

Investigating the impact of the COVID-19 pandemic on the cognitive dissonance of adolescents

Vishruth Dinesh^{1*}, Amulya Harish^{1*}, Tanisha Mehta^{1*}, Heejee Yoon¹, Lale Kurtulush¹, Maddy Zhang^{1*}, Manogna Tatapudi¹, Myra Malik¹, Rohan Kondapalli¹, Sahar Jahanikia^{1,2}

¹ Department of Biological, Human, and Life Science, Aspiring Scholars Directed Research Program, Fremont, California

² CognoTrain Inc, San Francisco, California

*These authors contributed equally to this work

SUMMARY

The COVID-19 pandemic has had a profound impact on adolescent mental health, leading to the formation of distinct perspectives on the pandemic. These perspectives often give rise to internal conflict within individuals. In this study, we aimed to examine the variability and complexity of these perspectives through the lens of cognitive dissonance, the psychological discomfort one feels when their external behaviors do not align with their internal beliefs. We collected the data through self-reported surveys, which assessed participant (teenagers aged 13-18) agreement with various opinions and statements related to the pandemic. The survey encompassed five main categories, or “batteries”: general COVID-19, vaccination, masking, government/authority, and school. We had three primary hypotheses: 1) adolescents would experience dissonance, 2) adolescents would consider different aspects of the pandemic independently from each other and hence cross-battery scores would be statistically different, and 3) both gender and vaccination status would have an effect on dissonance levels. Our results corroborated the conjecture that study participants experienced dissonance, as three out of the five batteries displayed mean scores indicative of dissonance. Furthermore, as evidenced by the absence of significant correlation (no r constant was greater than 0.341) and the presence of statistically significant differences between individual batteries (with seven out of nine comparisons having p -values < 0.05), we proved our second hypothesis true. Lastly, through a linear regression test, we identified gender, albeit not vaccination status, to have a considerable effect on adolescents' dissonance scores.

INTRODUCTION

Cognitive dissonance, first defined by the psychologist Leon Festinger in 1957, is the psychological discomfort that arises as a result of a disconnect between one's internal beliefs and their external behaviors (1). The magnitude of dissonance depends on one's value of their beliefs and actions. Dissonance with strongly held beliefs is usually larger in magnitude than dissonance with weakly held beliefs (1).

Psychological discomfort typically motivates the individual experiencing dissonance to achieve consistency between their attitudes and behaviors. Reaching this consistency entails changing one to match the other (1).

A popular example of cognitive dissonance is in the minds of smokers. Despite being aware of the harmful effects of smoking, smokers continue to engage in this behavior, creating a state of cognitive dissonance (2). Our conceptualization of cognitive dissonance involves two main categories: positive and negative dissonance (3). Negative dissonance arises when individuals hold morally righteous beliefs but engage in morally conflicting behaviors, as exemplified by animal lovers who still consume animal products (3). On the other hand, positive dissonance occurs when individuals hold morally questionable beliefs yet find themselves compelled to act in morally commendable ways (3).

The coronavirus (COVID-19) pandemic has profoundly affected adolescent mental health, causing increases in depression, anxiety, drug abuse, and extreme stress (4). Cognitive dissonance has been shown to affect certain aspects of adolescents' behavior towards improved mental health. One study found that cognitive dissonance treatment could help prevent eating disorders in adolescent females by decreasing body dissatisfaction, showing the significant effect cognitive dissonance may have on adolescents' negative behaviors and attitudes (5). Furthermore, the COVID-19 pandemic has led to cognitive dissonance within the public (6). This may be due to conflicting information about the COVID-19 pandemic, with one study finding nearly 75% of participants receiving exposure to conflicting information about COVID-19 from politicians, health experts, and others (6). We hypothesized that the conflicting and unclear information on the COVID-19 pandemic may have increased cognitive dissonance in adolescents (6).

Adolescents tend to engage in risk denial to reduce cognitive dissonance, thereby changing their attitude instead of their behavior (7). In terms of the pandemic, this could manifest in many different discrepancies between behavior and attitude — for example, not wearing a mask while it is required, or not adhering to social distancing even at risk of contracting COVID-19. Thus the aim of our study was to measure the behavioral plasticity adolescents have experienced in relation to the COVID-19 pandemic, and more specifically, the dissonance with adolescents' COVID-related attitudes and behaviors — such as wearing a mask or getting vaccinated. Ultimately, our study found that adolescents did, in fact, experience cognitive dissonance during the COVID-19

pandemic, indicating that cognitive dissonance can be used to explain why adolescents were conflicted in their views surrounding the unprecedented pandemic. Additionally, participants perceived different aspects of the pandemic independently from one another, with the different categories eliciting varying levels of dissonance; gender was also found to have a considerable effect on the adolescents' dissonance scores. In the future, our findings could potentially contribute to more effective public health interventions during crises such as COVID-19.

RESULTS

The goal of our study was to measure the cognitive dissonance adolescents have experienced with regard to the COVID-19 pandemic. Our primary hypothesis was that adolescents would experience dissonance. We collected the data from 56 adolescent participants living in the United States, who were asked to rate their agreement for 34 statements/opinions on a scale of 1-10. Participants identified as either male (36%) or female (63%) while others preferred not to reveal their gender (2%). Participants were aged 13-18 with the mean and median age being 15.8 and 16.0, respectively. Participants included the following races: Asian (93%), Middle Eastern or North African (4%), White (2%), or other race, ethnicity, or origin (2%) (**Table 1**).

Our questions were divided into five batteries (categories): general COVID-19 (G1), vaccines (G2), masks (G3), government/authority (G4), and school (G5). The questionnaire consisted of 17 pairs of two contrasting questions, with the first question worded to assess the participant's internal attitude (what the participant thinks) and second question worded to assess the participant's external behavior (how the participant actually acts). Each battery contained between 4-10 questions each. Our scoring measured dissonance on a quantified scale between 0-9, with 9 being lowest dissonance and 0 being highest dissonance.

We began our analysis by examining the mean and median of each battery to identify the level of dissonance. The government/authority battery (G4) has the lowest mean (3.07) and median (3.00) of all the batteries. The vaccination (G2) and masking (G3) batteries have the two highest mean and medians, which were significantly higher than the others (**Figure 1**).

	Number (N = 56)	%
Gender		
Male	20	36
Female	35	63
Prefer not to say	1	2
Race		
Asian	52	93
American Indian or Alaskan Native	0	0
Black or African American	0	0
Hispanic, Latino, or Spanish Origin	0	0
Middle Eastern or North African	2	4
White	1	2
Other race, ethnicity, or origin	1	2
Prefer not to answer	0	0
Vaccination Status		
Both doses + booster	45	80
2 doses	10	18
1 dose	1	2
0 doses	0	0
	Mean	Range
Age in years	15.84	13-18

Table 1: Demographic characteristics of participants. Metadata including gender, race, vaccination status, and age were collected for all study participants.

In order to test for linear relationships between batteries, we computed a correlation matrix (**Figure 2**). Despite the majority of comparisons displaying *p*-values < 0.1, correlation values were relatively weak—the highest *r* correlation value was just 0.341. This preliminary finding suggests that perceptions toward individual batteries were largely

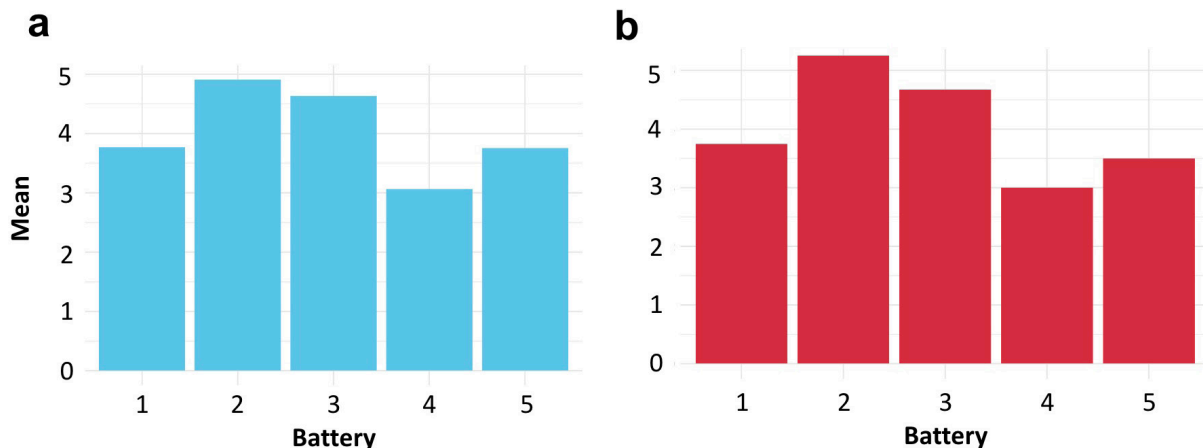


Figure 1: Identifying battery dissonance level. Computation of a) mean and b) median dissonance scores for each battery. Battery 1 = general COVID-19, Battery 2 = vaccines, Battery 3 = masks, Battery 4 = government/authority, Battery 5 = school.

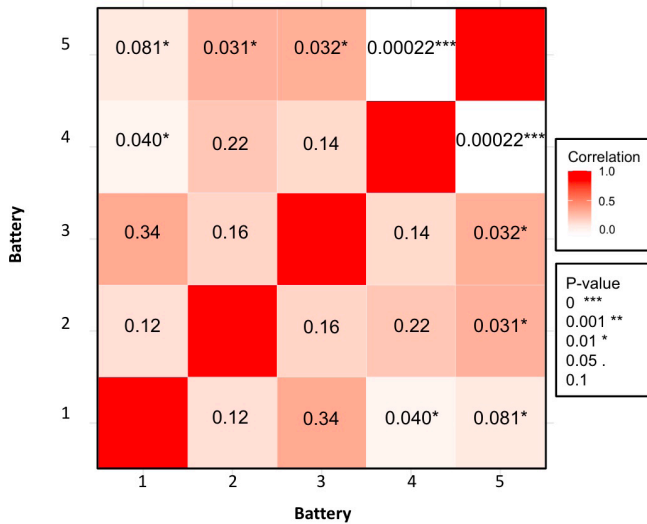


Figure 2: Identifying cross-battery correlation. Symmetric correlation matrix representing the strength of linear relationship between batteries. Color of a square signifies the extent to which two batteries are correlated: dark red signifies a strong positive correlation ($r > 0.5$), light red signifies a weak correlation ($r \leq 0.5$), and white signifies no correlation ($r \approx 0$). Value inside a box is the p-value for each correlation: *** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$. Battery 1 = general COVID-19, Battery 2 = vaccines, Battery 3 = masks, Battery 4 = government/authority, Battery 5 = school.

independent of each other. To further support this idea that there exists considerable variation in the dissonance scores among the five batteries, we performed an Analysis of Variance (ANOVA). ANOVA yielded a $Pr(>F)$ of $5.27e^{-10}$, ultimately supporting our second hypothesis and proving that there exists a statistically significant difference in dissonance scores (Figure 3). These results indicate that adolescents perceive different aspects of the pandemic parallelly from each other—in that each category posed unique levels of internal conflict.

A subsequent Tukey’s HSD post-hoc test pinpointed the most significant differences to six cross-battery comparisons: Battery 2 & Battery 1, Battery 4 & Battery 2, Battery 5 & Battery 2, Battery 4 & Battery 3, and Battery 5 & Battery 3 (Figure 4). Coupled with the ANOVA test, post-hoc analysis confirms that a participant’s dissonant feelings about questions from one battery did not influence dissonance in others.

Lastly, we sought to understand whether gender and vaccination status had an effect on the dissonance scores. To answer this question, we conducted a linear regression test (Figure 5). The linear regression test with gender displays p-values < 0.1 post Benjamini and Hochberg (BH) correction for every interaction, while vaccination status does not seem to have any significant effect on scores with p-values consistently greater than the 0.1 threshold. Therefore, there exists a robust linear relationship between gender and dissonance scores in adolescents. In other words, gender appeared to have influenced the internal conflict that adolescents experienced when navigating through the pandemic. In the future, we seek to investigate the specific nature of this relationship.

DISCUSSION

The goal of our study was to understand the extent to which adolescents faced psychological discomfort during the

COVID-19 pandemic. We had three hypotheses: adolescents will experience cognitive dissonance, participants will consider different aspects of the pandemic independently from one another, and dissonance levels would be affected by gender and vaccination status. Our data supported our first hypothesis, with results revealing that participants did, in fact, experience dissonance—three out of the five batteries displaying mean scores indicative of dissonance. The absence of significant correlation and presence of statistically significant differences between the individual batteries indicated that adolescents perceived different aspects of the pandemic independently, with some (like views on the government/authority) eliciting higher dissonance than others; accordingly, our results supported our second hypothesis as well. Furthermore, we proved our third hypothesis to be partially correct through a linear regression test, identifying gender, though not vaccination status, to have a considerable effect on participants’ dissonance scores. Thus, cognitive dissonance can be used to explain why adolescents were conflicted in their views surrounding the unprecedented global pandemic.

In summary, our study revealed that adolescents experienced cognitive dissonance during the COVID-19 pandemic. Batteries asking about the pandemic in general and in relation to government policy and school elicited the highest dissonance levels likely due to prevalent misinformation on those topics. Coupled with insignificant linear correlation between batteries, the ANOVA and Tukey’s HSD Post-hoc test demonstrated that there exists unparalleled variation in the manner by which adolescents perceive different aspects of the pandemic. In other words, there appears to be no spillover in the internal conflicts study participants face across categories. This would mean that interventions aimed at soothing cognitive dissonance among adolescents during

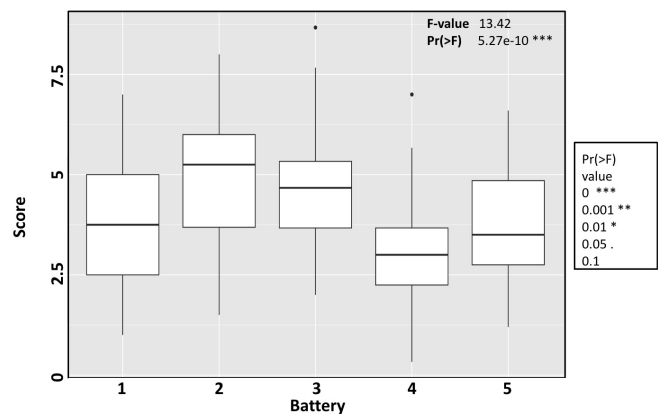


Figure 3: ANOVA reveals that battery scores display significant differences. The box represents the interquartiles range, which contains the middle 50% of dissonance scores; the line within the box represents the median (50th percentile of the data). The lower and upper bounds represent the 25th and 75th percentile respectively. Outliers are represented by individual points beyond the whiskers. The F distribution and $Pr(>F)$ values, calculated for battery scores as a whole, are noted in the top right hand corner. Taken together, the batteries displayed a $Pr(>F)$ value of $5.27e^{-10}$, indicating that there does, in fact, exist significant differences in dissonance scores across batteries. Battery 1 = general COVID-19, Battery 2 = vaccines, Battery 3 = masks, Battery 4 = government/authority, Battery 5 = school.

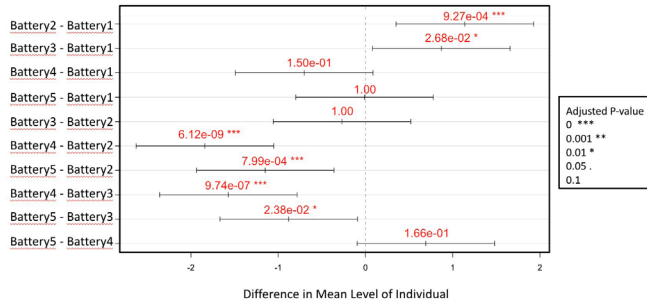


Figure 4: Tukey's HSD post-hoc test pinpointed the most significant differences in mean dissonance to six cross-battery comparisons. Tukey test–95% family-wise confidence level. The graph shows, for each combination of batteries, the difference between their means and their respective 95% CI. The vertical dashed line indicates the point where the difference between the means is equal to zero. The Bonferroni-corrected p-values are presented in red. The most statistically different mean dissonance scores were found between Battery 2 & Battery 1, Battery 4 & Battery 2, Battery 5 & Battery 2, Battery 4 & Battery 3, and Battery 5 & Battery 3. Battery 1 = general COVID-19, Battery 2 = vaccines, Battery 3 = masks, Battery 4 = government/authority, Battery 5 = school.

future health crises need to be tailored to specific contexts rather than assuming a uniform approach. Moreover, gender emerged as a significant variable in explaining the variation in dissonance scores among our participants, highlighting its potential influence in coping with cognitive conflicts during the crisis; additional research should delve into the nature of the connection between participants' gender and their experience of dissonance, as well as the reasons behind this relationship. These findings offer valuable insights into how adolescents coped with dissonance and navigated the challenges posed by the pandemic.

However, our participant pool does have one notable limitation – it is racially homogenous (93% Asian). To recruit participants, a random sample of high school students was contacted through word-of-mouth; however, this method

of advertising through word-of-mouth may not have been random sample selection, which might explain why our sample population was racially homogenous. As the majority of our participants are within the Asian minority group, our findings give us insight into the cognitive dissonance experienced by this specific group. However, to fully establish external validity, the study should be much more racially diverse, which would accurately reflect the general population. Additionally, because the study only has 56 participants, increasing our sample size would better ensure external validity as the results could be more accurately generalized to the broader population. While many studies reviewed utilized some form of a survey/questionnaire/assessment to measure cognitive dissonance, our use of a survey for this study may have resulted in some potential biases, such as wording bias, in which the wording of a question may have influenced participant response, or general response bias, in which participants may have falsely answered a question, perhaps because they might have been uncomfortable reporting their true answer or believe there was a specific “ideal” or “accepted” response. Furthermore, it may provide valuable insight to collect data on the political leanings of participants. This is because COVID-19 news coverage has been politically polarized, so the political beliefs of participants may influence the information they receive and the dissonance they experience in relation to COVID-19 (10,11).

A future application of our study includes utilizing the results to understand public distrust against the US government, given the high dissonance (lowest mean) faced in the government/authority category. It would be of interest to determine if adolescent opinion of the government during the pandemic may carry over to adulthood and eventual political participation. Furthermore, our study may prove useful in public health initiatives, especially for potential future pandemics. A 2021 study by Pearce & Cooper found that people who identified cognitive dissonance in their own experiences with adhering to COVID-19 guidelines and either changed their beliefs or behavior were more likely to comply

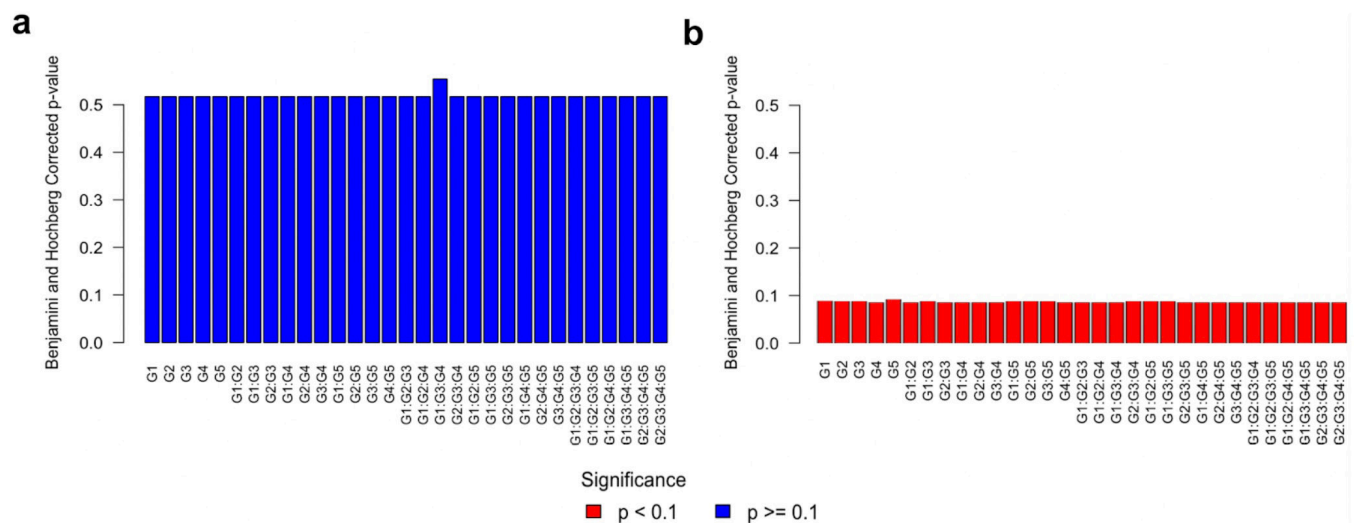


Figure 5. The effect of gender and vaccination status on dissonance scores. Fit a linear regression model to understand the respective impact of a) Vaccination status and b) Gender on dissonance scores. To reduce the risk of Type I errors (false positives), we applied the Benjamini and Hochberg (BH) correction method on p-values. We chose BH correction because of its ability to adjust well when numerous comparisons are made (8). Each figure contains 31 rows, ranging from interactions between the variable and battery 1 (General COVID-19 Questions) to the variable and all 5 batteries.

with COVID-19 guidelines and precautionary measures, such as getting vaccinated (9). Our novel survey could be modified and administered to measure such dissonance and may lead to participants reflecting on their own adherence to public health safety measures in future public health crises. These crises could range from the seasonal flu to another pandemic on the scale of the COVID-19 pandemic. Our study further contributes to research on cognitive dissonance and offers insights into how conflicting beliefs shaped adolescents' perceptions about the COVID-19 pandemic. These findings have practical implications for addressing crises like COVID-19, contributing to more effective public health interventions in the future.

MATERIALS AND METHODS

Participant Recruitment and Consent

Ethical approval for the study was obtained from the Aspiring Scholars Directed Research Program Institutional Review Board. Prior to participating, all participants, recruited through word-of-mouth, and their parents provided informed consent to ensure compliance with ethical guidelines and safeguard the rights and well-being of the participants. The questionnaire used in our study was administered using JotForm, a platform with compliance to the Health Insurance Portability and Accountability Act (HIPAA).

Assessment Design

In this study, we devised a novel dissonance assessment, consisting of questions that allowed participants to reflect on any discrepancies between their beliefs and actions during the pandemic, and a scoring system to assess behavior plasticity among the participants (12). We developed our novel questionnaire drawing inspiration from several psychological scoring methods (12-14). The questionnaire consisted of 17 pairs of two questions each, resulting in a total of 34 questions. Each battery contained between 4-10 questions each. Each question was designed to measure an attitude in conjunction with a dissonant behavior, encompassing both positive and negative dissonance examples. Participants were asked to indicate their level of agreement on a scale of 1 to 10 for each question (13). This approach allowed us to capture the complexities of cognitive dissonance by exploring the alignment or divergence between attitudes and behaviors exhibited by the participants.

Our scoring measured dissonance on a quantified scale between 0-9, with 9 being lowest dissonance and 0 being highest dissonance. This dissonance score was calculated by finding the absolute difference of the responses to paired contradictory questions. The average of all the differences in a battery was designated as the group's dissonance score. The cut-off for determining dissonance within a battery was 4.5, the mid-point between the lowest dissonance score of 9 and highest dissonance score of 0. A score indicating (high) dissonance would be below 4.5 while a score indicating no/minimal dissonance would be above 4.5.

The assessment was split into five batteries, including: general COVID-19 (4 questions), COVID-19 vaccination (8 questions), masking (6 questions), government/authority in relation to COVID-19 (6 questions), COVID-19 and school (10 questions).

After collecting responses to questions in each of these Batteries, the results were compared in each one to see

if there were any patterns or similarities in the dissonance people experienced about different parts of the COVID-19 pandemic.

Statistical Analysis

The study employed a comprehensive two-fold analysis approach, comprising preliminary qualitative analysis and secondary R-based analysis.

During our preliminary qualitative analysis, mean and median values of both battery scores and overall dissonance scores were calculated. This provided a snapshot of the central tendencies of the participants' responses in each category and the overall level of cognitive dissonance experienced by the adolescents.

In the secondary R-based analysis, we utilized various statistical tests to gain deeper insights into the data. Firstly, we generated an inter-battery correlation plot to identify potential interrelationships and dependencies among the adolescents' perspectives on the pandemic. We subsequently applied ANOVA with Tukey's HSD post-hoc test (Bonferroni corrected) to determine significance between mean dissonance scores across battery categories. By comparing means, we sought to understand whether certain categories elicited differential levels of dissonance amongst adolescents. Finally, we utilized linear regression analysis (Benjamini and Hochberg corrected) to explore the relationship between gender and vaccination status on dissonance scores.

Through this comprehensive analysis approach, the study aimed to discern the intricate patterns and dynamics of cognitive dissonance among adolescents concerning various aspects of the COVID-19 pandemic. The combination of qualitative and quantitative methods provided a nuanced understanding of the participants' viewpoints and their underlying cognitive conflicts.

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APPENDIX

Dissonance Questionnaire

Demographic Information

Name*
Age*
Zip code*
Participant Email Address*
Sex*

How would you describe your gender identity?*

Which categories describe you? Select all that apply.*

1. Asian (ex. Chinese, Filipino, Asian Indian, Vietnamese, Korean, Japanese, etc.)
2. Native American or Alaska Native (ex. Navajo Nation, Blackfeet Tribe, Mayan, Aztec, Native Village of Barrow Inupiat Traditional Government, Nome Eskimo Community, etc.)
3. Black or African American (ex. Jamaican, Haitian, Nigerian, Ethiopian, Somalian, etc.)
4. Hispanic, Latino or Spanish Origin (ex. Mexican or Mexican American, Puerto Rican, Cuban, Salvadoran, Dominican, Columbian, etc.)
5. Middle Eastern or North African (ex. Lebanese, Iranian, Egyptian, Syrian, Moroccan, Algerian, etc)
6. White (ex. German, Irish, English, Italian, Polish, French)
7. Other race, ethnicity, or origin
8. Prefer not to answer

Have you been vaccinated against the COVID-19 virus (both doses + booster booster)?*

1. Yes, both doses + booster
2. Only 2 doses
3. Only 1 dose
4. 0 doses

Survey Instructions:

Participants were asked to rate items on a scale of 1-10, where 1 = Strongly Disagree and 10 = Strongly Agree

General COVID-19 Questions

1. I think that COVID-19 is dangerous.*
2. I did not overreact to the virus.*
3. I think that the risk of new COVID-19 variants developing is high.*
4. It is unlikely that new COVID-19 variants will emerge.*

Questions About Vaccines and COVID-19

5. I think that vaccines are dangerous.*
6. I would take a bi-annual COVID-19 booster shot.*
7. I think that vaccine mandates are unfair.*
8. Everyone (excluding those with medical exceptions) should be vaccinated.*
9. I think people should be granted exemption from vaccination because of religion.*
10. All people, of all religions, should take the COVID-19 vaccine.*
11. I think it is reasonable to fire employees because of vaccination status.*
12. Companies/institutions cannot dismiss employees simply due to their vaccination status.*

Questions About Masks and COVID-19

13. I think masks should be required for both indoor and outdoor large gatherings.*
14. If people are vaccinated they do not need to wear masks outdoors.*
15. I think that masks are effective at preventing the spread of COVID-19.*
16. Not wearing a mask would spread the virus no more than when wearing a mask.*
17. I think that everyone should be required to wear masks.*
18. Wearing a mask is for personal protection, so it should be optional.*

Questions About the Government/Authority and COVID-19

19. I think that local governments should have unlimited power to enforce mask mandates/vaccines and penalize those who do not follow them.*
20. The government does not have authority to mandate vaccinations.*
21. I think that my government is handling the COVID-19 pandemic very well.*
22. I do not trust the CDC.*
23. I think that pharmaceutical companies act in my best interest in vaccine development.*
24. Pharmaceutical companies only stand to gain profits from the pandemic.*

Questions About School and COVID-19

25. I think that going to school (in-person) is more important than safety from the virus.*
26. I support distance learning over in-person school, as it promotes safety and still provides a way for students to learn effectively.*
27. I think that my school should mandate COVID vaccines for all students, besides religious and medical exemptions.*
28. Schools cannot enforce vaccine mandates on their students.*
29. I think that online school harms the mental health of students.*
30. Online school promotes the mental state of students because it provides them with less of a workload and more free time.*
31. I don't think that social distancing between students should be harshly enforced in the school environment.*
32. School facilities should space out desks in the classroom and require 6 feet of distance between students at all times, in order to prevent the spread of COVID-19.*
33. I think I am safe if I follow the mandates around masking/not masking in schools.*
34. I still do not feel comfortable keeping my mask off at school, despite recent alterations in COVID-19 mask mandates.*