Disgust Sensitivity and the Development of Political Attitudes among Children and Their Parents

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1 Introduction

The Behavioral Immune System, or the collection of cognitive processes selected through human evolution to guard against infections by using disgust, shapes political attitudes.[1] Recent research contends that the Behavioral Immune System, operating largely out of conscious awareness, motivates individuals who are more prone to experience disgust to adopt policy preferences that minimize (real or perceived) threats linked to objects and individuals threats potentially carrying pathogens. Individual variance in the susceptibility to feel disgusted, called *disgust sensitivity*, correlates with a preference for political policies that enable the avoidance of outgroup members, such as opposition to immigration and leeriness of homosexuals, among others.[2,3,4,5,6]

We are interested in studying whether there is a link between disgust sensitivity and the emerging political attitudes of children related to immigration — in particular, prejudice toward members of different ethnic groups. Among adults, there are many factors that influence attitudes toward immigrants, from economic threat to clashing cultural values.[7,8,9] For many adults prejudice against immigrants lies at the basis of these justifications.[10,11] Where does prejudice among adults come from? The standard explanation of adults' attitudes (including prejudiced attitudes that underlie particular political attitudes) presumes that they arise from a complex interaction of the childhood environment (including the in utero environment) and biological predispositions.[12] Childhood experiences, including interaction with parents and peers, are thought to structure the political attitudes to which adults gravitate later in life.[13,14,15] Nonetheless, there is little research on political attitude formation that directly studies children, and the few studies that do, tend to

examine the attitudes and behaviors of adolescents.[16] In contrast, we explore the sensory, cognitive, and behavioral correlates of disgust sensitivity in school-age children (6-10 years old) along with their parents.

Research that has examined children shows that their political attitudes correspond strongly with those of their parents, especially before children reach adolescence, but that this correspondence declines in adulthood when the influence of biologically instantiated psychological motivations becomes more apparent.[17] Similarly, previous research reports strong correlations between parents and their adult offspring on food-related disgust sensitivity.[18,19] Twin studies of adults show that genetic factors (which are inherited from parents) explain more variance in disgust sensitivity than does the shared childhood environment.[20] Yet because the influence of the shared environment on political attitudes tends to be stronger in childhood and adolescence and declines in adulthood,[21] it is still possible that the link between disgust sensitivity and children's emerging political attitudes surrounding immigration could reflect both biological predispositions and parental inputs.

Although children are capable of expressing opinions on political topics,[22] we anticipate that, unlike adults, children will not be able to connect disgust sensitivity to their nascent political attitudes about immigration in the abstract. In contrast, we expect both children and adults to be able to connect disgust sensitivity to concrete scenarios about interacting with immigrant children. This hypothesis is based on two reasons. First, concrete scenarios should draw on more intuitive mental modules devoted to social categorization that emerged early in the evolution of human ancestors navigating social coalitions in small scale societies.[23] Second, children do exhibit prejudice toward individuals of outgroups by five years old.[24] Nonetheless, children are capable of learning about abstract political issues[25] as well as prejudice toward social groups[26] from their parents. Therefore, we expect to find that the political attitudes of parents (along with the parents' level of disgust sensitivity) to be more closely linked to children's expression of political attitudes on more abstract questions about immigration.

2 A Multi-Faceted Approach to Measuring Disgust Sensitivity

Most studies measure disgust sensitivity with self-administered survey questions about how disgusted one feels in different scenarios (e.g., stepping in dog poop).[27] Simplified versions of the scales developed for adults have been applied to youth samples. The 30-item Disgust Emotion

Scale[28] has been developed as a reliable index of the multifaceted construct of disgust sensitivity and has been recently validated in children .[29] However, work remains to be done on systematically assessing whether cognitive responses demonstrate convergence validity with other measures of disgust (e.g., sensory and behavioral) by tapping the same underlying construct of disgust sensitivity, particularly during childhood development.

Different from self-report related to attitudes, sensory self-reports are deemed reliable and report accurately on the participant's experience. This is particularly true for the case of olfaction in relation to affective states.[30] As Yeshurun and Sobel[31] claim, the main dimension of the olfactory space — pleasantness — is affective in nature and it is general enough for children as young as five to be able to report about this olfactory dimension.[32] Specifically to disgust, adults can almost invariably evoke disgust via the olfactory channel, particularly for objects that carry microbial threat[33] and disgusting odors elicit stronger physiological reactions than their visual counterparts.[34] In other words, behavioral and physiological responses related to defensive motivation may be more effectively triggered by odors than by comparable visual stimuli and they are also less well modulated.

To validate whether disgust has direct behavioral consequences, researchers have devised behavioral tasks that should be affected by disgust sensitivity. In the child-versions of such tasks, children were asked to perform different consecutive steps in which they were asked to approach disgusting materials such as a sticky candy fallen on the ground, a dirty sponge, and a used cotton swab as well as to rate how disgusting each of these situations were.[35] This test allowed researchers to quantify disgust-induced avoidance (i.e., how many steps the child was able to complete) in relation to the disgust they reported experiencing.

A multi-faceted approach that includes sensory indicators (such as, olfactory responses of disgust), cognitive indicators (such as, survey measures), and behavioral responses provides an appealing way to investigate the effects of disgust sensitivity in association with prejudice, because it taps into psychological processes that are conscious as well as into those that lie outside of conscious awareness and control. Moreover, given the ease with which people of all ages can report the pleasantness of odors, including sensory measures not only helps circumvent social desirability bias in adults,[36] but it also provides an ideal approach for studying attitude formation in children.

3 Hypotheses

Our main set of hypotheses, for which we have adequate statistical power, centers on the thesis that in concrete scenarios disgust sensitivity and attitudes toward immigrants (e.g., playing with a child from another country) will correlate both in children and in parents, while in abstract scenarios (e.g., do you support immigration in your country?) such correlation will only emerge for adults. We will measure disgust sensitivity across multiple modalities: 1) sensory (olfactory disgust), 2) cognitive (self-reported disgust sensitivity), and 3) behavioral (avoidance of disgusting items). Specifically, we hypothesize that:

H_1: Olfactory disgust, self-reported disgust sensitivity, and behavioral avoidance will equally influence children and parents' answers to the concrete scenarios about immigrants.

H_2: Olfactory disgust, self-reported disgust sensitivity, and behavioral avoidance will influence the parents' answers to abstract questions about immigration more than the children's answers.

In addition, we plan to run a series of analyses to evaluate the thesis that parental socialization and innately prepared psychological predispositions jointly shape the development of political attitudes. Given the relatively short time frame of data collection and the greater complexity of these correlation analyses, we may not reach the sample size necessary to have sufficient power for testing these hypotheses. Even so, our analyses will provide an initial step and suggestive evidence that will guide additional research. In these more complex models, we will evaluate the hypotheses by using omnibus linear mixed model analyses to evaluate whether the olfactory disgust ratings and behavioral avoidance correlate with self-reported disgust sensitivity in children, even after controlling for their parents' disgust sensitivity.[37]

This set of hypotheses presumes that different measures of disgust converge in the concrete and abstract scenarios. However, as observed by Lang[38] measures expected to be part of the same construct often covary less than expected. If this appears to be the case in our dataset, we will use sensory, cognitive, and behavioral measures in the same factor analysis to characterize in a multifaceted manner the experience of disgust in a dispositional construct. This approach is similar to the one applied by the RDoC initiative, a research framework designed to integrate different levels of information to better understand complex phenomena such as mental health disorders.[39] By applying this approach to politics, it would be possible to transform the conceptualization of

how political behavior emerge and can be predicted.

4 Methods

4.1 Sampling

Based on the theoretical assumptions that we have advanced, on the available (limited) published research on similar topics as well as on our educated guess with respect to the specific aspects of this study, we opted for the creation of a hierarchical analysis plan which would first answer a question posed in low-dimensional terms (e.g., t-test like) and subsequently, sample size permitting, would explore a wider set of high-dimensional problems (e.g., linear and non-linear mixed models). For the power analysis of the low-dimensional problem, we chose a Bayes Factor (BF) hypothesis-testing approach, which allows us to quantify the necessary evidence to reach a conclusion on whether the effect is indeed null.[40] This is a necessary because our H_1 is expected to reveal no difference between children and parents. We employed a Sequential Bayes Factor (SBF) design with maximal N[41] and performed the design analysis via the *BFDA* R package.[42] This sequential design allows us to achieve the joint goal of maximising the probability of obtaining strong evidence and a low probability of obtaining misleading evidence, while considering the feasibility of the study by including the maximum expected sample pool. We also chose this approach because it usually requires half of the participants necessary for the optimal null hypothesis testing fixed-n designs, with comparable error rates.[43]

For our most conservative power analysis, we assumed a small effect size (0.1) in a two-tailed between t-test design. This analysis suggested a minimal sample size of N = 20 parent-child dyads and a max sample size of 100, which is a number of tested subjects that we can reasonably achieve in the given time-frame. This sample size should provide at least 80% of power for gathering sufficient data to achieve "anecdotal evidence" for testing the null hypothesis (denoted as $BF_{01} > 3$) and/or "moderate evidence" for the alternative hypothesis (denoted as $BF_{10} > 6$). A moderate evidence criterion implies that, within the assumptions of the model, there is a three-fold greater likelihood that a hypothesis is credible as compared to its alternative. A moderate evidence criterion raises this bar to a 6-fold greater likelihood.[44, 45] The prior for the t-test between participants is a Cauchy distribution with a non-centrality parameter equal to 0 and scale parameter set at $\frac{\sqrt{2}}{2}$. The 95% central credible interval of the posterior distribution will be used as criterion to define the effect

size.[46]

4.2 Participants

We will recruit white Italian parents living near the research site in Trieste, Italy, who report that they are non-smokers and that they and their children are in good health. The children age will range between 6 to 10 years old. To the best of our ability, we will try to recruit children that produce a sample evenly distributed by age. However, since it is not our primary goal to test whether the age of children moderates the relationship between disgust sensitivity and prejudice, we will include in the final sample all the consecutive participants that satisfy the inclusion criteria, without focusing on producing a fully balanced sample. Parents will provide consent for themselves and their children, whereas the children will provide verbal assent for participation. The researchers will present to the children four sets of stimuli (political scenarios, disgusting odors, disgusting materials and disgust sensitivity questions) and elicit their responses. The parents will be presented with the same set of stimuli given to the children, with the request to answer based on their own experience. In addition, they will be asked to answer questions related to their political ideology and basic demographics (gender, age, education, and income). Children and parents will be tested in different areas of the same space, while being unable to see or hear the responses of the other. We will only consider one parent-child dyad, however considering the citizen-science orientation of the experimental session, we will test multiple children from one family, if an interest is expressed. If the number of parents matched with multiple children is large enough (N>50), we will evaluate the variability across siblings and their one parent. In the mixed models, we will also include as a covariate a fixed effect for parents with multiple children.

4.3 Stimuli

We describe the stimuli and questionnaires in English. Because participants will be native Italian speakers, all materials will be translated into Italian.

4.3.1 Political scenarios

The political scenarios presented on immigration are proposed in a concrete and a more abstract form. The presentation of concrete scenarios will be preceded by the presentation of two pictures, one with the face of a white child and one with the face of a black child. Faces of white and black

children will be placed on a neutral background and piloted on a small group of children to avoid major variations in pleasantness and facial expression. We use the skin color of the child depicted in the picture as a marker of otherness. However, we keep the sex of the participant constant to that of the child shown in the picture (e.g., girls will see a picture of a girl). The order of the picture and the related questions will be counterbalanced across participants. The scenarios were asked to be read and completed alone, but younger children will be helped by an experimenter who will read out loud the instructions and the test material. We chose a visual analogous scale (VAS) anchored to a happy and to a sad face. Such scale requires the participants to use mark a 10-cm long line to indicate their level of agreement with the statement, so that children could provide more reliable responses.[47, 48]

Table 1: Concrete Questions on Immigration

I am about to show you some pictures. Imagine that these kids have just moved to your neighborhood. Please now indicate how much you would like or not like to do the things I am about to read. You can mark your preference on this line. The closer you place your mark to the happy face, the more you agree with what the sentence says. The more you place your mark to the unhappy face, the more you disagree with what the sentence says. The best answer is usually the one which comes to mind first, so just give us your first reaction and don't spend too long on any one question.
1) I would borrow a pencil from this child
2) I would play with this child for a whole afternoon
3) I would bite on this child's sandwich after him/her
4) I would sleep at this child's house
5) I would like it if this child moved next door to me

By calculating the difference between the responses given thinking of the child of the ingroup vs. the child of the outgroup, we will generate a standard measure of ingroup bias. To avoid concerns of explicit responses with reduced variance due to social desirability, a measure of intergroup bias well-validated in children will be introduced before proposing the concrete scenarios. Children and parents will be asked in a two-alternative forced choice task to pick the face of the child they prefer, while choosing between a picture of in-group and one of out-group children in a series of 14 unique face pairs.[49]

To ease participants into the tasks, the concrete scenarios will always precede the abstract ones. Abstract scenarios will use the prompt used in previous survey research that studies political attitudes in young children.[50] The questions are worded so that both children and adults can easily understand them, and we will use VAS (happy/sad faces) for children. Of course, these questions will be more abstract (and perhaps unintelligible to some of the younger children. Survey administers will note whether a child participant does not understand the question. After removing the answers of children who do not show a minimal understanding of the question, we will test the hypothesis that parental predispositions and attitudes have a stronger affect on abstract political questions that they do on intuitive ones.

Table 2: Abstract Questions on Immigration

Here is a list of various topics. Please now indicate how much you would like or not like to do the things I am about to read. You can mark your preference on this line. The closer you place your mark to the happy face, the more you agree with what the sentence says. The more you place your mark to the unhappy face, the more you disagree with what the sentence says. The best answer is usually the one which comes to mind first, so just give us your first reaction and don't spend too long on any one topic.
1) The Italian government should let people from Africa live here in Italy
2) The Italian government should let people from Ukraine live here in Italy
3) The people who come from Africa that are already here in Italy should live on their own and not in my community
4) The people who come from Ukraine that are already here in Italy should live on their own and not in my community

By comparing responses to the questions about African immigration to Ukrainian immigration, we will be able to test the hypothesis that individuals from less familiar cultures (Africa in the Italian context) could potentially be more likely to trigger the Behavioral Immune System.[51,52]

4.3.2 Disgusting odors

Different disgusting odors from household and perfumery materials will be piloted with children based on strength, pleasantness and disgust to identify three odors that range in disgust levels (e.g., fish sauce (100% solution), isovaleric acid (1%), civet (10%)). A neutral odor (e.g.,, propylene glycol, 100%) will be added as a control condition. The odors will be presented for 3 seconds each

in 125ml-wide-mouth glass jars with 2 ml of solution each positioned 2 cm below the nostrils of the child and parent. Upon exposure, participants will be asked to complete a paper and pencil visual analogous scale (0-100) on the strength and a separate one on the disgust elicited by each odor.

4.3.3 Disgusting materials

Three behavioral disgust tasks, inspired from Muris et al.[53] will be presented to each participant: 1) touch a sticky candy found on the ground; 2) touch a dirty, used sponge; 3) touch a used cotton swab. Each material will be presented in a randomized order and followed by the question "Can you touch this?" If the participant says yes, a 0-100 was will be presented as to record the answer to "How disgusting it is to touch this?" The answers to the first question will determine the behavioral avoidance (i.e., the higher the number, the lower the avoidance); the answers to the second question will determine the behavioral disgust rating.

4.3.4 Disgust sensitivity questions

To measure expressed disgust sensitivity, we selected seven questions proposed by Tybur et al.[54] as a specific measure of pathogen disgust. The response scale was changed from a 7-point Likert scale into a simpler VAS scale with four options ranging from 1) not at all disgusting, 2) a bit disgusting, 3) disgusting, and 4) very disgusting in which the verbal labels are matched with emoticons reflecting the different degrees of disgust. To clarify to younger children (6 years old) what disgust is, the experimenter will include example of "yucky" situations (e.g., a slimy animal) not included in the testing material. We chose the Pathogen Disgust Scale over the 30-item Disgust Emotion Scale for children,[55] because it better taps individual differences in the Behavioral Immune System than the older and less reliable disgust sensitivity scale on which the Disgust Emotion Scale was based. The psychometric properties of the responses given by the children to these scales will serve as the basis for validation of these scales in Italian, whereas previous evidence in English-speaking countries has been proposed.[56]

Because the meaning of some words may be unclear to some of the children, we will provide synonyms and concrete examples (e.g., an odor is a smell. A flower smells and gives an odor).

Table 3: Disgust Sensitivity Questions

Here is a list of various situations. Please now indicate how disgusting these situations are to you. You can find them 1) not at all disgusting (see the happy face here?) , 2) a bit disgusting (the face starts showing that this is a "yucky" thing), 3) disgusting (more "yucky" face), and 4) very disgusting (have you ever seen something "yuckier" than this?). The best answer is usually the one which comes to mind first, so just give us your first reaction and don't spend too long on any one topic.
1) Standing close to a person who has body odor
2) Shaking hands with a stranger who has sweaty palms
3) Stepping on dog poop
4) Accidentally touching a person's bloody cut
5) Seeing some mold on old leftovers in your refrigerator
6) Sitting next to someone who has red sores on their arm
7) Seeing a cockroach run across the floor

4.3.5 Political Ideology (for parents only)

We draw questions about partisanship and ideology from the Comparative Study of Electoral Systems (CSES) survey, which contained Italian versions of these standard questions. [57] The English translation of the partisanship question is "Which party best represents your opinion?" (and followed by a list of parties in parliament). The English translation of the ideology question is "When a lot of people talk about politics, they use the terms 'left' and 'right.' Where would you place yourself on a scale from 0 to 10 where 0 means the left and 10 means the right?"

4.4 Procedures

The investigation will be conducted at the International School for Advanced Studies (SISSA) in Trieste, Italy, to capitalize on the heterogeneity of the local cultural environment. SISSA Medialab, an in-house company working on all forms of science communication, will aid with data collection as part of their interactive science-related activities with the community. Both children and parents will be sampled from the general local population and invited to participate in the study in a research space at the main train station of the city as well as in the SISSA laboratories. As previously tested by one of us, this space and citizen-science research format allows for a quicker

yet reliable data collection (comparable to lab-based evaluations) and will maximize the possibility of simultaneously testing parents and children. Compliance to the task and data quality standards will be achieved by implementing a 1:1 researcher-participant ratio. The total research time for each child-parent dyad will be 15 to 20 minutes. Two experimenters will simultaneously test the child and their parent to avoid cross-influences. To avoid the induction of disgust that can influence the response to the political scenarios,[58, 59] participants will be first asked to answer to the concrete and abstract scenarios in the same order, then they will undergo the olfactory task, then the behavioral test and finally they will complete the disgust sensitivity scale. Parents will provide their political ideology when all other tasks have been completed. This order of the tasks has been chosen to minimize the carry over effects of knowing that the focus of the research is on disgust.[60]

4.5 Data analysis plan

For each of our hypotheses, we will use the ttestBF functions in the *BayesFactor* package in R[61] to calculate Bayes Factors (BF). In each statistical analyses, we will estimate random effects regression models. We will interpret the sizes of BFs according to the recommendations in extant research.[62, 63] Exploratory linear mixed models performed with the *nlme* package[64] will also be conducted based on the results of the reported analyses. For the factor analyses, which will allow to determine the convergence of the disgust measures selected to evaluate their effect on political decisions, we will use the built-in R functions *prcomp()* and *princomp()*.

We will quantify the data from the VAS scale by reporting them a 1-mm distance from the left-anchor on a 10-cm line. We do not anticipate extreme outliers, given the nature of the measures. If any do occur, we will define them based on the 2.5 MAD rule and analyses will be run with and without outliers and significant differences will be reported. Considering the 1:1 participant-experimenter ratio, we do not anticipate many missing values. For those that will occur, we will exclude them list-wise.

To test our main hypotheses H_1 and H_2, we will run the following regressions:

$$y_c = \beta_0 + \beta_1 DS_c + \Gamma \boldsymbol{X_c} + \epsilon \tag{1}$$

$$y_p = \lambda_0 + \lambda_1 DS_p + \Lambda \boldsymbol{X_p} + \upsilon \tag{2}$$

where y represents immigration attitudes, DS represents disgust sensitivity (measured in four ways: olfactory disgust, self-reported disgust sensitivity, behavioral avoidance, and behavioral disgust), $\boldsymbol{X}$ represents a matrix of controls for demographics variables (e.g., age and gender), the subscript c denotes children and the subscript p denotes parents. We will run separate regressions for each our dependent measures of immigration attitudes (concrete and abstract questions) as well as for each of the four measures of DS. The main test of our hypotheses will be t-statistics for β_1 and λ_1 and a t-test of the difference between β_1 and λ_1.

5 Results and Discussion

To be completed once we have collected data.

Notes

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[37]If we have a sample size sufficiently powered to test for moderations, we will then test whether olfactory disgust ratings moderate the relationship between self-reported disgust sensitivity and political attitudes for both children and their parents. It is possible that individuals who react strongly to odors will show a stronger connection between their self-report level of disgust and their political attitudes, suggesting that when autonomic inputs and cognitive self-reports are aligned, self-reports do a better job predicting relevant attitudes than when they are not aligned.

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[46]We also conducted power analyses for paired t-test and correlations aimed at investigating the relative effects of children's and parent's disgust sensitivity on the formation of children's immigration attitudes. As noted above, these analyses will require a much larger sample size (N = 250 if the effect size is small, d = 0.10, at $\beta = 0.80$). For paired t-tests, the power analysis included the degrees of freedom set at 1. For correlations, we used a stretched beta prior with the hyperparameter Kappa. Since we had specific directional hypotheses, we constrained the BF to 6.

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