

Chapter 2

This Is How We Do It: Inductions, Methods, and Measurement in Disgust Research



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As indicated by the collection of works in this volume, research now suggests that disgust—a “forgotten” emotion—regarding objects, animals, foods, and the behaviour of others is an important influence on how people feel and act. Disgust predicts health behaviours, indices of mental health, and political attitudes. We have evidence from cross-sectional studies, prospective designs, and experimental studies, but what do we really know? More technically it seems, we know that self-report indices of a construct we think is probably disgust is correlated with certain outcomes. We know that when we show people images or videos we think are disgusting (or others have told us are disgusting), they score on our scales (and sometimes behave) in particular ways. Thus, in a very real sense, our confidence in the conclusions of those working with disgust is predicated on our confidence in the ways in which they induce, manipulate, and measure this “thing” we call disgust.

In contributing to what is now a fast-moving area of study, the following chapter will review and critically evaluate the common methodologies social scientists use in the conduct of disgust research. The purpose of this review is to “take stock” in how we study disgust, evaluate how our measures do (and do not) fit with our theories, and use these observations to provide guidance for ongoing methodological thought and development in the area. The chapter is broadly organised into two major sections—a section on the methods we use to induce (and measure) disgust in the laboratory and a section on how we study what appear to be relatively stable differences across people in the general tendency to get disgusted (or experience disgust as difficult). Observations, criticisms, and future directions are provided throughout the text. Note that *cross-population methods* such as those used in the study of the behavioural immune system are not covered here (see Tybur et al. 2014 for a recent overview).

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The Measurement of Dispositional/Trait Disgust via Self-Report

Overview and Description

As is common in the early studies of individual differences, most empirical work on disgust has concentrated on linking self-reported trait measures of responses to potentially disgusting stimuli to attitudinal, behavioural, and/or mental health outcomes. The list of outcomes associated with trait disgust as measured in this way is truly remarkable but would (in brief) include food preferences (e.g., Powell et al. 2019), taste sensitivities (Schienle and Schintl 2020), cancer screening frequency (Reynolds et al. 2018), cancer treatment side effects (Dev et al. 2020), the stigmatisation of people with cancer (Azlan et al. 2020), and mating strategies (Al-Shawaf et al. 2015), as well as attitudes towards immigrants, Muslims (Brenner and Inbar 2015), homosexuals (Kiss et al. 2020), and obese individuals (Vartanian et al. 2016; see also Vartanian et al., Chap. 10, this volume). Measures are slowly being adjusted for new groups such as children (Rottman et al. 2019), with recent adaptations to adult instruments (Muris et al. 2012) as well as novel child-specific measures (Viar-Paxton et al. 2015).

So far, so good. At a dispositional level, the tendency to get disgusted looks like it's "a thing," a stable aspect of functioning that is associated with outcomes in theoretically sensible ways. Our confidence in these findings is, however, only as good as the evidence and interpretations regarding the measures of dispositional disgust we employ. It is also worth remembering that disgust propensity and sensitivity (the "experience" of disgust) are latent constructs insofar as they may exist but cannot be directly measured. All self-report (and many other indices of disgust responding) must thus be thought of as representing what are sometimes termed "manifest" or "indicator" variables. They are thus indices of the latent disgust construct but inevitably measure it with a degree of error. Put simply, measures of a construct like disgust do not only measure this construct but also capture variation of other kinds. This places very real constraints on how confident we can be.

Below, the major measures of dispositional or trait disgust are briefly considered. Given the availability of good reviews in this area (Tybur, Chap. 6, this volume; Tybur and Karinen 2018), rather than exhaustively compile prior psychometric data (or advocate for one measure versus another), this information is used to illustrate the considerations that researchers might contemplate when choosing an instrument. In parallel, it serves as a reminder that the way in which we measure (or induce) disgust, and the confidence we have in interpretations, is interwoven with our notions regarding what we think disgust is, how it is instantiated or manifest in psychological (and other processes), and what we think it is for.

In addition to early trait discrete emotion measures measuring the tendency to feel a range of emotions (e.g., the Differential Emotions Scale [DES]; Izard et al. 1974), the last three decades have seen a steady growth in the availability of disgust-specific trait measures. Most are what we might term "domain" based, maximising scale

content validity and interpretability by assessing disgust as it arises in response to different classes of elicitor. In general, content in these measures have been developed based on a combination of self-reported disgust in response to theoretically viable elicitors (rather than theory per se), although some have placed a greater emphasis on sensory (e.g., Schienle et al. 2020) or theoretical considerations (e.g., Curtis and de Barra 2018). Established measures are described more fully below.

The Disgust Scale (DS; Haidt et al. 1994) was the first of the more focal and detailed indices. Developed on the basis of self-reported elicitors, the scale is a mixture of true–false and disgust-rating questions grouped into seven domains (food, animals, body products, sex, body-envelope violations, death, and hygiene). It has been adapted several times (see Tybur et al. 2014 for details), with each variant employing slightly different component and scoring procedures. The Disgust Scale–Revised (DS-R; Olatunji et al. 2007) removed seven items (including most of the sexual items) resulting in a more robust three-component—core, animal-reminder, and contamination disgust—structure that became the most widely used measure for several years. Perhaps in part because of structural concerns and the omission of moral disgust from the DS-R, the Three-Domain Disgust Scale was later developed (TDDS; Tybur et al. 2009). For this measure, participants use a 1 (not at all disgusting) to 7 (extremely disgusting) scale to rate 21 items from three domains—pathogen, sexual, and moral disgust.

Sitting slightly off to one side of the domain-based measures is a measure based around a different model of how disgust may manifest in dispositional functioning. Originally presented in 2006, the Disgust Sensitivity and Propensity Scale (DPSS; van Overveld et al. 2006), and the subsequent adaptation in the Disgust Propensity and Sensitivity Scale-Revised (DPSS-R; van Overveld et al. 2010), measures how easily an individual is disgusted (their disgust *propensity*) as well as how unpleasant they find the experience of disgust (disgust *sensitivity*).

Evaluating Measures of Dispositional Disgust: Things to Consider

Across the different measures, face validity and internal reliabilities are generally acceptable, as are studies of convergent and criterion validity (e.g., Karinen et al. 2021; Rozin et al. 1999), and test-retest reliability (e.g., Polak et al. 2019). There are relatively few studies of test-retest reliability. Available data suggest varied stability ranging from .48 for moral disgust to .79 for sexual disgust across 12 weeks (Olatunji et al. 2012), although timeframes are quite short (e.g., Jones et al. 2018). Nonetheless, studies to date seem to suggest that the items we typically think of as indexing disgust sensitivity are reliably grouped together and that scores are consistent across assessments. Conversely, perhaps the most serious challenges for trait disgust measurement lie in ongoing questions regarding issues of structural and discriminant validity. These issues are briefly considered below.

As a starting point, it is worth noting that trait measurements vary in the number of underlying components they suggest; between two (the DPSS-R) and five (the new German 5-FES, Eickmeier et al. 2019) components have been suggested. In considering what this variation might mean for the study of disgust, it is initially worth recalling that an instrument's structure reflects the empirical regularities across self-reported data points while the labelling of the resultant groupings reflects particular theoretical interests. Empirically, however, we are talking about groupings (subscales) of different disgust items that covary in some systematic way. The groupings that result from component analyses thus mostly tell us that people who are more (or more frequently) disgusted by a certain stimulus are also likely to report being more disgusted by another. Nothing more and nothing less.

There are, however, many reasons that individual disgust items will covary—response sets, social desirability, participant ability to discriminate, item phrasing and proximity, and semantic overlaps, to name but a few—that have nothing to do with the content itself (Podsakoff et al. 2012). Thus, although it is often forgotten, using self-report to generate the content of measurement (and data reduction to generate the structure) can lead to the development of measures that then “echoes” through the subsequent structuring of our theories—a form of what we might term *measurement primacy*. The “animal reminder” items in the DS-R, for example, shows clear reference to Rozin's earlier theoretical work, but might well be labelled and interpreted differently in the context of the TDDS. More broadly, while measurement considerations are clearly central to the scientific endeavour, they are not (and should not be) the only basis upon which to theorise about disgust. Think Freud's unconscious, plate tectonics, and, potentially, string theory—hugely useful theories even if unequivocal proof was initially (or remains) lacking.

The measure put forth by Curtis and de Barra (2018) provides an example of how difficult reconciling theoretical and psychometric considerations can be in disgust research. Their theoretical model suggested that elicitors should be grouped in a manner corresponding to six distinct pathogen transmission pathways. Factor analyses did not support the model, perhaps suggesting that the disgust system(s) are not structured in this way. Indeed, I am not suggesting that they are. What I am suggesting is that *even if* the underlying disgust systems *were* structured in this way, there is no guarantee that this structure would be reflected in the structure of a self-report measure (see also Armstrong et al. 2021 on this and related issues). Clearly, we need reliability, factorial generalisability, and construct validity in our measures. Equally clearly, however, we should not forget that measures are, first and foremost, a tool and a frequently imperfect one at that. Choose wisely and avoid being bewitched by internal reliabilities and structure.

Relatedly, it is worth noting that while most trait measures are *content* based, content groupings are not the only possible way to structure elements of trait disgust. The DPSS-R, for example, is purported to index how easily an individual is disgusted (*propensity*) as well as how unpleasant they find it (*sensitivity*). Although the distinction is theoretically plausible and appears to have utility in clinical samples, like the content-based measures (Campbell et al. 2020), studies of the DPSS variants' structure have returned somewhat mixed results (e.g., three versus

the expected two components for the DPSS-12 in Goetz et al. 2013), with at least some evidence suggesting shorter versions may be more robust (Fergus and Valentiner 2009).

A second concern with the measurement of trait disgust regards separating it from other aspects of dispositional functioning. Although there are exceptions (see Tybur, Chap. 6, this volume), measures of trait disgust are reliably associated with other “negative” aspects of personality functioning (Oosterhoff et al. 2018; Tybur and Karinen 2018). In one meta-analysis, for example, disease avoidance traits (including both trait disgust and germ aversion) were associated with neuroticism, conscientiousness, openness to experience, and extraversion (Oosterhoff et al. 2018). Other studies have linked disgust sensitivity with political conservatism, anxiety, trait negative affectivity, depression, orderliness, and intuitive thinking, to name but a few. Perhaps more problematically, emotions tend to covary (Consedine and Moskowitz 2007). Both trait and state disgust covary with multiple emotions including fear, anxiety, embarrassment, and anger (McCambridge and Consedine 2014; Muris et al. 2008; Russell and Giner-Sorolla 2013). The question, of course, is how serious these associations are and how should we think about what they mean.

The magnitude of the correlations between disgust and other indices varies across studies. Some data suggest moderate correlations between indices of trait disgust and neuroticism (e.g., Druschel and Sherman 1999), while others suggest correlations less than .20 between disgust/germ aversion and personality factors (Oosterhoff et al. 2018). However, even if we are willing to tolerate this level of covariation as either (a) reflecting shared method characteristics or (b) inconsequential (both possibilities), there is nonetheless reason to be cautious. First, the problem may be more pronounced in particular domains, notably in studies of moral judgment where anger and disgust are often quite closely associated (e.g., Olatunji et al. 2012; see also Giner-Sorolla, Chap. 8, this volume) and in health (below).

Second, there is a sense in which contrasting indices of trait disgust with global personality or affective measures risks being a straw man test of what the problem actually is; demonstrating that trait disgust is only modestly correlated with *global* aspects of personality functioning is not a particularly convincing test of discriminant validity. Predictively, it may be that some specific (rather than general) emotional factor is conflating findings, but that its effects are “hidden” within the noise of a general measure of negative affectivity or neuroticism. Certainly in studies of emotion, our studies psychometrically “bundle” potential affective confounds within measures of general negative affectivity and then demonstrate that either that (a) disgust is only weakly associated with negative affectivity or (b) that disgust is a better predictor of outcomes (e.g., Olatunji et al. 2011). My suggestion here is that rather than uncritically assume our measures of disgust are separate from other measures or bundle multiple affective constructs together as some form of “control” variable, we should be identifying specific and likely confound candidates and carefully measuring them.

This issue has been grappled with for some time in studies of avoidance in healthcare. The problem here is that the same stimuli that elicit disgust in health settings (e.g., a stool collection procedure, some sort of bodily insertion) also

concurrently elicit embarrassment and fear (and perhaps shame). Of equal import, all of these emotions appear to have evolved, at least in part, because they promote avoidance (Consedine and Moskowitz 2007). Being sure that it is disgust specifically that is responsible for avoidance in such scenarios is thus exceedingly difficult, both conceptually and in terms of measurement. In one study, for example, Reynolds et al. (2018) found that fear and embarrassment regarding bowel screening were correlated with indices of faecal and insertion screening disgust at levels between .50 and .80 and with trait negative affects at approximately between .25 and .40; all emotion indices were correlated with screening outcomes. Thus, while these particular data reflect feelings about very specific stimuli (rather than general dispositions), they also show how multiple, closely-related emotional responses can potentially underpin the same outcome.

In making this comment, I am by no means suggesting that our measures of trait disgust are not dispositional. They probably are. Recent evidence suggests that self-other agreement is quite high (r 's of .36, .46, and .66 for moral, pathogen, and sexual disgust sensitivity, respectively), implying that self-reported sensitivities are reliably detected by others (Karinen et al. 2021). I am, nonetheless, suggesting that we must not become complacent in our thinking about the problem posed by discriminant validity where emotional responding is concerned. A significant number of studies simply measure elements of trait disgust and correlate scores with outcome without considering the very real conceptual and practical implications that walk hand-in-hand with the associations between disgust and other emotional responses. Evidence from studies of morality and health suggest an ongoing need to test the discriminant validity of dispositional measures of disgust from other specific elements of trait emotionality (rather than general aspects).

Domain Specific Disgust Measurement

As disgust measurement has matured and researchers have begun to more systematically pin down how disgust relates to outcomes in particular domains, the literature has also seen the parallel emergence of domain specific disgust measures. In some ways this development is the logical extension of the “content” or domain-based measurement that predominates, the assumption being that disgust regarding particular stimuli should (on balance) better predict behaviour or attitudes to that stimuli than more general measures. To the extent that emotions likely evolved to motivate behaviour regarding the elicitor (Consedine and Moskowitz 2007), the possibility that disgust sensitivities in particular domains are differentially associated with the motivation to avoid specific classes of elicitor is important for both theoretical and practical reasons.

In this line, measures have been developed to assess disgust specifically regarding *food* using either verbal self-report (Hartmann and Siegrist 2018) or pictures (Ammann et al. 2018) and there are multiple measures in colorectal cancer. Several groups have used the Emotional Barriers to Bowel Screening scale (EBBS, used by

Davis et al. 2017, and Reynolds et al. 2018) which provides separate indices of faecal and insertion disgust. Others have developed the ICK-C scale (used by O'Carroll et al. 2015, and Chambers et al. 2016) or, more recently, a two component (core and interpersonal disgust) measure of colostomy specific disgust (Jin et al. 2020). Interestingly, early evidence suggests some utility to more specific measures. In one study, for example, disgust regarding having something inserted into the body (but not faecal disgust, embarrassment, or fears about outcome) predicted the odds of having had an invasive bowel test in the last 5 years (Reynolds et al. 2018). Although such findings may reflect covariation created by shared measurement characteristics or language, they also stand in contrast to experimental findings which tend to suggest a relatively domain neutral effect to disgust inductions. The question of how *precise* the avoidant, risk-minimising adaptations comprising the disgust system are remains an area of active inquiry. Do indices of disgust regarding specific elicitors actually index a construct that is distinct from general sensitivities and are they a better predictor of outcomes? Answering such questions has the potential to substantially advance our thinking not only about measurement but also about the nature of disgust itself.

Concluding Remarks

Overall, while these comments may raise as many questions as they answer, the measurement of trait disgust has come no small distance—quiet confidence in the increasing maturity of measurement is warranted. Further, the sorts of considerations we should be giving weight to in choosing a measure are becoming increasingly clear. In addition to considering basic psychometric indices, researchers should use contextual theory and their specific research foci to determine the instrument best-suited to testing particular hypotheses (see Tybur et al. 2014). Further, it seems increasingly likely that particular measures, tapping into particular sensitivities or content, will be better suited to predicting (and perhaps explaining) variation in particular types of attitudinal and behavioural outcomes.

Inducing and Measuring Disgust in the Laboratory

Overview and Characterisation

In part because disgust is thought to produce avoidance in both physical (Reynolds et al. 2019) and mental (Deacon and Olatunji 2007) health contexts, experimental studies in which disgust is validly and discriminantly *induced* are critical to the advancement of the field. The question, of course, is how to go about inducing and measuring disgust in ways that are best suited to answering the complex questions disgust research entails. Perhaps because nearly all of the pathogens that disgust

evolved to counteract are too small to be directly observed, humans rely on indirect (and imperfect) sensory cues for their potential existence (Rottman et al. 2019). Textures, smells, noises, tastes, and visual cues that map onto aspects of the stimuli that historically posed a contamination threat are thus all potential induction modalities for the disgust researcher. More to the point in terms of the current chapter, and as in emotion inductions in general (see Siedlecka and Denson 2019), each means of inducing disgust has a mixture of conceptual and design advantages, some of which can be considered in advance (see Table 2.1).

Although mixed manipulations have been undertaken, most inductions occur via a single sensory modality, typically via visual (Culpepper et al. 2018) or olfactory routes (e.g., Reynolds et al. 2014; Tybur et al. 2011; see also Liuzza, Chap. 7, this volume). Cover stories designed to increase attention or post-hoc checks are sometimes used. Newer technologies have been incorporated, including use of virtual reality visual paradigms (e.g., Ammann et al. 2020) or pseudo-word stimuli (e.g., Darcy and Fontaine 2020) to elicit disgust. Other studies have used olfactory inductions (e.g., McCambridge and Consedine 2014; Reynolds et al. 2014; Tybur et al. 2011) or autobiographical narrative/imagination-based inductions that have people imagine contact with disease threats, such as mucus (e.g., White et al. 2013). Few studies have manipulated disgust through auditory, gustatory, or tactile means (although see Oum et al. 2011).

Content in visual stimuli includes wounds, rotten foods, vomit, faeces (e.g., Ammann et al. 2020), bodily products (Shenhav and Mendes 2014), watching a video of people eating animal eyeballs (Aldao and Wisco 2015), and similarly appetising entertainments. Pictures drawn from the International Affective Picture System (IAPS; Lang et al. 1999) are used, as are sets of images devised by Curtis et al. (2004), Haberkamp et al. (2017), and Culpepper et al. (2018). Other researchers use idiosyncratically developed sets with content varying from depictions of “immoral” sexuality, insects, bodily products, or disgusted faces. Film stimuli are similarly diverse and have included dissections, faeces or vomit, and painful injuries (e.g., Vianna and Tranel 2006). Sometimes visual cues are juxtaposed with information about disease threats (e.g., Ackerman et al. 2009).

Evaluating Disgust Induction Modalities: Things to Consider

As might be expected, different induction modalities offer distinct blends of advantages and disadvantages to researchers. Compared to other induction modalities, visual stimuli are advantaged insofar as they are available in standardised and previously validated sets, can be directly assessed for face validity, permit high control over conceptual content (e.g., contamination versus sexual stimuli), are remotely deliverable, and are potentially capable of being “dosed” and/or sustaining a disgust response for a period of time (see Simpson et al. 2006 on the issue of elicitation modality and time course). Conversely, however, designs employing visual stimuli are likely weaker in terms of participant blindness and demand.

Table 2.1 Preliminary assessment of design strengths and weaknesses of disgust induction modalities

Modality	Efficacy	Availability	Standardisation or control	Participant blindness	Experimenter blindness	Can be dosed?
Visual	++	++	++	—	++	Probably
	++	++	++	—	++	Probably
Olfactory	++	++	++	+	—	Probably
Audio	?	?	++	?	?	?
Tactile	?	?	++	?	?	?
Gustatory	+	?	++	?	?	?
Mental	++	++	+	—	++	Possibly
	++	++	--	--	++	?

Note: ++ = strong; + = modest; — = poor; -- = weakest; ? = unknown; comments on dosing are speculative

Ratings demonstrating the effect of the experimental manipulation are typically made regarding either stimuli themselves (i.e., how do you feel about these pictures?) or about feelings during stimuli exposure (i.e., how did you feel when you were looking at the pictures?), increasing the odds that participants become aware of and respond to experimental expectation. Put simply, it may be difficult to prevent participants gradually coming to realise that disgust responses are central to the study when stimuli are obviously curated to elicit disgust. Attempting to hide this fact via cover stories and/or burying disgust terms in longer lists of affective adjectives are the most common attempts to mitigate this problem but how successful they are is unknown. Despite these limitations, visual elicitation of disgust is the most common modality and, at least according to some writers, the most effective way to manipulate disgust in a controlled manner (Siedlecka and Denson 2019).

Induction of disgust via olfaction is increasingly common. In olfactory induction studies, the manipulation is often covert or not explained/justified to participants who, at least in theory, are less likely to suspect that odours form part of the experiment. Studies of this kind include Schnall et al. (2008) in which olfactant was sprayed into bags lining an outdoor trash receptacle, a technique also used in several laboratory studies (e.g., Fong and Sündermann 2020; McCambridge and Consedine 2014; Perone et al. 2020; Reynolds et al. 2014, 2015; Rottman and Kelemen 2012; Tybur et al. 2011). The most commonly used olfactant is a novelty spray called “Liquid Ass”™ which is non-hazardous but has a distinct faecal aroma. Three sprays of this product appears to be the modal “dose” but variations in space, ventilation, and participant proximity to the olfactant necessitate pilot testing.

Compared to visual inductions, inducing disgust via odour has several distinct advantages. With careful titration of the dose (pilot testing is a must!), it increases the odds of maintaining participant blindness, though (for obvious reasons) experimenter blindness can be difficult to maintain. Depending on the specific research foci, it may also be that there are advantages to eliciting disgust “directly” rather than requiring (as is the case with visual inductions) some cognitive mediation; detecting likely pathogen presence via olfaction may be taken as indexing the presence of a disease threat with an immediacy that is lacking in visual images. Finally, it is possible that olfactory manipulations offer a more precise manipulation in which disgust alone is impacted (e.g., McCambridge and Consedine 2014). Reynolds et al. (2014), for example, used an olfactory manipulation and specifically tested for effects on other avoidance-producing emotions; there were no effects on either fear or embarrassment.

However, in contrast to visual inductions, olfactory inductions may see the experimenter lose control over the duration of the exposure (via dissipation or, potentially, olfactory habituation processes) as well as the “content” of the disgust elicitor, something that may be important when grappling with questions in specific domains (discussed below). In addition, the extent to which odours elicit disgust may be conflated with individual differences in olfactory sensitivity (see e.g., Chan et al. 2020), allergies, viral infections, and/or smoking history is not entirely clear. Olfactory methods will likely require more extensive pilot testing, facilities must often be ventilated between participants, designs require the blocking of experimental and

control sessions (to prevent cross-condition contamination), and, of course, dedicated space in which experimental odours will not interfere with the research of others. Trust me on this one.

Autobiographical recall of disgusting events seems to reliably induce disgust (Lane et al. 1997), as do imaginary exposures. Some studies use vignettes, asking participants to narrate descriptions of incest or contact with bodily waste (e.g., Ottaviani et al. 2013). However, while they may reliably induce disgust, there are some limitations. Perhaps most prominently, demand is almost certainly higher than in other modalities for the simple reason that participants are specifically asked to recall a disgusting event. Control is also lower insofar as different people may choose to recall different events that will vary widely in content as well as in severity. Finally, it is not clear that participants are actually disgusted in that moment versus *having being disgusted* when the event actually occurred. No disease or contamination threat is currently present and the risk is that we end up correlating a mental representation of historical/expected feelings with another representational outcome (e.g., an attitude). This possibility noted, Siedlecka and Denson's (2019) review suggests both autobiographical and imagery methods may impact physiology, although whether physiological changes are specific to disgust is not yet clear.

In contrast to developing literatures regarding these methods, studies using audio or gustatory pathways to induce disgust are almost non-existent. According to Siedlecka and Denson's (2019) review of emotion induction methods, certain noises (burping, flatulence, and vomiting sounds) *may* increase disgust, but the review only references a single study (Marzillier and Davey 2005) in which noises were *combined* with imagery and recall. Gustatory and tactile inductions are similarly uncommon; anecdotal data from experienced disgust researchers suggest that such noises are often experienced as humorous, at least by university students. One study reported using consumption of a bitter drink to increase disgust (Adolph and Pause 2012) and tactile stimuli with wet or biological consistency appear more disgusting than dry/inanimate consistencies.

Overall, while it has been claimed that visual elicitation is the best technique for disgust elicitation while situational manipulations (including olfaction) are the worst (Siedlecka and Denson 2019), my own sense is that the issue is far from settled. A recent meta-analysis of 50 moral judgment studies (Landy and Goodwin 2015), for example, found that olfactory inductions had a stronger effect than visual disgust inductions. More broadly, core questions that have deep implications for how we think about disgust are yet to be tested. Does induction modality matter in terms of how disgust manifests in the different response subsystems? Can different modalities be "dosed" differently or do they have different time courses? What about habituation? How long can we elicit disgust in controlled ways without habituation effects? Does the *content* of visual disgust inductions matter in terms of the effects on attitudes or behaviour? Quite clearly, we do not know. What seems clear is that the choice of induction modality is a complex trade-off between how important control, blindness, resources, the content of elicitation, and the specific questions at stake are.

Stepping back slightly further, we can see that disgust induction studies have some interesting but potentially troublesome commonalities. Typically, in such approaches, visual or olfactory stimuli validated as being disgusting are presented (sometimes with a cover story and sometimes without), the manipulation is verified via statistical analyses of self-reported disgust, and the effects on psychological and behavioural processes tested. So, for example, in one recent study (Stewart et al. 2020), participants used a 100-point visual analogue scale to indicate how disgusted they were by images of dog faeces, vomit, or a cold sore. The resultant differences between experimental and control conditions was taken as evidence that the “stimuli that were used in this study powerfully induced the experience of disgust with a Cohen’s d of 1.91” (Stewart et al. 2020, p. 6).

To this point, the causal-experimental logic seems quite reasonable. However, while reporting and interpretations of this kind are *technically* accurate, because no other emotional responses were measured, we cannot be certain that any effects on outcomes (in Stewart et al. 2020, on “scrupulosity”) is caused by disgust per se rather than by other negative emotions that were inadvertently also elicited. Recent works have highlighted the difficulties inherent to validly measuring state emotion in laboratory studies (Weidman et al. 2017). In addition to issues with construct and face validity and use of single item measures (see Weidman et al. 2017), covariation and co-elicitation of negative emotions are common (McCambridge and Consedine 2014; Siedlecka and Denson 2019) making it difficult to determine which of several covarying negative emotions is causally responsible for effects (Consedine and Moskowitz 2007; Reynolds et al. 2018; Suls and Bunde 2005). Common emotion inductions such as eating chocolate might induce happiness, but also guilt. Similarly, consuming a bitter beverage might induce surprise in addition to disgust (Siedlecka and Denson 2019).

While there are exceptions (e.g., McCambridge and Consedine 2014), this issue pervades experimental emotions work. It may, however, be of particular relevance to studies of disgust because (a) avoidance or a negative judgment of some kind is so often the outcome of interest and (b) so many emotions (including disgust) evolved because they facilitate this type of function. Avoidant behaviour following a disgust induction can easily reflect the influence of other inadvertently induced emotions. Suffice to say that researchers must start more systematically measuring the effects of experimental manipulations in a way that permits the exclusion of competing (affective) explanations. This requires greater thought than merely obscuring target affect(s) and maximising blindness by hiding disgust terms amongst additional adjectives. Instead, conceptually viable confounds should be specifically targeted, measured, and proven to be irrelevant to the target effects of the manipulations.

Relatedly at a methods level, it is not yet clear which class of induction modality best discriminantly induces disgust rather than a mixed emotional response and/or whether induction modality matters for the magnitude or duration of the induction. Visual stimuli might initially appear have the advantage, at least at some levels, of being able to discriminantly induce disgust rather than other emotions, but, as has been discussed above, this is not entirely clear. Less debatably, because stimuli are comparatively simple, pictorial stimuli may offer a greater degree of control over

content; we can examine the effects of disgust regarding particular domains of stimuli. Video stimuli offer a greater degree of complexity and naturalism, but seem likely to induce a more differentiated emotional response. These observations noted, we simply do not know and, until we do, the above comments stand: we must carefully choose modalities and stimuli as well as measure the confounding presence of other emotional responses that are likely or conceptually important.

Measuring Disgust Outside of Self-Report

Disgust researchers have recognised the inherent limitations of self-report and, in many cases quite creatively, adapted existing methods or developed new methods to index disgust more objectively. A short list of alternate measurements would include salivary responses (Proctor and Carpenter 2007), facial coding (Ekman and Friesen 1979), facial electromyography (Chapman et al. 2009), electrogastrography (Meissner et al. 2011), and fMRI (Jabbi et al. 2008), which are periodically used. Obviously, the choice of index depends on the research question(s). However, objective indices are often used primarily to increase certainty regarding elicitation.

Perhaps surprisingly, however, the disgust face is not reliably produced when feeling disgust (e.g., covertly filmed students smelling urine did not necessarily show disgust, Gilbert et al. 1987) and neural localisation of emotional responses remains unlikely (Chapman and Anderson 2012). As importantly, such indices are design expensive, requiring expertise, time, and specialised equipment. A simpler (and cheaper) solution is to more routinely incorporate the measurement of behaviour into disgust study design. Disgust was selected in evolution because it promoted rejection and withdrawal from pathogens, yet it is these same behaviours that are often the most problematic. Studies have tested willingness to engage with apparently contaminated or disgusting objects such as maggots, dirty clothing, ostensibly used stomas (e.g., Reynolds et al. 2014; Stevenson et al. 2010) or indexed the desire to maintain seating distance (Reynolds et al. 2015; Vartanian et al. 2016).

Again, however, interpretative caution is needed. Behavioural avoidance or rejection can reflect emotions other than disgust (Rottman et al. 2019; Stevenson et al. 2010) and key questions remain unclear. For example, most experimental studies rely on disgust inductions that are *incidental* to the target of any subsequent judgment or behaviour. That is to say, we disgust our participants (say, using images of mutilation) and then assess behaviours or processes that are completely unrelated—the disgust is not necessarily “about” the issues that are being investigated. So, for example, people become more opposed to gay marriage when disgusted by an odour (Adams et al. 2014). It may be that disgust acts relatively non-specifically in terms of increasing the avoidance of potential threats, but it could also be that we’re not testing this question properly. According to Tybur et al. (2014), while tactile cues to pathogens (e.g., touching something wet or viscous; Oum et al. 2011) might lead to a stronger “pull away” responses than, say, olfactory cues, key questions remain unanswered. Are all methods eliciting

(a) the same basic response and/or (b) are different induction modalities activating a response that is differentially manifest in different components of the disgust response?

Concluding Remarks

Although studies of disgust are stretching their slightly sticky fingers into an increasingly wide range of research crevices, there is a very real sense in which our field remains young. Yes, the tendency to be disgusted appears trait like and relatively stable but questions regarding how important the differences between possible classes of core, sexual, contamination, and moral elicitors remain. Yes, we can reliably induce disgust and index disgust in controlled experimental settings but whether the eliciting modality matters (and for which outcomes) is a mystery to this point. Other methodological questions (e.g., regarding the dosing of disgust induction and response) are yet to be seriously asked. Methods and measurement are not truly distinct from our theories and there is a very real need to critically consider the implications the former has on the latter. Methods themselves must be scrutinised in the same way that we would examine, test, replicate, and verify any other phenomenon. Too often, we latch onto a measure or method that is widely used and has reasonable face validity and interpret is as “disgust” without thought or reflection. Ultimately, we must decide whether we want to evaluate and develop our tools or whether we are willing to let empirical regularities and covariation “drive” our thinking about this most intriguing of emotions.

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