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Voice of concern: Accents as evidence for in-group avoidance during the COVID-19 pandemic

BY

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ABSTRACT

Current research on the behavioral immune system postulates that avoiding out-group members is one strategy that individuals use to avoid contracting infection. The present study tested whether different news headlines related to the COVID-19 pandemic would evoke a disgust reaction in Canadian native-speaker participants by altering their perceptions of accent similarity to 3 different groups of speakers: native speakers of English, and speakers with both familiar and unfamiliar foreign accents. Participants were primed with news headlines unrelated to COVID-19 in the control condition, which preceded the two COVID conditions presenting headlines either emphasizing (COVID-severe) or downplaying (COVID-downplay) the severity of COVID-19. After rating headlines for each condition, participants listened to 24 recordings of 12 different speakers and rated how similar their accent was to the speech they heard. Analysis using ordinal Generalized Additive Mixed Models revealed an interaction between speaker group and headline prime; participants rated the accents of other native speakers as sounding less similar after viewing the COVID-severe and COVID-downplay headline primes compared to the control primes. No significant differences were found between headline prime and the familiar or unfamiliar foreign accented speakers, suggesting that a disgust response was evoked in participants solely towards in-group members (native speakers) after reading headlines mentioning COVID-19. The disgust response likely created psychological distance towards in-group members, altering perceptions of other native speakers of English who are likely to pass infection on during a pandemic. This result provides evidence against theories that out-group members are automatically distanced under a pathogen threat (Reid et al. 2012) and support for the view that disease avoidance behaviors are governed by threat specific knowledge, creating aversion to individuals who are likely to spread infection, regardless of group membership status.

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I would like to acknowledge and thank my fiancé, Zach McFarlane for his continued support throughout this process. Thank you for getting excited about my research and being my number one supporter (I know you are not actually passionate about accented speech, but thank you for pretending to be).

And lastly, thank you to my parents. You have been cheering me on my whole life, and I hope to continue making you proud.

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Chapter 1: Background

The present thesis seeks to investigate whether a speaker's accent provides listeners with information about the risk of contracting infection from a given speaker, and how a disease threat such as COVID-19 may heighten perceptions of risk from specific groups. More specifically, this thesis will explore how priming participants with media coverage related to COVID-19 interacts with perceptions of in-group (native speakers) and out-group (foreign accented speakers).

1.1 COVID-19 and Media Coverage

The media plays an important role in our daily lives: communicating social norms and informing the public of breaking news and events. News sources target specific audiences and communicate a desired message to viewers. As such, events such as the COVID-19 pandemic have been broadcasted in the media from a wide range of perspectives. Mass media can play a positive role by increasing awareness of safe health practices to large audiences with relative ease and spreading pressing information quickly. However, information presented by the media may not always be reliable and perspectives on the facts may be skewed. As a result, the media's subjective coverage of COVID-19 has an effect on viewers. Coverage may increase the perceived salience of disease threat, or even enforce beliefs that COVID-19 does not pose such a grave threat. Schaller and Park (2011, pg. 100) note "...the salience of potential infection may be temporarily heightened by specific circumstances (e.g., exposure to exaggerated media coverage of influenza outbreaks)." For example, Dhanani and Franz (2021) demonstrated that public health framing COVID-19 in terms of country of origin has a significant effect on discriminating and xenophobic attitudes towards Asian Americans during the early phases of the COVID-19 pandemic compared to neutral framing of the COVID-19 virus. Therefore, it is important to examine the effects of different media coverage on viewers.

The present study will investigate how differences in the media's reporting on COVID-19 will interact with individual differences in disgust sensitivity to alter the perception of in-group and out-group accented speech.

1.2 Disgust Sensitivity and Group Processing

It has been theorized that throughout evolution, humans have adapted their behavior to prevent infection through contact and situational avoidance of disgusting and potentially harmful stimuli. This adaptation has been coined the 'behavioral immune system' which is considered the first line of defense against infection, creating automatic aversion to situations and substances that may induce an immune response, such as pathogens (Schaller, 2006; 2011, Schaller & Neuburg, 2012, Schaller & Park, 2011). The extent to which the behavioral immune system is active in everyday life can be quantified by an individual's level of disgust sensitivity.

Disgust sensitivity refers to an individual's propensity to feel disgusted towards stimuli that may trigger an immune system response, with levels of disgust sensitivity varying within a population. One way disgust sensitivity can be measured is through self report: rating statements such as "it bothers me to hear someone clear a throat full of mucous" on the *Revised Disgust Scale* was used in Haidt, McCauley & Rozin (1994) and modified in Olatunji et al. (2007).

Disgust sensitivity influences the way we view the world and others around us. Specifically, disgust sensitivity can predict judgements of similarities between individuals. Research by Mentser and Nussinson (2020) explored the relationship between disgust sensitivity and perceived psychological similarity to others, finding that those with high levels of disgust sensitivity perceived themselves as less similar to others in a variety of modalities, such as visual, written descriptions, and personal preferences. As such, an individual's level of disgust

sensitivity is predictive of how one views themselves relative to others, with strong implications for intergroup processing.

Group membership status (in/out-group) of an individual may additionally be assessed through judgments of similarities between individuals. Those that are similar in a variety of social and cultural aspects would be considered an "in-group member", sharing common customs and practices. Situations where individuals may feel threatened are likely to perceptually strengthen intergroup boundaries, whereby out-group members are perceived as significantly less similar and in-group members as more similar. This can lead to increased feelings of prejudice towards individuals who are from different cultures and backgrounds. For example, Faulkner and colleagues (2004) explored how perceived vulnerability to disease may shape xenaphobic attitudes towards unfamiliar out-groups through a variety of experiments. The basic premise behind their study was that avoiding unfamiliar and unknown others may be one method for avoiding novel pathogens. Results from their study support this theory, finding that an individual's perceived vulnerability to disease was related to decreased support for imigration of subjectively unfamiliar and foreign cultures or ethnic groups.

As such, out-group avoidance has been cited as one of the behavioral immune system's strategies for preventing infection, causing an individual to avoid unknown others who may harbor novel pathogens. Millar et al. (2020) tested this theory by priming participants with either a control prime or a disease threat and then asked participants to rate images of individuals of the same or different race on multiple dimensions. They found that when participants were primed with a disease threat,they had less desire for contact with out-group members and rated out-group members as more likely to spread infection compared to ratings of in-group members, with disgust sensitivity and perceived infection risk mediating this relationship.

The exact nature of the relationship between pathogens and out-group members is relatively unclear. The previously mentioned literature claims that unfamiliar out-groups face negative consequences simply because they may have evolutionarily been deemed/considered likely to spread infection. Therefore, it is important to understand how this relationship functions and impacts individuals when there is a real world risk of infection such as the COVID-19 pandemic, where disease may spread both within and across group boundaries.

1.3 Disgust Sensitivity and Language Processing

Previous research has operationalized disease threat through media headlines, exploring how the media's stance on COVID-19 impacts language processing (Puhacheuskaya et al., n.d.). The authors discovered that priming participants with headlines both emphasizing and downplaying the severity of COVID-19 led to differences in ratings of the valence and disgust associated with words. Interestingly, this result was dependent on the participant's level of disgust sensitivity and their political views. Puhacheuskaya et al., (n.d.) measured Disgust Sensitivity through self-report, however, there are more indirect and online measures of disgust such as pupillometry paradigms.

Research conducted by Hubert-Lyall (2019), and Hubert-Lyall and Järvikivi (2021) investigated the role of extralinguistic factors such as the role of disgust sensitivity and personality in language comprehension using eye-tracking technology. Hubert-Lyall found that a participant's level of disgust sensitivity predicted increases in pupil size when reading sentences containing socio-cultural clashes (*I always by my bras at Hudson's Bay*, spoken with a male voice), suggesting that disgust sensitivity is at work mediating language comprehension in contexts that violate normative expectations.

1.4 Accented Speech Perception

Research by Rubin (1992) has demonstrated that the visual ethnicity of a speaker also influences accent strength perception, providing further evidence that our perceptions can be changed based on external information. The present study intends to extend prior research on variance in the perception of accented speech through the use of the COVID-19 global pandemic as a disease prime. Pathogen threats may influence the perception of accented speech by increasing psychological distance to speakers who are likely to spread infection (out-groups), which was found to be the case in Reid et al. (2012) discussed below.

There is currently limited research on the malleability of accented speech perception, and factors that either increase or decrease the salience of a foreign accent. Manipulating the label associated with speakers has been found to influence accent perception (Calkins et. al, 2021[1]). Labeling speakers as out-group members (as an immigrant or new Canadian) significantly increased the perceived foreignness of both native and foreign accented speakers of English. These findings suggest that our perceptions of others are sensitive to accompanying information in the form of origin specification.

1.5 Accents and Group Membership

There is a unique relationship between accent, identity, and speaker origin. Broadly, a speaker's geographic origin can be inferred based on pronunciation alone; native speakers can easily identify both native and non-native speakers of their language or dialect within a very short period of time (Pélissier & Ferragne, 2021). In multicultural and multiethnic societies, auditory cues such as a speaker's accent may take precedence over visual cues to geographic

[1] Speakers from four different language groups (Canadian English, Asian, European, and Middle Eastern) were rated as sounding more foreign when introduced as an "immigrant" and "new Canadian" compared to the control condition of no label. Labeling speakers as "Canadians did not significantly change perceptions of foreignness from the control condition.

origin and social/cultural background. Rakić et al. (2011) studied the role of accents in social categorization and found that auditory cues can be more reliable than visual cues for inferring identity. These findings suggest that a speaker's accent provides both valuable and reliable information about the group membership of a speaker.

This accent-origin mapping within the minds of speakers may additionally take into consideration the relative risk posed by a speaker based on their place of origin. Building on the discussed out-group pathogen avoidance theories, the greater the perceived foreignness of a speaker's accent should be related to greater inferred risk associated with the speaker and therefore trigger pathogen avoidance mechanisms (or the behavioral immune system), creating psychological distance to foreign accented speakers.

Since an accent is a cue to foreignness and to out-group status, accent alone should be enough to trigger a disgust response. Reid et al. (2012) operationalized group membership status through accented speech (in-group/native speaker, out-group/foreign accented speakers). It was found that after priming individuals with a disease threat, those with a higher propensity to feel disgusted by pathogens perceived out-group accents as less similar to themselves, and in-group accents as more similar. This result is consistent with the previously discussed behavioral immune system research claiming that out-group members are considered more likely to pass infection to others.

1.6 Present study

This thesis attempted to conceptually replicate the findings of Reid et al. (2012) within the context of a global pandemic. The COVID-19 pandemic provided a unique opportunity to study the effects of a real world and salient disease threat as opposed to a simulated disease threat on the perceived distance between an individual and their in/out-group. The experiment at

hand will investigate how the media's portrayal of COVID-19 serves as a disease threat, evoking disgust reactions and creating psychological distance measured by perceived accent similarity. Multiple individual difference measures will be assessed as potential predictors of accent similarity ratings. These include participant political views, disgust sensitivity, perceived COVID-19 threat, and the extent to which participants believe in and value science. For the purpose of the current thesis, only disgust sensitivity will be discussed as a predictor of accent similarity judgments.

There is currently limited research on the malleability of accented speech perception in general and on the effects of a salient and real life disease threat such as the COVID-19 pandemic in particular. The present study intends to extend prior research by studying the effects of the global pandemic as a disease prime, investigating whether and how headlines reporting on COVID-19 influence the perception of in-group and out-group speaker accents. Due to previous research distinguishing between unfamiliar and familiar foreigners in pathogen avoidance, out-group speakers will comprise familiar/identifiable foreign accents and unfamiliar and hard to identify foreign accents. Additionally, findings from this study will identify novel predictors of accent perception, which may identify factors associated with the stigmatization of foreign accented speech.

The experiment will prime participants with three types of stimuli: headlines unrelated to COVID-19, and headlines both emphasizing and downplaying the severity of COVID-19. Employing a repeated measures design, participants will be primed with three blocks of headlines and then rate various accents (native speakers, familiar and unfamiliar foreign accented speakers). Upon completion, participants will complete an exit questionnaire with self-reports for multiple post-tests to use in data analysis.

I hypothesize that an individual's level of disgust sensitivity will moderate accent similarity ratings within the three experimental conditions, producing differences between the three groups of speakers. Due to the cost of misidentifying out-group members as in-group members, I predict that group membership boundaries will become more salient to participants when under a severe, as opposed to the neutral or downplay disease prime. Specifically, if the disease-avoidance theory of disgust sensitivity is correct (Reid et al. 2012), I predict that participants with higher levels of disgust sensitivity should perceive a larger difference between in-group and out-group accents after being primed with headlines emphasizing the risks of COVID-19.

Chapter 2: Method

2.1 Ethics

The planning and execution of this research project was reviewed by the University of Alberta Research Ethics Board 2 for adherence to ethical guidelines (reference number Pro00111839).

2.2 Participants

184 participants were recruited from the University of Alberta Linguistic students pool 'the Sona pool' (https://www.sona-systems.com/) in exchange for partial course credit (2%). The Sona pool contained both native and non-native speakers of English. As a result, non-native speakers of English (N=90) were excluded from the analysis to control for any systematic differences second language learners would have in accent perception. The requirement to self-identify as Canadian was necessary to ensure that participants would perceive and identify the recordings of Canadian speakers as in-group members. Taking into account these constraints and removing any participants with incomplete trials, 72 native speakers of English were included in the analysis. Of the final 72 participants, 46 indicated their sex as female, 22 as male, and 4 participants preferred not to disclose this information. Participants were between the ages of 18 and 37, with a mean age of 21 and a median age of 19 years old.

2.3 Materials

2.3.1 Visual Primes

All headlines used for priming participants can be found in Appendix A. Images of the headlines for the COVID-severe and COVID-downplay conditions were gathered from Puhacheuskaya et al. (n.d.) as well as from online news platforms in order to gather headlines reflecting the updated state of the pandemic. To prevent the images of headlines from distorting

when presented on the experimental web page, grey borders were added to the smaller images from Puhacheuskaya et al. (n.d.) to maintain proper proportions. The severe headline condition (Appendix A.2) depicted COVID-19 as a severe disease, outlining the possible long-term effects, the number of deaths recorded compared to the 1918 pandemic, the measures taken by the government to reduce hospitalizations, and the death of young patients. The downplay headlines contained news headlines undermining the severity of COVID-19, including articles about 100-year-old survivors, declining cases, lower death rate than the flu, not more severe than the common flu, and arguments that COVID-19 does not exist (Appendix A.3).

The neutral headline condition was included in the current study as a control condition to determine baseline accent ratings where a pathogen threat was not present. Neutral media headlines were gathered from Canadian online news sources and did not mention COVID-19 or any disease threats. The neutral headlines reported on mosquitoes (Figure 2.1), lumber, phone scams, tourist destinations (the remaining headline examples can be found in Appendix A.1).

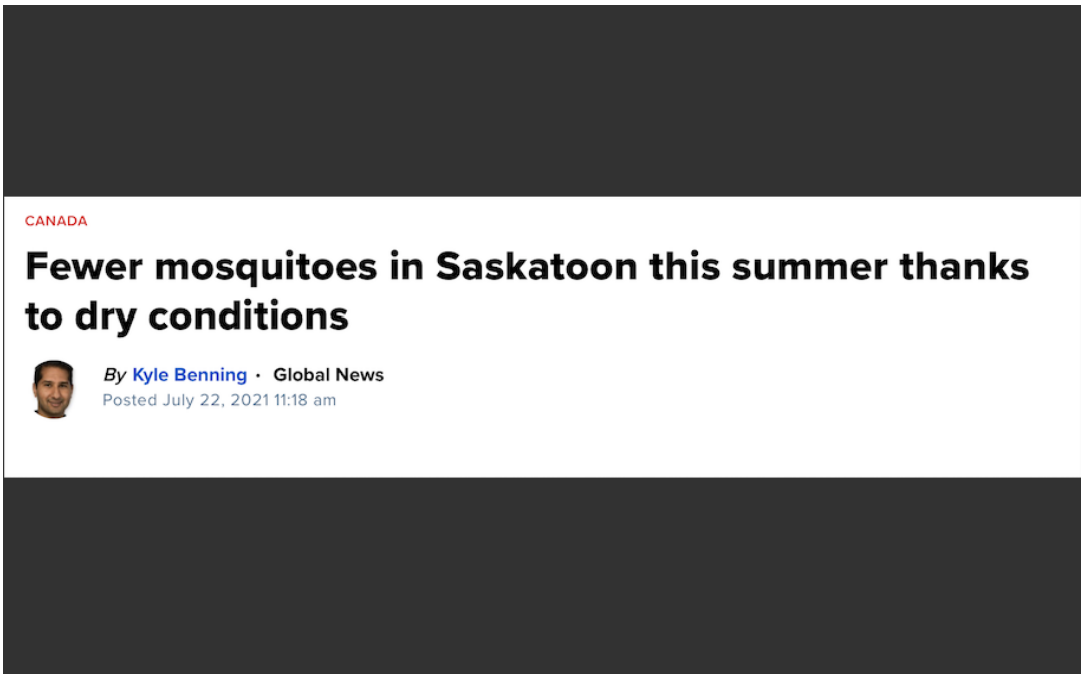

Figure 2.1: Example of a neutral headline presented to participants.

2.3.2 Auditory Stimuli

Recordings of speakers were sourced from the *Speech Accent Archive* (Weinberger, 2015). Within this archive, speakers of different language backgrounds are recorded reading the same content. Each speaker is recorded reading the following passage:

> *"Please call Stella. Ask her to bring these things with her from the store: Six spoons of fresh snow peas, five thick slabs of blue cheese, and maybe a snack for her brother Bob. We also need a small plastic snake and a big toy frog for the kids. She can scoop these things into three red bags, and we will go meet her Wednesday at the train station."*
>
> Weinberger (2015)

Recordings were selected based on the accent strength ratings data from a separate group of listeners provided by Schnoor et al. (2021) to ensure that both the foreign-accented and the native-accented speakers selected would be of equivalent accent strength. Based on the rating data provided, foreign accent stimuli for both groups of speakers (familiar and unfamiliar) were selected for accent strength ratings between four and six on a 9-point scale (1-no accent, 9-very strong accent). Recordings of Canadian English speakers were selected for accent strength ratings between one and two on the same 9-point scale.

Based on the previous criteria, 12 recordings of speakers were selected to form three groups of speakers: four native speakers of Canadian English, four speakers with familiar and potentially recognizable foreign-accents (two speakers with Spanish and two with Mandarin as native languages), and four speakers with unfamiliar or hard to recognize foreign-accents (Zulu, Kurdish, Kiswahili, and Amazigh as native languages). Each accent group consisted of two male and two female speakers, for a total of six male and six female speakers. Recordings of each speaker were approximately 21 seconds for native speakers and 24 seconds for non-native

speakers. Each recording was split in half (i.e., the first and last two sentences were put into separate recordings) in order to expose the participants to the same speaker more than once within each condition, allowing for an assessment of the reliability of participants' accent ratings for a given speaker. Therefore, 24 recordings from 12 speakers were used as experimental stimuli.

2.4 Procedure

Data collection took place between November 15th, 2021 and December 7th, 2021. The study took place online using a cognition.run server (https://www.cognition.run). The experiment webpage was coded using the JsPsych library, version 6.3.1 (de Leeuw, 2015). At the beginning of the experiment participants were asked to provide their informed consent of the risks and benefits of the study without revealing the purpose of the study. If the participant chose to give their consent, they were directed to the experiment.

Participants completed two practice trials of accent ratings before beginning the main study to familiarize them with the format and content of the recordings. For the practice trials, the recording presented was a different native speaker of Canadian English from the native speaker stimuli selected for the main experiment. Once the practice trials were completed, the participant was asked to adjust their volume to their comfort and proceed to the main experiment. Participants were randomly assigned to one of two counterbalanced orders of headline conditions (neutral-severe-downplay and neutral-downplay-severe). The experiment always began by first presenting the control condition (neutral headlines) to create baseline ratings for participants and control for any carryover effects associated with disease priming.

Each block of headlines presented five separate images of headlines. However, due to an error in the experiment, a subset of the first 15 participants to complete the experiment viewed 6

severe image headlines, with later participants only viewing five (see appendix A.2 vi.). Differences in the number of severe headlines viewed are controlled for in subsequent analyses. Headlines within each prime condition block were randomized. Participants viewed and rated all five headlines consecutively. After viewing each headline, participants were asked to rate how much they agree with the content of the headline on a 7-point scale (1-strongly agree, and 7-strongly disagree). This was done to ensure that the participants read each headline thoroughly and to measure participants' views on the news story.

The experiment always began with the control condition where the five neutral headlines were presented, rated for agreement, and then immediately followed by a block of accent ratings. Participants were exposed to 24 randomized speaker recordings from 12 separate speakers (4-native speaker, 4-familiar, 4-unfamiliar) and asked to rate each one. Accent similarity was operationalized with a 7-point scale (1-this accent sounds very similar to mine, and 7-this accent sounds very different from mine) as used in Reid et al. (2012).

After the neutral headlines and speaker ratings were completed, participants were assigned to a counterbalanced of the headline blocks of interest (either covid-severe first, or covid-downplay first). After each block of headlines was viewed and rated for agreement, the same randomized list of 24 speaker recordings were presented. In total, participants rated three blocks of five headlines, each followed by 24 recordings, for a total of 15 headline ratings and 72 accent rating trials across the entire experiment.

2.5 Post-Tests

Once the main experiment trials were completed, participants completed the exit questionnaire containing fiveself-report post-tests (Appendix B). To avoid contamination of the results, post-tests were completed last, after all the headlines and speakers were rated. As a test

of political views and ideology, participants completed the 20-item Wilson-Patterson Conservatism Scale (Wilson & Patterson, 1968) by reading a set of statements and reporting their agreement with each statement (1-strongly disagree, 5-strongly agree). This scale was chosen due to its reliability and prevalence in the literature. High scores on this scale indicate strong conservatism and lower scores indicate left-leaning or progressive views.

Participants completed two tests of Disgust Sensitivity: the 26-item Disgust Scale-Revised (DS-R, Haidt, McCauley & Rozin, 1994, modified by Olatunji et al. 2007) and the 6-item pathogen disgust subscale of the Three Domains of Disgust Sensitivity (Tybur et al., 2009). The pathogen disgust subscale from the Three Domains of Disgust sensitivity was measured by presenting six statements to participants and having them rate their perceived disgust from 1-no disgust to 6-extreme disgust. The Disgust Scale-Revised was measured by presenting 26 statements to participants and having them rate their agreement with the first 16 statements (1-strongly disagree, 5-strongly agree) and having them rate their disgust with the final 10 statements (1-not at all disgusting, 5- extremely disgusting). For both scales, high scores indicate high levels of disgust. Both disgust scales were chosen as inventories to assess the correlation between the pathogen disgust portion of the Three domains of Disgust Sensitivity and the DS-R to discover which scale would be a stronger predictor of accent similarity ratings.

The degree to which participants value and accept science was also measured by the Belief in Science Scale (BISS) created by Farias et al. (2013). Participants read 10 statements and indicated their agreement with each one on a scale of 1-strongly disagree to 6-strongly agree. High scores on this scale indicate a strong value and belief in science.

Finally, the extent to which participants feel feared and threatened by COVID-19 was measured through the COVID Concern Questionnaire (Conway et al., 2020). Participants were

presented five statements and asked to rate their agreement with each one (1-strongly disagree, 5-strongly agree). High scores indicate a greater fear in COVID-19 and its effects.

A language background questionnaire (Appendix B.6) with demographic information was also completed. Participants were asked to report their age, sex, if they were native speakers of English, whether they spoke languages other than English, what those languages were, what country they were born in, whether or not they identified as a Canadian, whether their parents were born in Canada, and how frequently they interacted with both native and non-native speakers of English.

Chapter 3: Results

Given the results from previous research Puhacheuskaya et al. (n.d.), it was expected that headline condition would have a significant priming effect on participants. This priming effect was hypothesized to be in the direction of increased perceived similarity to native speakers of English (in-group members)and decreased perceived similarity to non-native speakers (out-groups) after being reminded of COVID-19, which was based on replicating the findings from Reid et al. 2012.

3.1 Statistical Analysis

Data analysis was conducted using R statistical software (R Core team, 2020, version 4.1.1) using Ordinal General Additive Mixed-Models (GAMM, Baayen & Divjak, 2017). Models were created using the mgcv package (mgcv, version 1.8-40; Wood, 2017) and effects were visualized and compared using the itsadug package (van Rij et al., 2020). The model included accent similarity ratings (1-7) as the dependent variable and independent variables for the models were backwarded fitted by comparing AIC scores for each model using the compareML() function in R from the package itsadug (van Rij et al., 2020). The final model included accent similarity rating as the dependent variable, headline condition (neutral, severe, downplay), speaker group (native, familiar, unfamiliar), participants' self identification as a Canadian (yes, no, partially), order of conditions presented (covid-severe before covid-downplay, covid-downplay before covid-severe), and the number of severe images the participant viewed (five or six severe headlines) as fixed predictors, as well as random intercepts for participants and items and by-trial smooths for participants. The output of the final model is listed in Table 3.1.

3.2 Headline Condition and Speaker Group

The statistical analysis (Table 3.1) revealed a significant effect of headline condition. Participants rated recordings of speakers from all backgrounds as less similar to their own accent after exposure to the covid-downplay headlines and covid-severe headlines, compared to ratings after exposure to the neutral headlines (Figure 3.1). Native English speakers were rated as significantly different from the unfamiliar and familiar foreign-accented English speakers. This effect is expected, but serves as confirmation that participants perceived large differences between native speakers and foreign-accented speakers throughout the experiment.

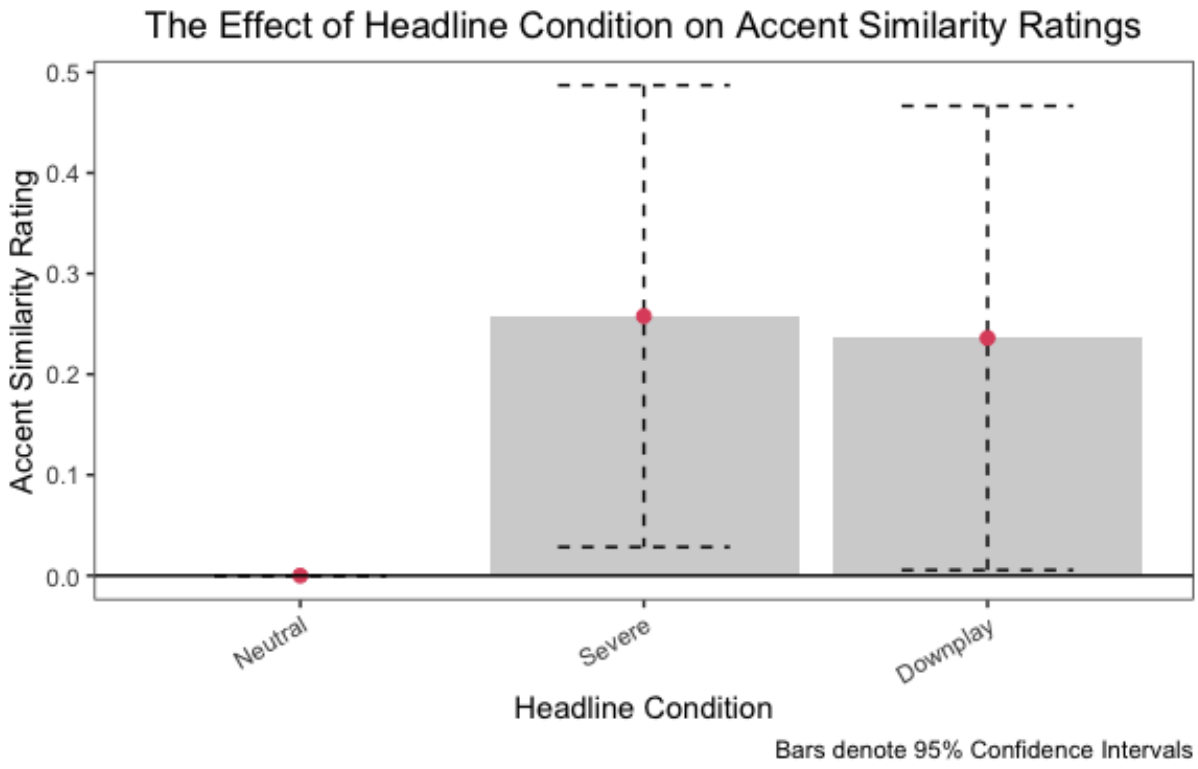

Figure 3.1: Effect of headline condition on ratings of all speakers.

Not identifying as a Canadian (Canadian_no) significantly predicted accent strength ratings in the current model (p=.0344). Participants who did not identify as Canadian rated

speakers from all groups as sounding less similar to themselves overall compared to participants who identified as Canadian.

Additionally, there appears to be a significant interaction between headline condition and speaker group that was supported by model comparison. Participants rated unfamiliar accented speakers as significantly less similar to their own accents after viewing covid-severe headlines (p=.018), compared to the neutral headlines. This same trend is present for the unfamiliar accented speakers following the covid-downplay conditions. Visualization of the interaction did not lead to any significant discoveries of what the exact nature of the interaction is, and is thus not discussed further.

Parametric Coefficients	Estimate	Std. Error	t-value	Pr(>|t|)
intercept	-0.64932	0.36330	-1.787	0.0740
Severe	0.25776	0.11702	2.203	0.0277 *
Downplay	0.23603	0.11762	2.007	0.0448 *
Familiar	6.91194	0.34160	20.234	<2e-16 ***
Unfamiliar	6.33459	0.34118	18.567	<2e-16 ***
Canadian_no	2.06135	0.97431	2.116	0.0344 *
Canadian_partially	0.37967	0.58049	0.654	0.5131
Order_severe-downplay	-0.42364	0.32268	-1.313	0.1893
Six severe images presented	-0.04087	0.40177	-0.102	0.9190
Severe:Familiar	-0.07259	0.16280	-0.446	0.6557
Downplay:Familiar	-0.14178	0.16311	-0.869	0.3848
Severe:Unfamiliar	-0.37950	0.16004	-2.371	0.0178 *
Downplay:Unfamiliar	-0.28229	0.16104	-1.753	0.0797

Significance of Smooth Terms	edf	Ref.df	F	p-value
s(participant)	32.523	67	0.94	<2e-16 ***
s(stimulus)	8.641	9	24.85	<2e-16 ***
s(trial, participant)	46.862	643	11.16	0.042*

Table 3.1: Approximate significance of parametric effects, smooth terms and random effects for the final model. Note: intercept is set to neutral headline, native speaker, Canadian_yes, Order_downplay-severe, five severe images presented.

3.3 Headline Ratings

The Participants' average ratings for agreement for headlines within each condition (1-strongly agree, and 7-strongly disagree) were calculated. The neutral headline ratings were not analyzed as a predictor of accent ratings and were excluded from future analysis. Of interest was the difference in agreement ratings between the covid-downplay and covid-severe condition headlines. This numerical difference was used as a continuous measure of the participant's beliefs about COVID-19 presented by the media. The average headline rating for the covid-downplay condition was subtracted from the covid-severe condition. This resulted in large absolute values indicating that a participant differed greatly in their agreement with the different conditions, with negative values indicating greater agreement with covid-downplay headlines and positive values indicating greater agreement with covid-severe headlines. A model with headline condition, speaker group, order of condition blocks and participant's identity as a Canadian was run with smooths for the newly introduced variable for headline agreement differences and random intercepts for auditory stimulus, participants, and a by-trial smooth for participants.

Differences in how participants rated headlines in the downplay and severe headline condition was not predictive of accent similarity ratings (p=0.575), and were not included in

further analysis. Output of the model including participants' headline ratings can be found in Appendix C.1.

3.4 Individual Difference Measures

Correlations between the individual difference measures measured are presented (Table 3.2) and discussed separately below. For the purpose of this thesis, only the two disgust sensitivity measures were analyzed and will be discussed.

	Disgust Sensitivity (DS-R)	*Political Views*	*Perceived COVID threat*	*Belief in Science*	*Pathogen Disgust Sensitivity*
Disgust Sensitivity (DS-R)	1.00	-0.25	0.36	0.02	0.58
Political Views	-0.25	1.00	-0.32	-0.16	-0.12
Perceived COVID threat	0.36	-0.32	1.00	0.13	0.14
Belief in Science	0.02	-0.16	0.13	1.00	-0.17
Pathogen Disgust Sensitivity	0.58	-0.12	0.14	-0.17	1.00

Table 3.2: Correlations between individual difference measures across participants.

To determine how each individual difference measure interacted with the levels of the independent variable, a new grouping variable was created to express the 3x3 factorial for headline type consisting of the three manipulated conditions: neutral headlines, headlines downplaying COVID-19 and headlines emphasizing the severity of COVID-19 and speaker accent type containing levels of Canadian native-speaker, familiar foreign accented and unfamiliar foreign accented speakers.

For the analysis of individual differences (pathogen disgust sensitivity and disgust sensitivity), continuous variables were added to the previous final model (Table. 3.1) as smooth predictors individually by the newly created 3x3 grouping factor.

3.4.1 Disgust Sensitivity (DS-R)

A participant's level of disgust sensitivity was calculated using the DS-R inventory. Questions were reverse-scored according to the scoring scheme used in appendix B.4. Data from participants who did not answer the attention checks correctly were excluded. Scores for participants were mean centered with negative values indicating less than average disgust and positive values indicating higher than average disgust within the current study's participants. A GAMM model with disgust sensitivity scores included as a continuous smooth predictor by the was statistically significant (p=.019). Output for the final model is presented in Appendix C.2.

A model was run with a smooth term for the DS-R disgust sensitivity scores by the 3x3 grouping condition. The model output is below in Table 3.3. We see that the smooths for native speakers are significantly different from zero within all three headline conditions. Visualization of the model in Table 3.3 is presented in appendix D.

Parametric Coefficients	Estimate	Std. Error	t-value	Pr(>|t|)
(Intercept)	-0.5278	0.3368	-1.567	0.1171
Neutral-Familiar	7.0172	0.3453	20.319	<2e-16 ***
Neutral-Unfamiliar	6.4449	0.3450	18.681	<2e-16 ***
Severe-Native	0.2532	0.1181	2.145	0.0320 *
Severe-Familiar	7.1998	0.3455	20.837	<2e-16 ***
Severe-Unfamiliar	6.3330	0.3447	18.374	<2e-16 ***
Downplay-Native	0.2242	0.1190	1.884	0.0596
Downplay-Familiar	7.1073	0.3454	20.578	<2e-16 ***
Downplay-Unfamiliar	6.3925	0.3449	18.536	<2e-16 ***
Order_severe-downplay	-0.4395	0.3124	-1.407	0.1595

Significance of Smooth Terms	edf	Ref.df	F	p-value

s(DS-Rdisgust):neutral-native	3.314	3.747	4.847	0.00205 **
s(DS-Rdisgust):neutral-familiar	1.000	1.000	2.406	0.12090
s(DS-Rdisgust):neutral-unfamiliar	1.529	1.886	3.653	0.04808 *
s(DS-Rdisgust):severe-native	3.474	3.843	12.314	< 2e-16 ***
s(DS-Rdisgust):severe-familiar	1.070	1.134	1.414	0.21081
s(DS-Rdisgust):severe-unfamiliar	3.383	3.787	3.939	0.02165 *
s(DS-Rdisgust):downplay-native	3.467	3.840	13.029	< 2e-16 ***
s(DS-Rdisgust):downplay-familiar	1.000	1.000	1.075	0.29980
s(DS-Rdisgust):downplay-unfamiliar	1.000	1.000	3.366	0.06661
s(participant)	33.421	69.000	0.936	< 2e-16 ***
s(stimulus)	8.648	9.000	25.324	< 2e-16 ***
s(trial, participant)	49.435	645.000	10.334	0.02671 *

Table 3.3: Approximate significance of parametric effects and smooth terms effects by condition and (DS-R disgust sensitivity). Note: intercept is set to neutral headline-native speaker.

3.4.2 Pathogen Disgust Sensitivity

The pathogen disgust questions, a subset of the pathogen related questions from Tybur et al. (2009) were calculated as mean centered scores for participants. Scores with a positive value indicated higher than average sensitivity to pathogenic stimuli from the population studied, and negative values indicated lower than average pathogen disgust sensitivity. Statistical modeling with pathogen disgust sensitivity as a non-linear (smooth) predictor of accent similarity ratings was statistically significant (p<.01), with the output of the model shown in appendix C.3.

Much like the previous disgust sensitivity model, a new model was run with a smooth for pathogen disgust sensitivity by the different combinations of conditions (grouping factor with the nine combinations of the 3x3 factorial). The model output for the fixed effects of condition on accent ratings and the effect of smooth terms are shown in Table 3.3.

Parametric Coefficients	Estimate	Std. Error	t-value	Pr(>|t|)
(Intercept)	-0.6129	0.3288	-1.864	0.0624
Neutral-Familiar	6.9442	0.3410	20.362	<2e-16 ***
Neutral-Unfamiliar	6.3623	0.3404	18.689	<2e-16 ***
Severe-Native	0.2537	0.1175	2.159	0.0309 *
Severe-Familiar	7.1205	0.3412	20.871	<2e-16 ***
Severe-Unfamiliar	6.2488	0.3401	18.372	<2e-16 ***
Downplay-Native	0.2248	0.1183	1.900	0.0575
Downplay-Familiar	7.0334	0.3410	20.624	<2e-16 ***
Downplay-Unfamiliar	6.3189	0.3404	18.565	<2e-16 ***
Order_severe-downplay	-0.3142	0.3025	-1.039	0.2990

Significance of Smooth Terms	edf	Ref.df	F	p-value
s(pathogen_disgust):neutral-native	1.000	1.000	7.498	0.006198 **
s(pathogen_disgust):neutral-familiar	1.802	2.232	3.415	0.028979 *
s(pathogen_disgust):neutral-unfamiliar	1.230	1.421	2.900	0.050725
s(pathogen_disgust):severe-native	1.580	1.950	7.667	0.000419 ***
s(pathogen_disgust):severe-familiar	1.000	1.000	5.432	0.019806 *
s(pathogen_disgust):severe-unfamiliar	1.000	1.000	7.916	0.004919 **
s(pathogen_disgust):downplay-native	1.000	1.000	20.374	6.72e-06 ***
s(pathogen_disgust):downplay-familiar	1.055	1.107	5.176	0.017814 *
s(pathogen_disgust):downplay-unfamiliar	1.000	1.000	6.090	0.013628 *
s(participant)	33.364	69.000	0.933	< 2e-16 ***
s(stimulus)	8.639	9.000	24.713	< 2e-16 ***
s(trial, participant)	49.251	645.000	9.211	0.022224 *

Table 3.3: Approximate significance of parametric effects and smooth terms by condition and pathogen disgust sensitivity.

The smooths for pathogen disgust for native speaker recordings were statistically significant from zero across experimental headline conditions, apart from the neutral-unfamiliar pathogen disgust smooth.

Using the compareML function in R, models with scores for pathogen disgust sensitivity were found to be a better predictor of accent similarity ratings when compared to models with general disgust sensitivity (DS-R) scores. Thus, pathogen disgust sensitivity is used in further modeling and visualization.

Plotting the smooths for condition by pathogen disgust sensitivity using the plot_smooth() function in R from the package *itsadug* (2.4) are shown in Figure 3.2., we can see that there are considerable differences in the ratings of native speakers (left panel) between the severe (blue), downplay (green) and the neutral (red) conditions.

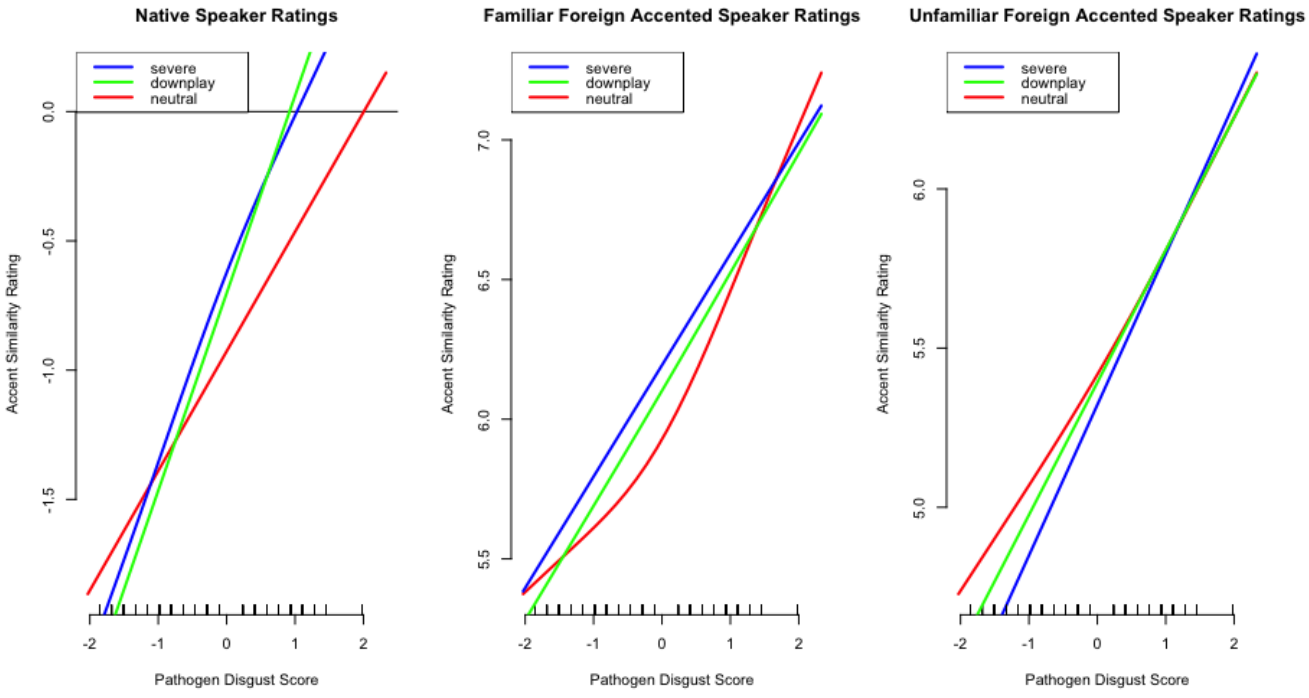

Figure 3.2: Smooths for accent similarity ratings by speaker group and condition by participants pathogen disgust sensitivity. Note: low scores indicate low disgust sensitivity.

To test whether the difference between the neutral condition and the covid-severe/downplay conditions was statistically significant, we used the plot_diff() function from the package *itsadug* (2.4) in R. Figure 3.3 outlines the differences in smooths for the different conditions by speaker group. Areas of significant difference are highlighted in red. Based on these plots, we see that individuals with average to above average disgust sensitivity rated native speakers of English as sounding more dissimilar after viewing the covid-downplay (top-right panel) and covid-severe headlines (top-middle panel). The top right panel of Figure 3.3 indicates that there are no significant differences in responses between the covid-severe and covid-downplay conditions for ratings of native speakers. For the foreign accented speakers (both familiar and unfamiliar), headline condition did not significantly alter perceptions of similarity to the non-natvive speakers. However, there seems to be an area of significant difference between the severe and neutral conditions for the familiar speakers (middle graph). This effect may not be practically significant given the small area of difference, for only the one comparison of conditions.

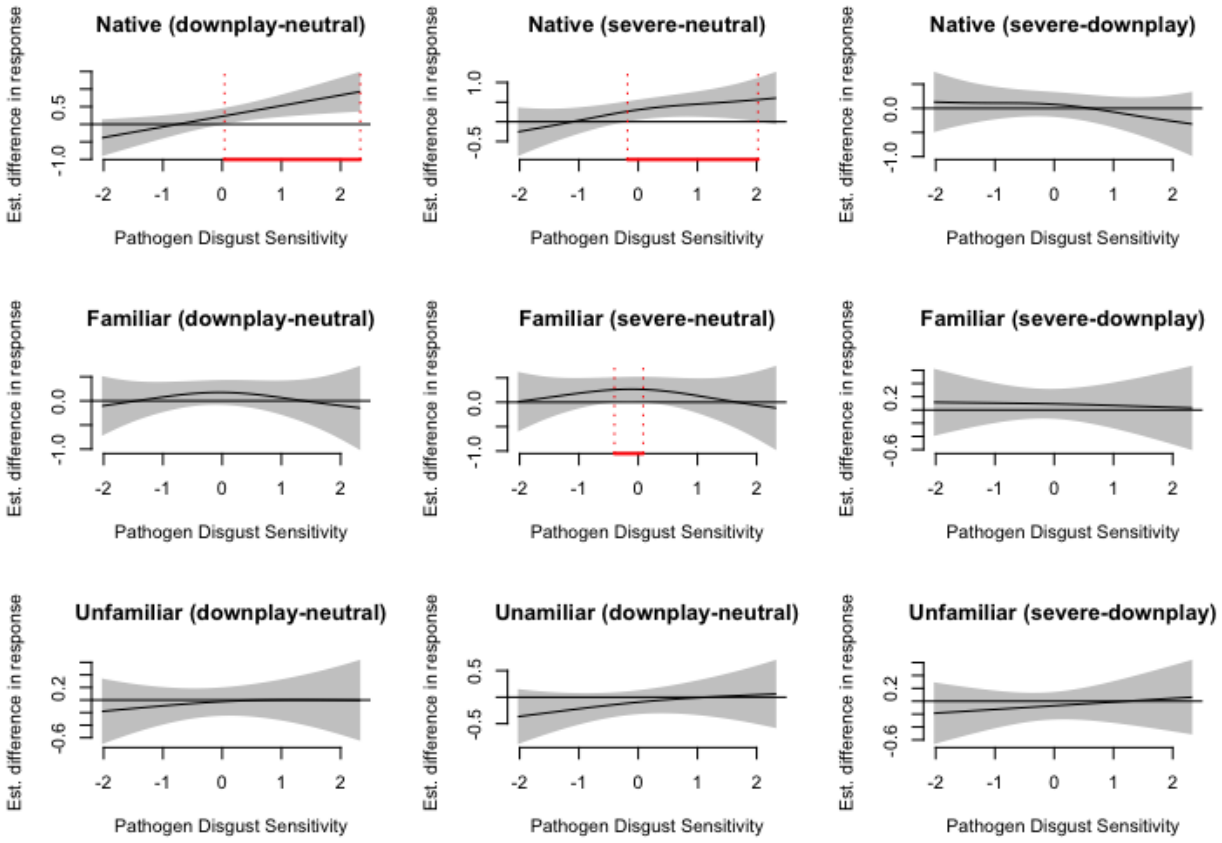

Figure 3.3: Areas of significant difference in responses between conditions by participant pathogen disgust sensitivity.
Areas of significant differences are indicated in Red. Note: "Native"= native speakers of English, "Familiar"= familiar foreign-accented speakers of English and "Unfamiliar"= unfamiliar foreign-accented speakers of English. Low scores for disgust indicate low disgust sensitivity.

Chapter 4: Discussion

The current study sought to replicate the results from Reid et al. (2012) which reported that participants with high disgust sensitivity rated native speakers (in-group members) as sounding more similar and foreign accented speakers (out-group members) as sounding less similar following exposure to a pathogen prime. Results from the present study do not support this hypothesis. It was instead found that participants with average and higher-than-average disgust sensitivity rated native speakers as sounding more dissimilar (less similar) after being primed with the covid-severe and covid-downplay headlines. Interestingly, ratings of non-native speakers (who would traditionally be classified as out-group members) were not significantly influenced by prime condition overall. Perceptions of non-native speakers did not change according to condition, suggesting that a disease threat did not produce a pathogen avoidance response to out-group members.

Given that native speakers of English were rated more severely (as less similar) following headlines related to COVID-19 (severe and downaplay conditions) in comparison to the following the neutral headlines, we can be confident that a disgust reaction was evoked towards in-group members (native speakers of English) within the current study's participants after COVID-19 was mentioned (in both the covid-severe and covid-downlay conditions). Ratings of native speakers following the covid-severe and covid-downplay conditions were not significantly different from each other, which indicates that mentioning COVID-19 in any capacity was enough to elicit a disgust reaction in participants with average to above average disgust sensitivity. It is likely that this effect extends only towards native speakers of English because of the participant's knowledge about COVID-19 and its common mechanisms for infection; in-group members are likely to transmit COVID-19 to other group members. Additionally, there

has been a substantial amount of media attention directed towards encouraging social distancing and discouraging physical and social contact with other in-group members.

Most current theories of the behavioral immune system and disgust sensitivity posit that a disgust response is warranted to anyone deemed unfamiliar and foreign (e.g., Schaller & Park, 2011; Schaller & Neuberg, 2012). It is possible that in the absence of any accompanying information, individuals may fall back on general strategies or heuristics that have been helpful throughout evolution in avoiding pathogens such as out-group avoidance or conforming to the stereotype that all out-group members are unhygienic. Given the results of the current study, it is likely that when speakers know the nature of the disease in question, disgust reactions are evoked towards those likely to spread infection, regardless of traditionally defined group membership boundaries or perceived levels of foreignness.

A dichotomy between aversion to out-group and attraction to in-group members may be too simplistic to encapsulate common disgust reactions. As such, disease avoidance behaviors may be more complex than previously theorized. For example, during a pandemic where limiting contact with others is encouraged, the standard "out-grouping" effect is extended to in-group members due to an increased risk of contracting COVID-19 within the group. Accent perception, and more broadly the perception of others is possibly sensitive to knowledge about a particular disease, likely mediating how individuals with high pathogen disgust sensitivity perceive both in-group and out-group members.

It is evident that pathogens do shape our behavior and how we view others. When the risk of infection is heightened, our perceptions of those likely to spread infection shift. This research provides experimental support for the view discussed in van Leeuwen and Petersen (2018) that

the behavioral immune system creates aversion to potentially infectious others, and not across the board aversion to out-group members.

Further research may explore how specific diseases interact with the perceptions of others. For example, diseases that are known to come solely from abroad may trigger out-group disgust reactions while infections that are commonly spread within groups may elicit disgust reactions towards fellow in-group members, similar to the results presented in this thesis. It may be worth investigating how disgust reactions may extend more strongly to individuals who are explicitly known to harbor a disease or infection compared to general likelihood of infection.

Replication may be a problem for further research related to the COVID-19 pandemic and group processing. It is possible that the results found in this thesis may be strictly time dependent, and therefore hard to replicate. For example, disgust reactions may depend on the perceived salience of disease at the time of data collection, with potential for different results at different points in time during the course of the pandemic. However, results that change depending on perceived risk may strengthen the claim made in this thesis that disgust reactions change as a function of perceived infection risk to those most likely to spread disease.

The beginning of the pandemic may have produced results consistent with out-group avoidance mechanisms when the threat of disease was predominantly from abroad. Research by Moran and colleagues (2021) discovered that individuals with higher levels of perceived risk of infection had higher support for travel bans during early phases of the pandemic. Their second experiment revealed that support for travel bans was limited to countries with high, but not low levels of infection risk, providing further experimental support to the notion that disgust responses are graded towards perception of infection risk, and not to all perceived out-group or unfamiliar out-group members.

Given the results of this thesis and a growing body of research investigating threat specific responses of the behavioral immune system, one can conclude that there may not be an automatic disgust reaction towards out-group members and foreigners in general but instead are a product of context-dependent threat assessments. It is undeniable that disease threats have increased prejudice to specific groups of individuals, which has been true for the COVID-19 pandemic and has been documented by multiple researchers (Adler et al., 2022, Dhanani & Franz, 2021, Lu et al., 2021). However, as the pandemic progresses, the present thesis provides evidence that out-group avoidance may be replaced by in-group avoidance due to the ever evolving and widespread nature of the COVID-19 virus.

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Appendix A: Visual Stimuli

A.1 Neutral Headlines

i)

'Like herding cattle': Crews struggle to keep boaters away from wildfire, B.C. water bomber forced to abort refill

The weather isn't the only challenge for crews fighting a wildfire near Sicamous, B.C. There's also boaters.

ii)

Jasper earns praise in Time Magazine's 'World's Greatest Places of 2021' list

By Phil Heidenreich · Global News
Posted July 21, 2021 6:14 pm · Updated July 21, 2021 6:15 pm

The town of Jasper, Alta., in Jasper National Park on Friday, May 15, 2020. **Nicole Stillger/Global News**

iii)

B.C. man accused of stealing $200K in 2019 CRA phone scam has fled Canada, court documents say

One of Haoran Xue's alleged victims asks why it took so long to charge the former B.C. Lower Mainland man

Jason Proctor · CBC News · Posted: Jul 22, 2021 4:00 AM PT | Last Updated: 5 hours ago

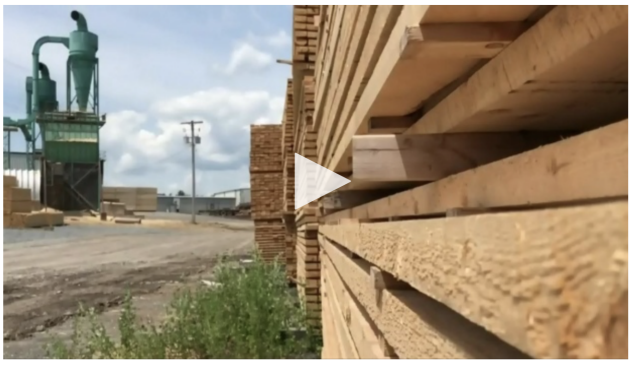
A former B.C. man faces fraud charges for his alleged role in an organized crime group whose members posed as Canada Revenue Agency employees to bilk victims out of more than $1 million. (CBC)

iv)

After sharp decline, lumber prices rising again due to B.C. wildfires

Ian Holliday
CTVNewsVancouver.ca Staff
Contact

Published Sunday, July 25, 2021 4:36PM PDT
Last Updated Sunday, July 25, 2021 7:00PM PDT



A.2 COVID-severe headlines

i)

Alberta asks Ottawa for help to airlift COVID-19 patients out of the province

Province has also formally requested additional critical care staff

Sarah Rieger · CBC News · Posted: Sep 21, 2021 4:30 PM MT | Last Updated: 11 hours ago

Staff members work at an Alberta intensive care unit during the COVID-19 pandemic. Alberta's government has formally requested that Ottawa provide aero-medical evacuation capability to relocate COVID-19 patients out of the province, and staff to assist in its critical care response. (AHS)

ii)

Alberta reports first COVID death in patient under 20, hospitalizations continue record climb

BY JOSH RITCHIE
Posted Sep 22, 2021 3:57 pm MDT Last Updated Sep 22, 2021 at 5:25 pm MDT

Registered nurse Jane Abas tends to a COVID-19 variant patient who is intubated and on a ventilator in the intensive care unit at the Humber River Hospital during the COVID-19 pandemic in Toronto on Tuesday, April 13, 2021. THE CANDIAN PRESS/Nathan Denette

iii)

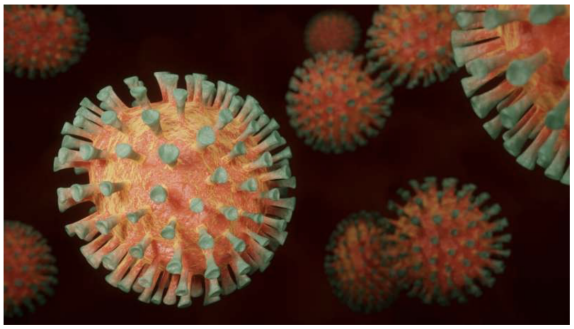
COVID has killed about as many Americans as the 1918-19 flu

By CARLA K. JOHNSON September 20, 2021

iv)

Delirium is a common consequence of severe COVID-19, study finds

by University of Michigan



v)

[redacted]

Severe COVID-19 may trigger autoimmune conditions; New variants cause more virus in the air

[redacted]

vi)

[redacted]

Alberta asks for federal help dealing with COVID-19 as nearly 1,000 people are in hospital

There are 996 people in hospital with COVID-19, including 222 who are in intensive care

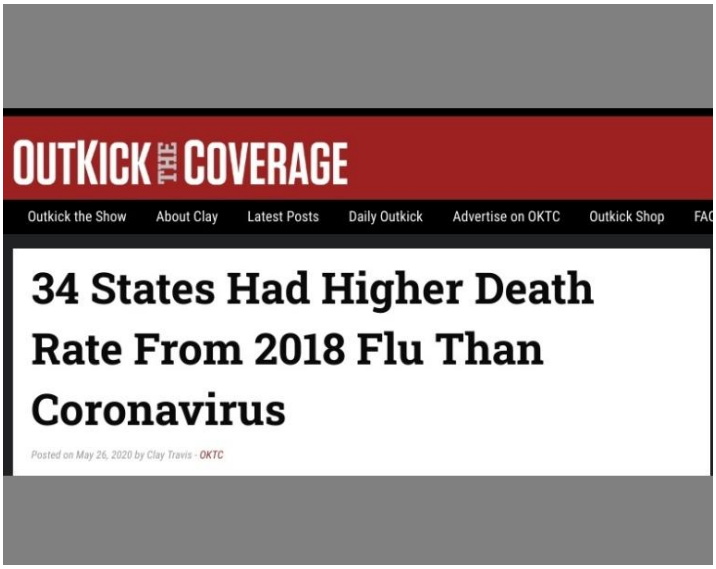
[redacted]

A.3 COVID-downplay headlines

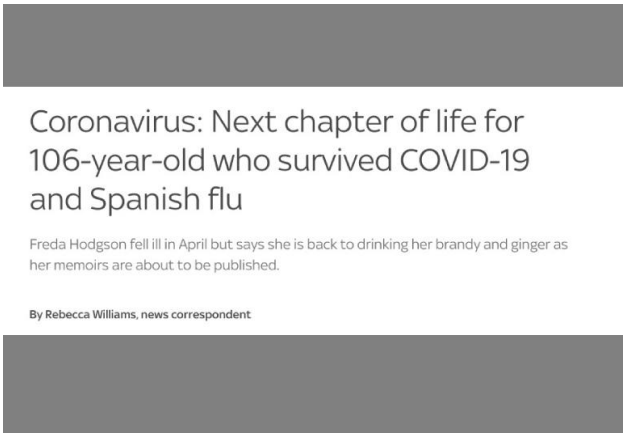
i)

ii)

iii)



iv)



v)

Appendix B: Post-Tests

B.1 Wilson-Patterson Conservatism Scale

	Strongly Disagree (0)	Disagree (1)	Neutral (2)	Agree (3)	Strongly Agree (4)	
1. School Prayer						
2. Stop all immigration						
3. Death penalty						
4. Universal healthcare						*
5. Gay marriage						*
6. Right to legal abortion						*
7. Biblical truth						
8. Increase welfare spending						*
9. Increase military spending						
10. Foreign aid for nations in crisis						*
11. Lower taxes						
12. Allow torture of terrosim suspects						
13. Sex before marriage						*
14. Gender equity						*
15. Climate change action						*
16. Obedience						
17. Compromise						*
18. Patriotism						
19. Gun control						
20. Free market						

*Indicates reverse scored item. (Wilson & Patterson, 1968)

B.2 Belief in Science Scale

Please Rate how strongly you agree with the following statements

0 = Strongly disagree
1 = Disagree
2 = Slightly disagree
3 = Slightly agree
4 = Agree
5 = Strongly agree

1. Science provides us with a better understanding of the universe than does religion.
2. “In a demon-haunted world, science is a candle in the dark.” (Carl Sagan)
3. We can only rationally believe in what is scientifically provable.
4. Science tells us everything there is to know about what reality consists of.
5. All the tasks human beings face are soluble by science.
6. The scientific method is the only reliable path to knowledge.
7. The only real kind of knowledge we can have is scientific knowledge.
8. Science is the most valuable part of human culture.
9. Science is the most efficient means of attaining truth.
10. Scientists and science should be given more respect in modern society.

(Farias et al., 2013)

B.3 Perceived Coronavirus Threat Questionnaire

Please Rate how strongly you agree with the following statements

0 = Strongly disagree
1 = Mildly disagree
2 = Neither agree nor disagree
3 = Mildly agree
4 = Strongly agree

1. Thinking about the coronavirus (COVID-19) makes me feel threatened.
2. I am afraid of the coronavirus (COVID-19).
3. I am not worried about the coronavirus (COVID-19). *
4. I am worried that I or people I love will get sick from the coronavirus (COVID-19).
5. I am stressed around other people because I worry I'll catch the coronavirus (COVID-19). I have tried hard to avoid other people because I don't want to get sick.

*Indicates reverse-scored item.
(Conway et al., 2020)

B.4 Disgust Scale-Revised (DS-R)

Please indicate how much you agree with each of the following statements, or how true it is about you. Please write a number (0-4) to indicate your answer:

0 = Strongly disagree
1 = Mildly disagree
2 = Neither agree nor disagree
3 = Mildly agree
4 = Strongly agree

1. I might be willing to try eating monkey meat, under some circumstances. *
2. It would bother me to be in a science class, and to see a human hand preserved in a jar.
3. It bothers me to hear someone clear a throat full of mucus.
4. I never let any part of my body touch the toilet seat in public restrooms.
5. I would go out of my way to avoid walking through a graveyard.
6. Seeing a cockroach in someone else's house doesn't bother me. *
7. It would bother me tremendously to touch a dead body.
8. If I see someone vomit, it makes me sick to my stomach.
9. I probably would not go to my favorite restaurant if I found out that the cook had a cold.
10. It would not upset me at all to watch a person with a glass eye take the eye out of the socket. *
11. It would bother me to see a rat run across my path in a park.
12. I would rather eat a piece of fruit than a piece of paper. **
13. Even if I was hungry, I would not drink a bowl of my favorite soup if it had been stirred by a used but thoroughly washed flyswatter.
14. It would bother me to sleep in a nice hotel room if I knew that a man had died of a heart attack in that room the night before.

(continued)

How disgusting would you find each of the following experiences? Please write a number (0-4) to indicate your answer:

0 = Not disgusting at all
1 = Slightly disgusting
2 = Moderately disgusting
3 = Very disgusting
4 = Extremely disgusting

15. You see maggots on a piece of meat in an outdoor garbage pail.
16. You see a person eating an apple with a knife and fork. **
17. While you are walking through a tunnel under a railroad track, you smell urine.
18. You take a sip of soda, and then realize that you drank from the glass that an acquaintance of yours had been drinking from.
19. Your friend's pet cat dies, and you have to pick up the dead body with your bare hands.
20. You see someone put ketchup on vanilla ice cream, and eat it.
21. You see a man with his intestines exposed after an accident.
22. You discover that a friend of yours changes underwear only once a week.
23. A friend offers you a piece of chocolate shaped like dogdoo.
24. You accidentally touch the ashes of a person who has been cremated.
25. You are about to drink a glass of milk when you smell that it is spoiled.
26. As part of a sex education class, you are required to inflate a new unlubricated condom, using your mouth.
27. You are walking barefoot on concrete, and you step on an earthworm.

(Haidt et al., 1994, modified by Olatunji et al., 2007)
*Indicates reverse scored item.
**These questions are used as attention checks - throw out scores below 2 for question 12 and throw out scores above 2 for question 16. Sum all scores for each question.

B.5 Three Domains of Disgust Sensitivity - Pathogen Disgust Items

Please rate how disgusting you find the concepts described in the items:

0 = No disgust
1 = Very little disgust
2 = Slight Disgust
3 = Moderate disgust
4 = Considerable Disgust
5 = Extreme disgust

1. Sitting next to someone who has red sores on their arm.
2. Shaking hands with a stranger who has sweaty palms.
3. Seeing some mold on old leftovers in your refrigerator.
4. Standing close to a person who has body odor.
5. Seeing a cockroach run across the floor.
6. Accidentally touching a person's bloody cut.
7. Stepping on dog poop.

(Tybur et al. 2009)

B.6 Language Background Questionnaire

Here you will be asked some questions about your language background.

1. **What is your sex?**

   Options: male, female, other/prefer not to say

2. **Do you consider yourself a native speaker of English?**

   Options: yes, no

3. **Do you consider yourself multilingual (proficient in two or more languages)?**

   Options: yes, no

4. **How old are you? _____**

5. **Please indicate any other languages you speak: _____**

6. **Were your parents born in Canada?**

   Options: yes, no, only one was born in Canada, other

7. **Do you identify as Canadian?** Options: yes, no, partially

8. **How often do you interact with native speakers of English?**

   Options: very frequently, frequently, average, infrequently, very infrequently

9. **How often do you interact with non-native speakers of English?**

   Options: very frequently, frequently, average, infrequently, very infrequently

Appendix C: Model Outputs

C.1 Headline ratings as a smooth predictor

Parametric Coefficients	Estimate	Std. Error	t-value	Pr(>|t|)
(Intercept)	1.5541	1.0800	1.439	0.1502
Severe	0.2576	0.1170	2.202	0.0277 *
Downplay	0.2359	0.1176	2.005	0.0450 *
Familiar	6.9120	0.3416	20.235	<2e-16 ***
Unfamiliar	6.3346	0.3412	18.568	<2e-16 ***
Canadian-partially	-1.6374	1.1955	-1.370	0.1709
Canadian-yes	-2.2223	1.0498	-2.117	0.0343 *
order_severe1_downplay2	-0.4436	0.3181	-1.395	0.1632
severe:familiar	-0.0724	0.1628	-0.445	0.6565
downplay:familiar	-0.1415	0.1631	-0.868	0.3856
severe:unfamiliar	-0.3793	0.1600	-2.370	0.0178 *
downplay:unfamiliar	-0.2821	0.1610	-1.752	0.0799

Table 3.3: Fixed effects by condition. Note: the intercept is neutral headline, native speaker.

Significance of Smooth Terms	edf	Ref.df	F	p-value
s(diff_headline)	1.571	1.584	0.773	0.575
s(participant)	32.229	67.000	0.927	<2e-16 ***
s(stimulus)	8.641	9.000	24.844	<2e-16 ***
s(trial, participant)	46.648	643.000	10.461	0.019 *

Formula: (response~headline_type*group + ident_Canadian + condition + s(diff_headline) + s(sona_id, bs="re") + s(stimulus, bs="re") + s(trial, sona_id, bs="fs", m=1), data=hdat, family=ocat(R=7))

C.2 Disgust Sensitivity (DS-R) as a smooth predictor

Parametric Coefficients	Estimate	Std. Error	t-value	Pr(>|t|)
(Intercept)	1.10464	0.95302	1.159	0.2465
Severe	0.25733	0.11702	2.199	0.0279 *
Downplay	0.23543	0.11761	2.002	0.0454 *
Familiar	6.90979	0.34162	20.226	<2e-16 ***
Unfamiliar	6.33219	0.34119	18.559	<2e-16 ***
Canadian_partially	-1.85837	1.06638	-1.743	0.0814
Canadian_yes	-1.97277	0.93693	-2.106	0.0353 *
severe:familiar	-0.07208	0.16279	-0.443	0.6580
downplay:familiar	-0.14105	0.16311	-0.865	0.3872
severe:unfamiliar	-0.37885	0.16003	-2.367	0.0179 *
downplay:unfamiliar	-0.28142	0.16102	-1.748	0.0806

Significance of Smooth Terms	edf	Ref.df	F	p-value
s(DS-Rdisgust)	1.000	1	5.501	0.0190 *
s(participant)	32.939	68	0.935	<2e-16 ***
s(stimulus)	8.641	9	24.857	<2e-16 ***
s(trial, participant)	47.242	644	9.771	0.0469 *

Formula: response ~ headline_type * group + ident_Canadian + s(Sdisgust_score) + s(sona_id, bs = "re") + s(stimulus, bs = "re") + s(trial, sona_id, bs = "fs", m = 1)

C.3 Pathogen Disgust Sensitivity as a smooth predictor

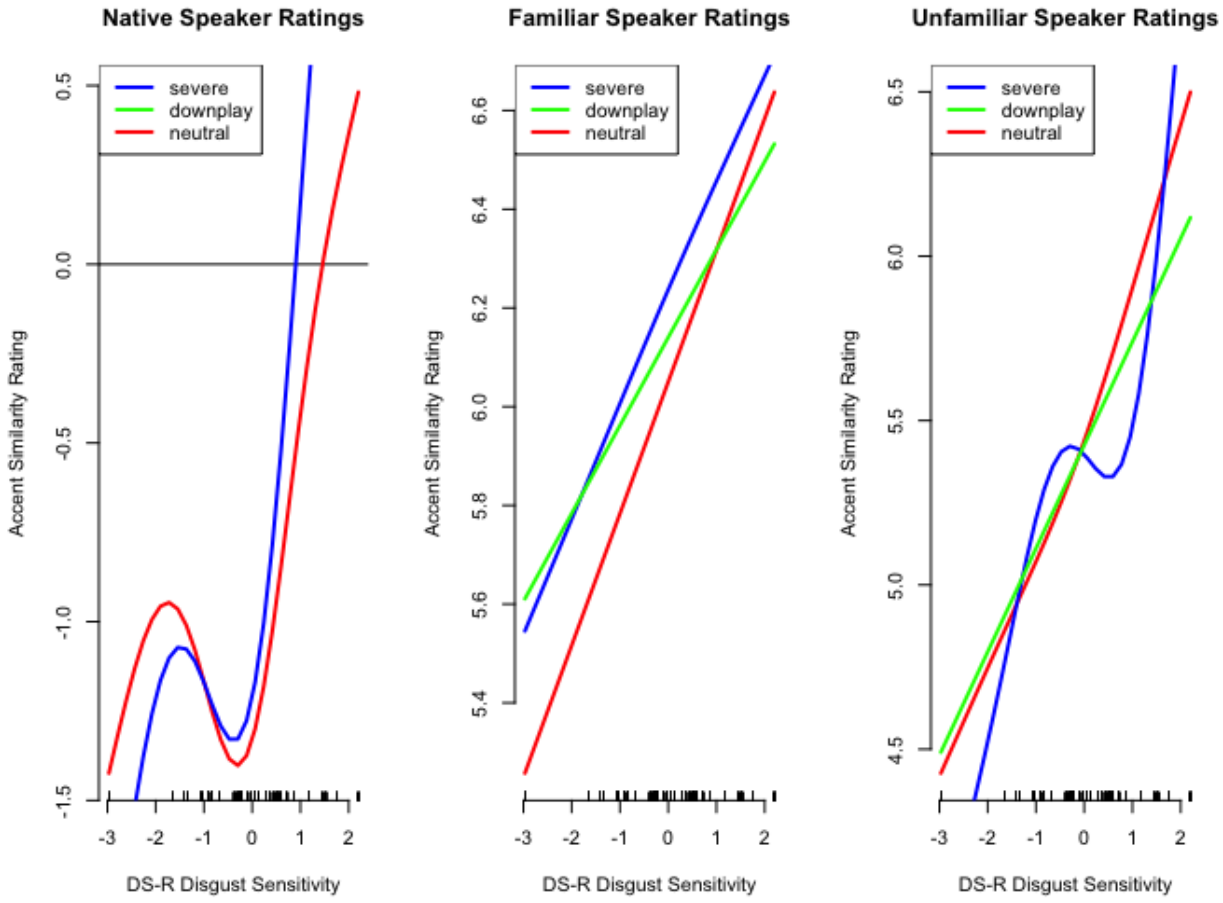
Parametric Coefficients	Estimate	Std. Error	t-value	Pr(>|t|)
(Intercept)	0.30558	0.95718	0.319	0.7496
Severe	0.25700	0.11701	2.196	0.0281
Downplay	0.23543	0.11759	2.002	0.0453 *
Familiar	6.91375	0.34159	20.240	<2e-16 ***
Unfamiliar	6.33621	0.34116	18.572	<2e-16 ***
Canadian_partially	-1.16683	1.03578	-1.127	0.2600
Canadian_yes	-1.13787	0.94496	-1.204	0.2286
severe:familiar	-0.07154	0.16277	-0.439	0.6603
downplay:familiar	-0.14101	0.16309	-0.865	0.3873
severe:unfamiliar	-0.37846	0.16003	-2.365	0.0181
downplay:unfamiliar	-0.28144	0.16103	-1.748	0.0806

Significance of Smooth Terms	edf	Ref.df	F	p-value
s(pathogen_disgust)	2.274	2.295	6.177	0.00249 **
s(participant)	32.209	68.000	0.907	< 2e-16 ***
s(stimulus)	8.641	9.000	0.907	< 2e-16 ***
s(trial, participant)	46.667	644.000	24.847	0.02678 *

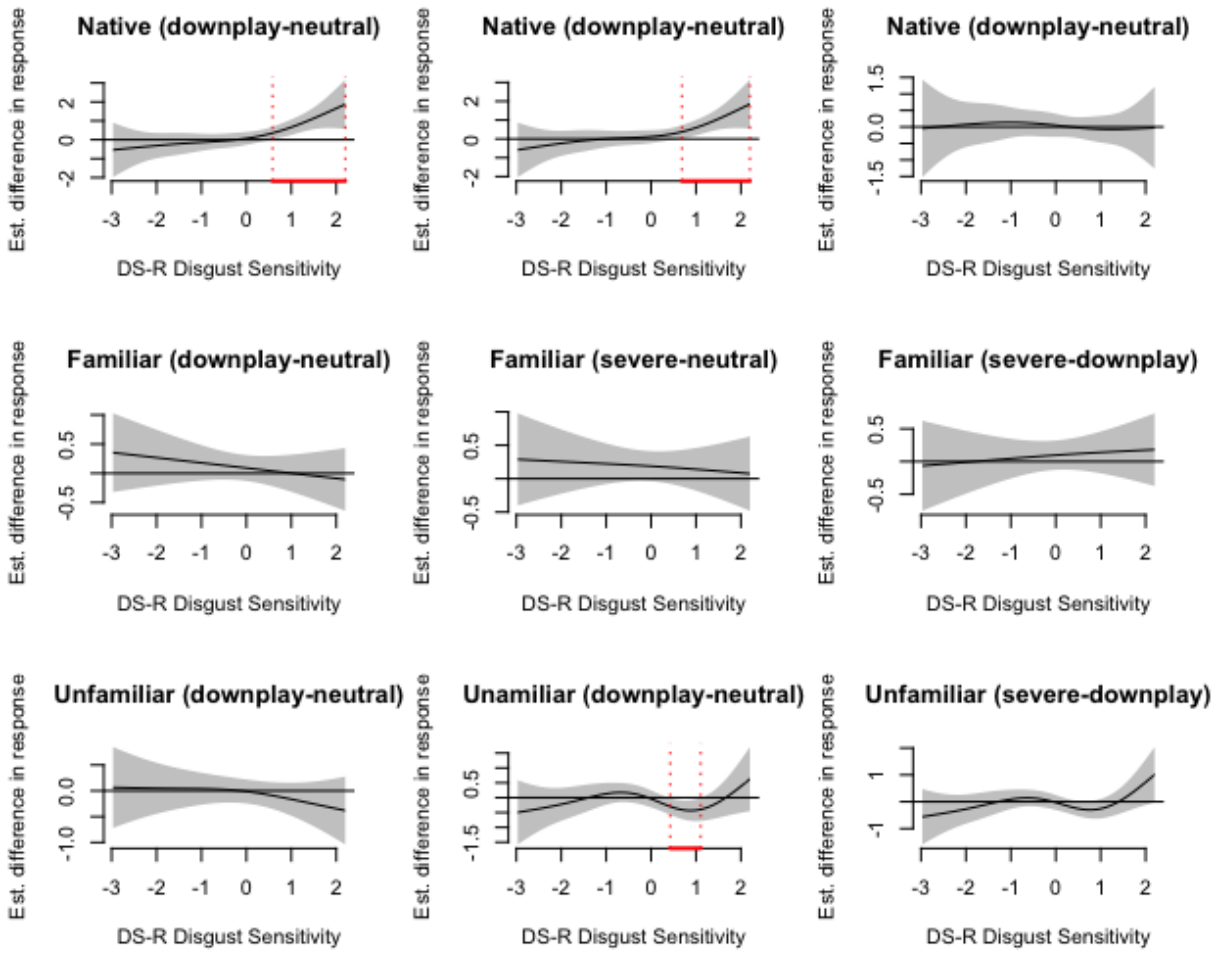
Formula: response ~ headline_type * group + ident_Canadian + s(Spathogen) + s(participant, bs = "re") + s(stimulus, bs = "re") + s(trial, participant, bs = "fs", m = 1)

Appendix D: Data Visualization

D.1 Visualization of Table 3.3 - Smooths of disgust sensitivity on ratings by speaker group membership



D.2 Visualization of Table 3.3 - Difference between DS-R smooths by headline condition



Note: Areas of significant difference in responses between conditions are in red.