided not to vaccinate stage could have diminished our ability to prove the superiority of the video intervention in increasing vaccine intentions. Additionally, the use of an active control group could have diminished our capacity to prove the statistical superiority of the video intervention, perhaps due to social desirability. Finally, follow-up 3-6 months later would have allowed us to evaluate the translation of increased vaccine intentions into actual vaccine uptake.

Conclusions

Using a web-survey and a pre-post and RCT study design, we showed that a brief video eliciting prosocial (altruism) motives increased COVID-19 vaccine intentions of Canadians aged 20-39 years, especially among those who were less engaged in the decision to vaccinate or were undecided. As web streaming is highly popular among younger adults, using short videos is an efficient modality to disseminate public health messages. The effect of the new intervention on increasing intentions was modest, but delivering messages that elicit prosocial motives to vaccinate to a large population could increase vaccine intentions in a significant number of individuals and assist in reaching vaccination targets and curbing the effect of the pandemic. As vaccine hesitancy is complex, it is likely that a multifaceted messaging approach that includes the benefits of vaccination for the community would be beneficial, especially in societies where individual values prevail over collective values. Our intervention could be adapted to align with the latest COVID-19 immunization recommendations (eg, boosters) or to increase vaccine intentions for other preventable diseases.

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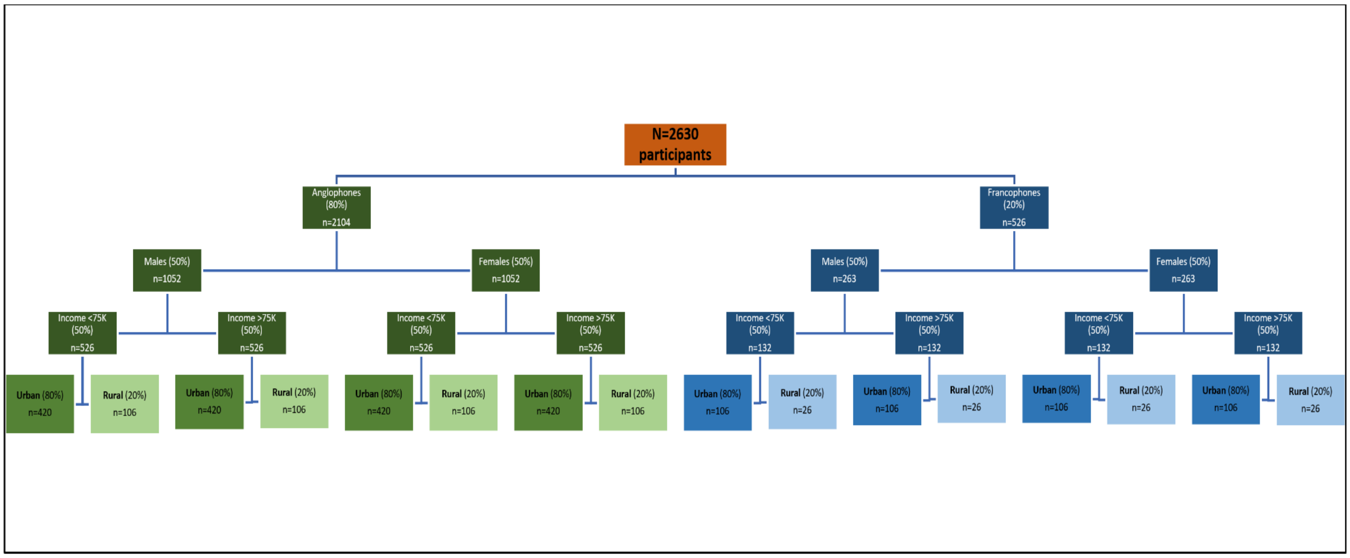
Conflict of interest

Within the past 5 years, GZ has served as a consultant to Merck (regarding human papillomavirus [HPV] vaccination), Pfizer (regarding meningococcal vaccination), and Sanofi Pasteur (regarding adolescent vaccination). GZ also has served on advisory boards for Merck (regarding HPV vaccination) and Moderna (regarding COVID-19 vaccination). The other authors declare no conflicts of interest.

Multimedia Appendix 1. Strata



Multimedia Appendix 2. Text intervention

Text intervention and attention check questions

COVID-19 spreads from an infected person to others through respiratory droplets and aerosols (smaller droplets) created when an infected person talks, sings, shouts, coughs, or sneezes. COVID-19 can also spread by touching something that has the virus on it, then touching your mouth, nose or eyes with unwashed hands. You can transmit COVID-19 even before you start showing symptoms or without ever developing symptoms.

The Public Health Agency of Canada recommends practicing several preventive health behaviours to reduce the spread of COVID-19 disease. Here is a reminder of what these recommended behaviours are:

General hygiene

In your day-to-day activities, you can reduce the risk of infection and or spreading infection to others by doing the following:

- Wash your hands often, with soap and warm water for at least 20 seconds
- Cough or sneeze into a tissue or the bend of your arm (not your hand)
- Avoid touching your eyes, nose, or mouth with unwashed hands
- Wear a mask when in a shared space (both indoors and outdoors)
- Regularly clean high-touch surfaces such as door handles, phones, television remotes, and toilets with regular household cleaners or diluted bleach
- Ensure proper ventilation to reduce potentially infectious particles in the air indoors.

Quiz/check:
Please select the statement that was ***not*** *explained in the text you have just read:*

a. *Cleaning high touch surfaces*
b. *Washing your hands often, with soap and warm water*
c. *Wearing a mask when in a shared space*
d. *Limit sexual activity with new partners*

Physical distancing

Public health recommends keeping your contact with people outside your household to a minimum. This includes:

- Avoiding closed spaces with poor ventilation and crowded places
- Staying home and away from others if you feel sick
- Keeping the number of people you have prolonged contact with as small as possible
- Sticking to a small and consistent social circle and avoiding gathering in large groups
- Talking to your employer about working at home if possible
- Limiting contact with those at risk of more severe illness such as older adults, those with underlying medical conditions, and those with compromised immune systems
- Maintaining a physical distance of 2 meters from people outside your household
- Limiting sexual activity with new partners.

Quiz/check:
Please select the statement that was ***not*** *explained in the text you have just read:*

a. *Staying home and away from others if you feel sick*
b. *Avoiding gathering in large groups*
c. *Providing proof of a negative COVID-19 test before returning to Canada after travelling*
d. *Limit contact with those at risk of more severe illness*

Travel/quarantine/isolation

Public health recommends avoiding all non-essential travel outside of Canada as travelling increases your risk of getting infected with COVID-19. If you are planning to return to Canada, you may be required to take a COVID-19 test and provide proof of a negative COVID-19 test result before entering Canada.

Upon your return to Canada (as well as for return from inter-provincial travel between certain provinces/territories), you may be required to:

- Quarantine (self-isolate) at home when you may have been exposed to COVID-19 and have no symptoms
- Isolate at home if you have been diagnosed with COVID-19, you have symptoms of COVID-19, or if you are waiting to hear results of a COVID-19 lab test

Quiz/check:
Please select the statement that was ***not*** *explained in the text you have just read:*

a. *Avoiding all non-essential travel*
b. *Engaging in physical activity outdoors instead of indoors*
c. *Taking a COVID-19 test before entering Canada*
d. *Isolating at home if you have symptoms of COVID-19 upon your return to Canada*

Multimedia Appendix 3. Sociodemographics Subgroups

Table 1. Sociodemographics, all participants who responded to the baseline vaccine intentions question (n = 2089)

		Total (N = 2089)	Video group (N = 1095)	Text group (N = 994)	Between group difference*
		n (%) or Mean (SD)	n (%) or Mean (SD)	n (%) or Mean (SD)	
Age		30.6 (5.2)	30.8 (5.2)	30.4 (5.2)	p = 0.11
Sex					
	Male	1019 (48.8)	530 (48.4)	489 (49.2)	p = 0.72
	Female	1070 (51.2)	565 (51.6)	505 (50.8)	
Gender					
	Man	1025 (49.1)	532 (48.6)	493 (49.6)	p = 0.86
	Woman	1026 (49.1)	542 (49.5)	484 (48.7)	
	Gender diverse	38 (1.8)	21 (1.9)	17 (1.7)	
Canadian region					
	Western	702 (33.6)	373 (34.1)	329 (33.1)	p = 0.04
	Central	1207 (57.8)	640 (58.4)	567 (57.0)	
	Eastern	163 (7.8)	70 (6.4)	93 (9.4) *	
	Territories	17 (0.8)	12 (1.1)	5 (0.5)	
Place of residence					
	Rural	561 (26.9)	315 (28.8)	246 (24.7)	p = 0.04¶
	Urban	1528 (73.1)	780 (71.2)	748 (75.3)	
Self-perceived visible minority					
	Yes	739 (35.4)	398 (36.3)	341 (34.3)	p = 0.33
	No	1350 (64.6)	697 (63.7)	653 (65.7)	
Language spoken at home					
	English	1761 (84.3)	929 (84.8)	832 (83.7)	p = 0.50
	French	262 (12.5)	136 (12.4)	126 (12.7)	
	Other	66 (3.2)	30 (2.7)	36 (3.6)	
Education (any post-secondary)					
	Yes	1381 (66.1)	718 (65.6)	663 (66.7)	p = 0.59
	No	708 (33.9)	377 (34.4)	331 (33.3)	
Income (CAD)					
	<19999	216 (10.3)	109 (10.0)	107 (10.8)	p = 0.88
	20000-39999	362 (17.3)	196 (17.9)	166 (16.7)	
	40000-59999	312 (14.9)	157 (14.3)	155 (15.6)	
	60000-79999	352 (16.9)	182 (16.6)	170 (17.1)	
	80000-99999	318 (15.2)	164 (15.0)	154 (15.5)	
	>100000	444 (21.3)	239 (21.8)	205 (20.6)	
	Prefer not to answer	85 (4.1)	48 (4.4)	37 (3.7)	
Ethnicity					

	North American Aboriginal	221 (10.6)	125 (11.4)	96 (9.7)	p = 0.54
	Other North American	969 (46.4)	491 (44.8)	478 (48.1)	
	European	444 (21.3)	235 (21.5)	209 (21.0)	
	Asian	148 (7.1)	78 (7.1)	70 (7.0)	
	Other	307 (14.7)	166 (15.2)	141 (14.2)	
Identification as a parent					
	Yes	1171 (56.1)	621 (56.7)	550 (55.3)	p = 0.53
	No	918 (43.9)	474 (43.3)	444 (46.7)	

Obs: * denotes effect size, Cohen's h=0.11 (very small); ¶ denotes Cohen's h=0.09 (very small)

Table 2. Sociodemographics, all participants who responded to the post-intervention vaccine intentions question, including participants who were flagged as careless responders during data cleaning (n = 1654)

		Total (N = 1654)	**Video group (N = 827)**	**Text group (N = 827)**	**Between group difference***
		n (%) or Mean (SD)	n (%) or Mean (SD)	n (%) or Mean (SD)	
Age		30.7 (5.3)	30.8 (5.3)	30.6 (5.3)	p = 0.41
Sex					
	Male	759 (45.9)	381 (46.1)	378 (45.7)	p = 0.88
	Female	895 (54.1)	446 (53.9)	449 (54.3)	
Gender					
	Man	752 (45.5)	376 (45.5)	376 (45.5)	p = 0.98
	Woman	871 (52.7)	436 (52.7)	435 (52.6)	
	Gender diverse	31 (1.9)	15 (1.8)	16 (1.9)	
Canadian region					
	Western	523 (31.6)	265 (32.0)	258 (31.2)	p = 0.02
	Central	997 (60.3)	511 (61.8)	486 (58.8)	
	Eastern	127 (7.7)	47 (5.7)	80 (9.7)*	
	Territories	7 (0.4)	4 (0.5)	3 (0.4)	
Place of residence					
	Rural	383 (23.2)	191 (23.1)	192 (23.2)	p = 0.95
	Urban	1271 (76.8)	636 (76.9)	635 (76.8)	
Self-perceived visible minority					
	Yes	493 (29.8)	253 (30.6)	240 (29.0)	p = 0.49
	No	1161 (70.2)	574 (69.4)	587 (71.0)	
Language spoken at home					
	English	1367 (82.6)	685 (82.8)	682 (82.5)	p = 0.64
	French	228 (13.8)	116 (14.0)	112 (13.5)	
	Other	59 (3.6)	26 (3.1)	33 (4.0)	
Education (any post-secondary)					
	Yes	1053 (63.7)	526 (63.6)	527 (63.7)	p = 0.96

	No	601 (36.3)	301 (36.4)	300 (36.3)	
Income (CAD)					
	<19999	179 (10.8)	88 (10.6)	91 (11.0)	p = 0.48
	20000-39999	302 (18.3)	161 (19.5)	141 (17.0)	
	40000-59999	266 (16.1)	128 (15.5)	138 (16.7)	
	60000-79999	268 (16.2)	130 (15.7)	138 (16.7)	
	80000-99999	232 (14.0)	105 (12.7)	127 (15.4)	
	>100000	344 (20.8)	183 (22.1)	161 (19.5)	
	Prefer not to answer	63 (3.8)	32 (3.9)	31 (3.7)	
Ethnicity					
	North American Aboriginal	129 (7.8)	69 (8.3)	60 (7.3)	p = 0.43
	Other North American	757 (45.8)	359 (43.4)	398 (48.1)	
	European	383 (23.2)	199 (24.1)	184 (22.2)	
	Asian	133 (8.0)	70 (8.5)	63 (7.6)	
	Other	252 (15.2)	130 (15.7)	122 (14.8)	
Identification as a parent					
	Yes	860 (52.0)	431 (52.1)	429 (51.9)	p=.92
	No	794 (48.0)	396 (47.9)	398 (48.1)	

Obs: * denotes effect size, Cohen's h=0.15 (very small)

Table 3. Sociodemographics, participants who dropped between baseline and post intervention assessment of vaccine intentions (n=435)

		Total (N = 435)	Video group (N = 268)	Text group (N = 167)	Between group difference*
		n (%) or Mean (SD)	n (%) or Mean (SD)	n (%) or Mean (SD)	
Age		30.4 (4.9)	30.8 (4.8)	29.8 (5.0)	p = 0.03*
Sex					
	Male	260 (59.8)	149 (55.6)	111 (66.5)	p = 0.02¶
	Female	175 (40.2)	119 (44.4)	56 (33.5)	
Gender					
	Man	273 (62.8)	156 (58.2)	117 (70.1)♦	p = 0.03
	Woman	155 (35.6)	106 (39.6)	49 (29.3)●	
	Gender diverse	7 (1.6)	6 (2.2)	1 (0.6)	
Canadian region					
	Western	179 (41.1)	108 (40.3)	71 (42.5)	p = 0.65
	Central	210	129 (48.1)	81 (48.5)	
	Eastern	36	23 (8.6)	13 (7.8)	
	Territories	10 (2.3)	8 (3.0)	2 (1.2)	
Place of residence					
	Rural	178 (40.9)	124 (46.3)	54 (32.3)	p = 0.004§
	Urban	257 (59.1)	144 (53.7)	113 (67.7)	

Self-perceived visible minority					
	Yes	246 (56.6)	145 (54.1)	101 (60.5)	p = 0.19
	No	189 (43.4)	123 (45.9)	66 (39.5)	
Language spoken at home					
	English	394 (90.6)	244 (91.0)	150 (89.8)	p = 0.91
	French	34 (7.8)	20 (7.5)	14 (8.4)	
	Other	7 (1.6)	4 (1.5)	3 (1.8)	
Education (any post-secondary)					
	Yes	328 (75.4)	192 (71.6)	136 (81.4)	p = 0.02[¥]
	No	107 (24.6)	76 (28.4)	31 (18.6)	
Income (CAD)					
	<19999	37 (8.5)	21 (7.8)	16 (9.6)	p = 0.55
	20000-39999	60 (13.8)	35 (13.1)	25 (15.0)	
	40000-59999	46 (10.6)	29 (10.8)	17 (10.2)	
	60000-79999	84 (19.3)	52 (19.4)	32 (19.2)	
	80000-99999	86 (19.8)	59 (22.0)	27 (16.2)	
	>100000	100 (23.0)	56 (20.9)	44 (26.3)	
	Prefer not to answer	22 (5.1)	16 (6.0)	6 (3.6)	
Ethnicity					
	North American Aboriginal	92 (21.1)	56 (20.9)	36 (21.6)	p = 0.91
	Other North American	212 (48.7)	132 (49.3)	80 (47.9)	
	European	61 (14.0)	36 (13.4)	25 (15.0)	
	Asian	15 (3.4)	8 (3.0)	7 (4.2)	
	Other	55 (12.6)	36 (13.4)	19 (11.4)	
Identification as a parent					
	Yes	311 (71.5)	190 (70.9)	121 (72.5)	p=.73
	No	124 (28.5)	78 (29.1)	46 (27.5)	

Note: *Cohen's d=0.22; ¶ Cohen's h=0.22; ♦ Cohen's h=0.25; ● Cohen's h=0.22; § Cohen's h=0.29; Cohen's h=0.23
Effect sizes in the range 0.2-0.3 are interpreted as being small.

Multimedia Appendix 4. Result Tables

Table 1. Participant PAPM vaccine intention stage transitions from baseline to post intervention for the video and text groups

Video group (n=686)					
		Post intervention PAPM stage			
		Unengaged	Undecided	Decided not	Decided to
Baseline PAPM stage	Unengaged (n=74)	41	16	7	**10**[*]
	Undecided (n=234)	8	187	10[§]	**29**[¶]
	Decided not (n=292)	4	**28**[§]	256	4
	Decided to (n=86)	1[*]	5[¶]	4	76
Text group (n=687)					
		Post intervention PAPM stage			
Baseline PAPM stage	Unengaged (n=73)	38	16	**14**[*]	5
	Undecided (n=255)	7	220	12	**16**[¶]
	Decided not (n=272)	2[*]	11	256	3
	Decided to (n=87)	0	2[¶]	3	82

Note: Significant transitions between stage pairs are marked with the same symbol. The direction of effect is marked in bold.

Table 2. Exact test of symmetry and effect size for the **video group** (n=686)

McNemar pairwise group symmetry tests Stage before/after vs. stage before/after	p value	p adjusted	OR	Probability	Cohen's g
Unengaged vs. undecided	0.153	0.229	2	0.667	0.167
Unengaged vs. decided not	0.546	0.655	1.75	0.636	0.136
Unengaged vs. decided to	0.0159	**0.0318**	**10**	0.909	**0.409**
Undecided vs. decided not	0.00582	**0.0175**	**2.8**	0.737	**0.237**
Undecided vs. decided to	8e-05	**0.00048**	**5.8**	0.853	**0.353**
Decided not vs. decided to	1	1	1	0.5	0

Note: In bold significant differences and effect size

Table 3. Exact test of symmetry and effect size for the **text group** (n=687)

McNemar pairwise group symmetry tests Stage before/after vs. stage before/after	p value	p adjusted	OR	Probability	Cohen's g
Unengaged vs. undecided	0.0953	0.143	2.29	0.696	0.196
Unengaged vs. decided not	0.00596	**0.0179**	**7**	0.875	**0.375**
Unengaged vs. decided to	0.0736	0.143	Inf	1	0.5
Undecided vs. decided not	1	1	1.09	0.522	0.0217
Undecided vs. decided to	0.00218	**0.0131**	**8**	0.889	**0.389**
Decided not vs. decided to	1	1	1	0.5	0

Note: In bold significant differences and effect size

Multimedia Appendix 5. Additional Analyses

Participants who responded to the post-intervention vaccine intentions question, including participants who were flagged as careless responders during data cleaning (n = 1654)

Table 1. PAPM vaccine intention stage per group at baseline and post intervention (N=1654)

Group	Unengaged	Undecided	Decided not	Decided to	n (%)	Between group difference*
Baseline n (%)						
Video	96 (11.6)	292 (35.3)	323 (39.1)	116 (14.0)	827 (50.0)	p =0.61
Text	97 (11.7)	317 (38.3)	305 (36.9)	108 (13.1)	827 (50.0)	
Post intervention n (%)						
Video	77 (9.3)	295 (35.7)	304 (36.7)	151 (18.3)	827 (50.0)	p =0.62
Text	77 (9.3)	296 (35.8)	322 (38.9)	132 (16.0)	827 (50.0)	

Note: * denotes Chi-squared test at baseline: $X - squared = 1.8331, df = 3, p - value = 0.6078$, and post intervention: $X - squared = 1.7949, df = 3, p - value = 0.616$

For the binary outcome (Yes/No), pre-intervention: X-squared = 0.33047, df = 1, p-value = 0.5654; and post intervention: X-squared = 1.5389, df = 1, p-value = 0.2148

Table 2. PAPM vaccine intention stage transitions from baseline to post intervention for the video and text groups (N=1654)

Video group (n=827)					
		Post intervention PAPM stage			
		Unengaged	Undecided	Decided not	Decided to
Baseline PAPM stage	Unengaged (n=96)	58	18	9	11
	Undecided (n=292)	12	236	10[§]	**34**[¶]
	Decided not (n=323)	4	**33**[§]	281	5
	Decided to (n=116)	3	8[¶]	4	101
Text group (n=827)					
		Post intervention PAPM stage			
Baseline PAPM stage	Unengaged (n=97)	56	18	**15**[*]	8
	Undecided (n=317)	16	261	17	**23**[¶]
	Decided not (n=305)	2[*]	14	285	4
	Decided to (n=108)	3	3¶	5	97

Note: Significant transitions between stage pairs are marked with the same symbol. The direction of effect is marked in bold.

Observations:

- In the video group the change pre to post is significant (McNemar's chi-squared = 18.846, df = 1, p-value = 1.417e-05)
- In the text group the change pre to post is significant (McNemar's chi-squared = 12.522, df = 1, p-value = 0.0004022)

Table 3. Exact test of symmetry and effect size for the **video group** (n=827)

McNemar pairwise group symmetry tests Stage before/after vs. stage before/after	p value	p adjusted	OR	Probability	Cohen's g
Unengaged vs. undecided	0.361	0.433	1.5	0.6	0.1
Unengaged vs. decided not	0.267	0.400	2.25	0.692	0.192
Unengaged vs. decided to	0.0614	0.123	3.67	0.786	0.286
Undecided vs. decided not	0.000794	**0.0238**	**3.3 (2.8)**	0.767	**0.267 (0.237)**
Undecided vs. decided to	0.000115	**0.00069**	**4.25 (5.8)**	0.81	**0.31 (0.353)**
Decided not vs. decided to	1	1	1.25	0.556	0.0556

Note: In bold significant differences and effect size

Observation:

- In brackets the OR and effect size on n=686 (corresponding to per protocol analyses, n=1373)

Table 4. Exact test of symmetry and effect size for the **text group** (n=827)

McNemar pairwise group symmetry tests Stage before/after vs. stage before/after	p value	p adjusted	OR	Probability	Cohen's g
Unengaged vs. undecided	0.864	1	1.12	0.529	0.0294
Unengaged vs. decided not	0.00361	**0.0108**	**7.5 (7)**	0.882	**0.382 (0.375)**
Unengaged vs. decided to	0.228	0.456	2.67	0.727	0.227
Undecided vs. decided not	0.719	1	1.21	0.548	0.0484
Undecided vs. decided to	0.000194	**0.00116**	**7.67 (8)**	0.885	**0.385 (0.389)**
Decided not vs. decided to	1	1	1.25	0.556	0.0556

Note: In bold significant differences and effect size

- Obs: In brackets the OR and effect size on n=687 (corresponding to n=1373)

Table 5. Baseline (pre intervention) vaccine intentions in the control group and post intervention intentions in the video group (n=1654)

Study group	**Non-intenders** n(%)	**Intenders** n(%)	**Total** n(%)
Active control (text)	719 (86.9)	108 (13.1	827 (50)
Video	676 (81.7)	151 (18.3)	827 (50)
Total	1395	259	1654

X-squared = 8.4644, df = 1, p-value = 0.003622

Table 6. Baseline (pre intervention) vaccine intentions in the video group and post intervention intentions in the control group (n=1654)

Study group	**Non-intenders** n(%)	**Intenders** n(%)	**Total** n(%)
Active control (text)	695 (84.0)	132 (16.0)	827 (50)
Video	711 (86.0)	116 (14.0)	827 (50)
Total	1406	248	1654

X-squared = 1.2143, df = 1, p-value = 0.2705

Participants who responded to the baseline vaccine intentions question (n = 2089, ITT)

Table 7. PAPM vaccine intention stage per group at baseline and post intervention (n=2089)

Group	**Unengaged**	**Undecided**	**Decided not**	**Decided to**	**n (%)**	**Between group difference***
Baseline n (%)						
Video	176 (16.1)	376 (34.3)	381 (34.8)	162 (14.8)	1095 (52.4)	*p* =0.48
Text	170 (17.1)	361 (36.3)	335 (33.7)	128 (12.9)	994 (47.6)	
Post intervention n (%)						
Video	157 (14.3)	379 (34.6)	362 (33.1)	197 (18.0)	1095 (52.4)	*p* =0.34
Text	150 (15.1)	340 (34.2)	352 (35.4)	152 (15.3)	994 (47.6)	

Note: * denotes Chi-squared test at baseline: $\chi^2(3) = 2.47$, $p = .480$, and post intervention: $\chi^2(3) = 3.34$, $p = .342$. For the binary intentions outcome preintervention: X-squared = 1.602, df = 1, p-value = 0.2056; and post-intervention: X-squared = 2.7278, df = 1, p-value = 0.09862

Table 8. Baseline (pre intervention) vaccine intentions in the control group and post intervention intentions in the video group (n=2089)

Study group	**Non-intenders** n(%)	**Intenders** n(%)	**Total** n(%)
Active control (text)	866 (87.1)	128 (12.9)	994 (47.6)
Video	898 (82.0)	197 (18.0)	1095 (52.4)
Total	1764	325	2089

X-squared = 10.371, df = 1, p-value = 0.00128

Table 9. Baseline (pre intervention) vaccine intentions in the video group and post intervention intentions in the control group (n=2089)

Study group	**Non-intenders** n(%)	**Intenders** n(%)	**Total** n(%)
Active control (text)	842 (84.7)	152 (15.3)	994 (47.6)
Video	933 (85.2)	162 (14.8)	1095 (52.4)
Total	1775	314	2089

X-squared = 0.10086, df = 1, p-value = 0.7508

Analyses on the dataset that does not include careless responders (n=1373)

Table 10. Baseline (pre intervention) vaccine intentions in the control group and post intervention intentions in the video group (n=1373)

Study group	**Non-intenders** n(%)	**Intenders** n(%)	**Total** n(%)
Active control (text)	600 (87.3)	87 (12.7)	687 (50.0)
Video	567 (82.7)	119 (17.3)	686 (50.0)
Total	1167	206	1373

X-squared = 5.9033, df = 1, p-value = 0.01511

Table 11. Baseline (pre intervention) vaccine intentions in the video group and post intervention intentions in the control group (n=1373)

Study group	**Non-intenders** n(%)	**Intenders** n(%)	**Total** n(%)
Active control (text)	581 (84.6)	106 (15.4)	687 (50.0)
Video	600 (87.5)	86 (12.5)	686 (50.0)
Total	1181	192	1373

X-squared = 2.3883, df = 1, p-value = 0.1222

General Discussion

To our knowledge, this is the first study to examine the efficacy of a video to increase COVID-19 vaccination intentions. The main objectives of this study were to evaluate the efficacy of a video eliciting altruism on vaccination intentions of younger adults, and to compare the efficacy of the video to an active control (text-based, non-COVID-19 vaccine related preventive health behaviours). We found that the video increased participants' intentions to receive a COVID-19 vaccine from pre- to post-intervention; however, compared to the text intervention, there was not a significant difference between groups. Importantly, the video is a deliverable that can be used as is to help increase COVID-19 vaccine acceptance amongst younger Canadian adults. Given the 4.8% increase in vaccine intentions in the video group, on a population level of younger adults (around 10.5 million (Statistics Canada, 2021)) for which around 30% are vaccine hesitant, a 4.8% increase in vaccine acceptance could mean that an additional 151,000 people would intend to get the vaccine after viewing our video. The study results can also help inform public health authorities in creating messages that help increase acceptance of COVID-19 vaccines, booster shots, other vaccines, or in preparation for future pandemics.

Understanding altruism

In a systematic review by Feigin et al. (2014), the authors proposed two main theories of altruism: pseudo-altruism and true altruism. Pseudo-altruism suggests that the underlying motivator of altruism is to benefit oneself, with the rewards often being covert. For example, the arousal-reduction and negative state relief models argue that when someone observes another person's suffering, the observer will experience negative emotions that drive them to aid the person who is suffering in order to diminish their own negative arousal (Feigin et al., 2014). One study during the COVID-19 pandemic found that individuals with high levels of altruism reported more anxiety and depressive symptoms than those with low levels of altruism (Feng et al., 2020). This may be because individuals with high levels of altruism could not help people who were affected by COVID-19, as social distancing and self-isolation were mandated to prevent further outbreaks. Contrasting pseudo-altruism, true altruism occurs when the "end goal [is to increase] another's welfare and any feelings of self-reward or alleviation of personal distress are by-products of this" (Feigin et al., 2014). This can be illustrated by the empathy-altruism hypothesis which describes altruism as a seven step process (Feigin et al., 2014): (1) observing someone in need of help; (2) adopting of the perspective of the person in need of help; (3) attachment to the person in need of help; (4) empathizing with the person in need of help; (5) becoming altruistically motivated to help the person (i.e., feeling sympathy and compassion); (6) determining the most effective method of helping the person; and (7) helping the person.

While much research has identified specific motives of prosocial behaviours and altruism, few studies have synthesized these motives to form theories. An expansion of Feigin et al. (2014) two theories of altruism (i.e., pseudo-altruism and true altruism) may be Batson et al.'s (2011) four forms of prosocial motivation: egoism, altruism, collectivism, and principalism. Egoism, like pseudo-altruism, is defined as benefiting others to ultimately benefit oneself. That is, one may perform prosocial acts to gain material, social, or rewards; reduce aversive arousal; or avoid punishment. One example of egoism is the theory of warm-glow giving (Andreoni, 1989, 1990), in which feelings of joy and satisfaction associated with helping behaviour can evoke prosocial acts. From an evolutionary biology perspective, nepotistic/kin altruism (i.e., acting altruistically to those who are related to oneself (Díaz-Muñoz et al., 2014; Nedelcu, 2009)) and reciprocal altruism (i.e., acting altruistically to someone with the expectation that they will return the favour in the future (Ashton et al., 1998; Trivers, 1971)) further highlight the egoistic forms of altruism. An interesting finding from a blood donation study suggested that some people donate blood because of a lack of trust in, and frustration with, others which the authors termed “reluctant altruism” (Ferguson et al., 2012). While this has not yet been studied in vaccine research, reluctant altruism could also play a role in individuals’ vaccine decision-making and requires further attention. For example, one could get a vaccine because he or she is frustrated with those who are not getting vaccinated, thus taking the social responsibility upon him- or herself to mitigate virus spread. In addition, as Feigin et al. (2014) suggested, social learning may contribute to pseudo/egoistic altruism as children can learn to be altruistic through conditioning, which then reinforces future altruistic behaviour. However, researchers have argued that social learning itself is insufficient in explaining altruistic behaviour because it cannot account for perspective-taking and higher-order reasoning (Feigin et al., 2014).

As Feigin et al. (2014) also note in their systematic review, Batson et al. (2011) describe altruism as having the primary aim of increasing the welfare of others. Batson et al. (2011) argued that the empathy-altruism hypothesis is the underlying mechanism for altruism. However, in addition to the empathy-altruism hypothesis, Feigin et al. (2014) suggested that identity relations, that is, when the “self” becomes indistinguishable from the “other” and creates a sense of “we-ness”, can also lead to altruistic acts.

Meanwhile, Batson et al. (2011) distinguishes collectivism from altruism, defining collectivism as the “motivation to benefit a group” instead of a specific other (Batson et al., 2011). Collectivism has been associated with decreased spread of COVID-19 and increased engagement with preventive health behaviours (Courtney et al., 2022; Maaravi et al., 2021). In Canada, there are several COVID-19 vaccination campaigns that promote the importance of community and call for a collective effort to end the pandemic. For example, the $11 million "Ripple Effect" advertising campaign, launched by PHAC, "remind[s] Canadians about the collective vaccination effort required to see a reduction in restrictions and public health measures" (Government of Canada, 2021d). The "This Is Our Shot" campaign is a grass-roots movement that began with healthcare workers who were then joined by community and business leaders, and influencers. It aims to "rally Canadians… so that we can end the pandemic – together" (*This Is Our Shot to be #TogetherAgain*, 2021).

Finally, principalism has been defined as "benefiting others to uphold a moral principal" (Batson et al., 2011). This form of altruism reflects the normative theory described by Feigin et al. (2014), in which moral obligations influence altruistic behaviour. Feigin et al. (2014) considers normative theory to be pseudo-altruistic, as moral obligations depend on social norms or social rewards. Thus far, studies have argued that principalism is form of pseudo/egoistic altruism, in that upholding moral principles is often motivated by self-interest (Bersoff, 1999; Tsang, 2002). However, Batson et al. (2011) argue that in theory, in specific situations or for specific individuals, principalism may still exist in its genuine form vested beyond self-interest, though more research is needed to confirm this.

In the present study, while we had intended for the video to elicit altruism, it is possible that the video also appealed to empathy, collectivism, or other forms of prosocial motivation instead. Thus, it may be worthwhile to conduct qualitative research in order to understand the nature of the motivation stimulated our video and which motivations lead to actual vaccine uptake.

With respect to those who are "rigid hesitant", one factor driving their resistance to vaccination could be a lack of intellectual humility, defined as "the degree to which people recognize that their beliefs might be wrong" (Leary et al., 2017). This can apply to both facts (recognizing an incorrect recall of an event or scientific fact) or opinions (recognizing unfounded political, cultural, and religious beliefs). Previous studies have found intellectual humility to be negatively associated with anti-vaccination attitudes (Huynh & Senger, 2021; Senger & Huynh, 2021). A possible explanation for this relationship is the Dunning-Kruger effect, a "meta-ignorance" bias in which those who have limited knowledge overestimate their expertise, resulting in both a deficiency in knowledge itself and being incapable of recognizing one's mistakes (Dunning, 2011). As population studies have found COVID-19 vaccine knowledge to be generally low (Mangla et al., 2021; Ruiz & Bell, 2021), individuals who are "rigid hesitant" may be overconfident in their knowledge about vaccination, leading to a reluctance to consider facts that do not support their own beliefs, and a lack of openness to revise their viewpoint (a facet of intellectual humility) (Huynh & Senger, 2021; Senger & Huynh, 2021). Related to intellectual humility, research has shown openness (one of the Big Five Personality traits) to be negatively associated with anti-vaccination attitudes (Howard, 2022), and positively associated with altruism towards strangers (Oda et al., 2014). While personality is generally stable over time (Costa & McCrae, 1986; Damian et al., 2019), some studies have demonstrated that expressing gratitude or eliciting feelings of awe can temporarily increase humility (Kruse et al., 2014; Stellar et al., 2018); however, more research is needed to examine whether these strategies can have an impact on vaccination intentions or uptake.

Future directions

Future studies should examine specific messages or aspects of the video that may have been more effective at increasing vaccine acceptance for individuals in different decision-making stages (e.g., which narrative was most impactful, emphasis on collectivistic and social benefits vs. benefit to specific others). Using the same modality (e.g., video) to deliver different messages in an RCT can limit threats to validity and should be explored in future studies. Additional research may be needed to compare the efficacy of an altruism-eliciting video to alternative interventions, such as highlighting the personal benefits of the vaccine or fostering trust in science and public health authorities. A forthcoming manuscript will examine mediators of altruism (e.g., empathy, distress, sociodemographic factors) to understand the mechanisms of altruism and to identify groups that may benefit the most from watching our video.

Conclusion

The COVID-19 pandemic continues to impact everyone's daily lives, even two years after its beginning. Many people have died or experienced serious, lasting symptoms from COVID-19. Vaccines were developed in record time, but misinformation and disinformation, conspiracy theories, and frequent changes to vaccination guidelines have impeded COVID-19 vaccine uptake, particularly amongst younger adults. In a large national sample, the present study demonstrated that a video eliciting altruism was able to increase younger Canadians' intentions to receive a COVID-19 vaccine and provided a more nuanced understanding of how the video influenced people in different vaccine decision-making stages. This study contributes to the understanding of messages that are effective in increasing vaccine acceptance and can be modified by public health authorities to promote COVID-19 vaccination or boosters. Identifying and creating tailored messages for younger Canadians at different levels of hesitancy is necessary to increase COVID-19 vaccine uptake and to protect Canadians of all ages.

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