



## Psychological and social factors associated with wastewater reuse emotional discomfort



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### ARTICLE INFO

#### Article history:

Available online 7 February 2015

#### Keywords:

Wastewater reuse  
Disgust  
Emotion ideology  
Exposure

### ABSTRACT

Wastewater reuse (WWR) technology has improved greatly in recent decades and may be an important solution to global water challenges. Nevertheless, several psychological and social barriers to widespread adoption still exist. Negative emotional reactions to WWR, known as the “yuck factor,” have been identified as central to public acceptance. The present study used a large, context-neutral, web-based, U.S. sample ( $N = 207$ ), to examine factors underlying these negative emotions, here measured as discomfort felt toward WWR. We used a more nuanced measure to isolate what aspects of disgust sensitivity predict discomfort and then explored this relationship in the context of other individual and psychological differences. Being female, having less education, and being particularly sensitive to pathogen-related disgust stimuli, all were factors that were significantly and independently associated with reported discomfort. Mediation analysis showed that women felt greater discomfort because of higher levels of pathogen disgust sensitivity.

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### 1. Introduction

Wastewater reuse (WWR) is a key strategy for the conservation of finite water resources. It is increasingly important to consider and implement such approaches, given the mounting pressure on fresh water reserves from population growth, pollution, and climate change (see review in [Jury & Vaux, 2007](#); [Vorosmarty et al., 2010](#)). Despite the advantages for the environment and public health, WWR is often only adopted in dire circumstances and as a last resort. Public acceptance has been found to be critical to the success of plans to reuse water (e.g., [Chen, Ngo, & Guo, 2012](#); [Rodriguez et al., 2009](#)). In several cases, public opposition alone has overturned municipal plans even for indirect potable reuse ([Lejano & Leong, 2012](#)). A significant amount of research has addressed the issue of public acceptance through a variety of methods – extensive reviews of which can be found in [Mankad and](#)

[Tapsuwan \(2011\)](#) and [Po, Kaercher, and Nancarrow \(2003\)](#). Within this body of work both qualitative and empirical studies have found that negative emotional reactions are important for acceptance at the individual and societal level ([Marks, Cromar, Fallowfield, & Oemcke, 2003](#); [Nancarrow, Leviston, Po, Porter, & Tucker, 2008](#)). For example, public campaigns opposing WWR plans are often framed in terms of disgust (e.g., the “toilet to tap” framing in Los Angeles and Australia’s “Citizens Against Drinking Sewage”) ([Hurlimann & Dolnicar, 2010](#); [Lejano & Leong, 2012](#)). Despite the acknowledged role that negative affect plays in determining attitudes toward WWR, the exact nature of these emotional reactions and how they relate to other psychological and individual differences is not well understood.

The broad concept of negative emotional reactions to water reuse is known in the literature as the “yuck factor” and has been identified in a number of studies. In a large-scale survey, structural equation modeling was used to identify important explanatory variables in determining intended behaviors around water reuse (including trust, subjective social norms, perceived control, and emotional aversion). In that study an individual’s emotional reaction toward water reuse was one of the strongest predictors ([Nancarrow et al., 2008](#); [Nancarrow, Leviston, & Tucker, 2009](#); [Po](#)

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et al., 2005). The degree to which an association between WWR and disgust is made apparent on a semantic level also impacts acceptance. For example, the description “recycled water” elicits more acceptance than “treated waste water” (Menegakia, Mellonb, Vrentzoua, Koumakisa, & Tsagarakisc, 2009), and “purified water” is preferred to “recycled water” (Leovy, 1997). Some have argued that a focus on the “yuck factor” in the literature may be counter-productive as it ignores cultural strategies for increasing acceptance (Russell & Lux, 2009). However, others such as Mankad (2012) argue for the importance of better understanding aversive emotional reactions to decisions about decentralized water technology, such as WWR. Mankad also notes the role that psychological research can play in determining the mechanism of such emotions in order to further strategies for communication and broader public acceptance.

This approach is supported by research demonstrating the important role of emotions in decision making more broadly (see review in Weber & Johnson, 2009). Further, anticipated emotions have been found to be important to a variety of ecological behaviors ranging from choices about public transportation (Carrus, Passafaro, & Bonnes, 2008), views about climate change (Ferguson & Branscombe, 2010), and decisions about recycling (Smith, Haugtvedt, & Petty, 1994). Theoretical models of decision-making have been used to explore choices about other water-related environmental decisions such as conservation behaviors (Corral-Verdugo, Carrus, Bonnes, Moser, & Sinha, 2008). Some factors in these models, such as an individual's beliefs and attitudes, may be related to emotion (Seyranian, Sinatra, & Polikoff, 2014) and positive emotional reactions to communication strategies about water conservation have been related to the effectiveness of those strategies (Marandu, Moeti, & Haika, 2010). Often the anticipated emotions found in the relation to environmental behaviors take the form of anticipated regret or pride at the idea of violating or conforming to existing environmental and social norms. For a relatively more controversial environmental issue such as water recycling, anticipated emotions may be more complex and thus a more nuance understanding of what underlies them may be even more important for gaining insight into public attitudes and decisions.

### 1.1. Emotion and decision-making

Relative to cognitive processes, which are comparatively slower and more deliberative, affective or “emotional” processes are fast and automatic, making them particularly important in the face of complex tasks that require rapid responses (Kahneman, 2003). Emotions act to focus attention, to motivate both cognitive and behavioral reactions, to provide information about the situation and potential consequences of actions, and to allow for easier evaluation of complex situations (Weber & Johnson, 2009). How emotion specifically impacts any particular decision will vary based on which emotion is elicited (Lerner & Keltner, 2000), whether the emotion is “immediate” (i.e., occurring at the moment of decision making) or “anticipated” (i.e., what one expects to feel about potential future consequences of a decision) (Mellers, 2001; Zeelenberg, van Dijk, & Manstead, 1998), and whether the emotion is perceived as being directly relevant to the situation or incidental (Lerner, Small, & Loewenstein, 2004). In particular, anticipated emotions, can direct and prioritize cognitive processes (Armony, Servan-Schreiber, Cohen, & Ledoux, 1997), impact behavioral intention and goal formation (Baumgartner, Pieters, & Bagozzi, 2008), and act to form heuristics for decision making (Baumgartner et al., 2008; Zeelenberg, Nelissen, Breugelmans, & Pieters, 2008).

Emotions are generally categorized as having either a positive or a negative valence, and can be characterized by the intensity

(representing the degree of arousal) with which they are experienced. Specific emotions have been theorized to map onto two broad behavioral patterns, including approach or avoidance tendencies (Elster, 1998; Higgins, 1997). Considering specific emotions that fall within these overarching classifications, research has demonstrated that even emotions of the same valence can lead to significantly different patterns of attitudes, perceptions, and behavior. For example, sadness and disgust, two negative emotions, motivate opposing strategies in economic buying/selling scenarios. Sadness triggers behaviors that will increase one's holdings such as increased buying activities and lowered willingness to sell. In contrast, disgust prompts behaviors consistent with “purging” – less willingness to buy/acquire new things and increased willingness to sell (Lerner et al., 2004).

Disgust, the emotion most likely underlying the negative affective reactions to water reuse, could pose a unique challenge to WWR adoption due to the natural function this basic emotion performs (Haidt, McCauley, & Rozin, 1994; Tybur, Lieberman, & Griskevicius, 2009). Researchers have found that there are three different “types” of disgust: disgust toward substances harboring disease-causing organisms (pathogen disgust); moral disgust toward inappropriate sexual partners or acts (sexual disgust); and disgust toward socio-moral violations (moral disgust). These different disgust systems are distinct both behaviorally and biologically (Borg, Lieberman, & Kiehl, 2008; Tybur, Bryan, Lieberman, Hooper, & Merriman, 2011). Although the assumption could be made that pathogen disgust underlies negative reactions to WWR, the exact nature of how these different disgust domains are related to WWR has not yet been examined in the literature. Gaining a greater understanding of the specific facet of disgust most strongly associated with affective responses, as well as how this factor may relate with other individual differences linked with WWR acceptance/refusal could inform how WWR campaigns tailor their messages to the public. The ‘yuck factor’ may be more easily overcome if messaging focuses on the most relevant aspects of disgust and if that messaging is targeted at the sectors of the public most discomforted by water reuse.

### 1.2. Other factors important to WWR acceptance

Another question that has not been answered in the extant literature, is whether the “yuck” factor (i.e., disgust) explains any variance in WWR acceptance above and beyond other demographic, experiential, and ideological variables. For example, past research has indicated that women, the elderly, and those with less education tend to view risks associated with WWR as greater than other demographic groups, though this finding is not entirely consistent across the literature (Mankad & Tapsuwan, 2011; Po et al., 2003; Robinson, Robinson, & Hawkins, 2005). Drinking tap water (as opposed to filtered or bottled water) was important for predicting a stated intention to drink recycled water but not for an intention to vote for recycled water scheme (Gibson & Burton, 2013). Current or future water shortage has also been found to be a factor in determining people's willingness to use recycled water, with acceptance being shown to correlate with water scarcity and experiences of water restrictions (Bakopoulou & Kungolos, 2009; Bakopoulou, Polyzos, & Kungolos, 2010; Dolnicar, Hurlimann, & Grun, 2011). Ideological variables implicated in WWR acceptance include moral beliefs about the fairness of a water reuse plan (Nancarrow et al., 2009; Wilson & Pfaff, 2008) or the religious purity of the practice (Alhumoud & Madzikanda, 2010; but see Wilson & Pfaff, 2008 for a study finding no religious objection).

A related consideration is the manner in which the predictors of WWR acceptance might relate to one another. For example, research within social psychology has demonstrated that disgust

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