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Fear and Disgust in Childhood: Emotion Understanding, Attentional Processes, and Children's Responses to Potential Threat

Author
Parsafar, Parisa

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Fear and Disgust in Childhood: Emotion Understanding, Attentional Processes, and Children's Responses to Potential Threat

A Dissertation submitted in partial satisfaction
of the requirements for the degree of

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in

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by

Parisa Parsafar

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Dissertation Committee:
Dr. Elizabeth Davis, Chairperson
Dr. Ariel Dinar
Dr. John Franchak
Dr. Mary Gauvain
Dr. Tuppett Yates

The Dissertation of Parisa Parsafar is approved:

Committee Chairperson

University of California, Riverside

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DEDICATION

To my parents for always pushing me to believe in myself,

follow my dreams, and do my best.

ABSTRACT OF THE DISSERTATION

Fear and Disgust in Childhood: Emotion Understanding, Attentional Processes, and Children's Responses to Potential Threat

by

Parisa Parsafar

Doctor of Philosophy, Graduate Program in Psychology
University of California, Riverside, September 2019
Dr. Elizabeth Davis, Chairperson

Fear and disgust are both evoked in response to a potential threat and motivate a broad range of behaviors and beliefs but knowledge of children's experiences and understanding of these two emotions as different is limited. The purpose of this dissertation was to a) examine age-related differences in children's differentiation of fear and disgust, b) investigate whether children's attention differs across a disgust or fear context and relates to individual differences in how children understand and experience these emotions, and c) examine whether individual differences in important aspects of emotion development relate to children's emotions and beliefs about a potential threat with real-world implications – tap water.

To capture fear and disgust intensity, 69 four- to seven-year-old children were interviewed about how scared and disgusted typical fear and disgust elicitors made them feel. Children were interviewed about their water-related preferences, emotions, and beliefs. To capture orienting, total looking duration, and disengagement attention processes, children's visual attention towards and away from a disgust OR fear-relevant stimulus during a free-play episode was recorded. Children were invited to approach/engage with evocative items and rated the intensity of their fear and disgust towards each. Children's differentiation of fear and disgust was captured by correlating fear and disgust intensity ratings for the items presented hypothetically (interviews) and in person.

Findings revealed that age did not relate to differentiation of fear and disgust. Children differentiated between fear and disgust more strongly when responding to disgust than fear elicitors and when asked about them hypothetically (interview) than in person. Attention patterns across the fear and disgust contexts were similar and did not relate to reported experiences of fear or disgust, or children's preferences, negative emotions, and beliefs about tap water. Children who reported more intense fear and disgust and those who demonstrated less awareness of the distinctions between fear and disgust reported more negative emotions towards tap water. Understanding of fear and disgust and their appraisals of tap water as potentially threatening should be addressed early in development to promote more sustainable water solutions and greater acceptance of tap water.

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Chapter 1: Introduction

People encounter potential threats that can evoke feelings of fear or disgust like eating expired foods, online dating, sharing beverages, driving at night, meeting a growling or slobbering dog, entering a dark or grimy space, or encountering a disfigured or sick stranger every day. The way potentially threatening situations are interpreted and responded to shapes a broad range of attitudes, beliefs, and behaviors (e.g., food preferences, race biases, political ideologies, hygiene and health-related behaviors, morality, acceptance of recycled water; Curtis, De Barra, & Aunger, 2011; Haidt, 2003; Rozin & Fallon, 1987; Lilienfeld & Latzman, 2014; Oaten, Stevenson, & Case, 2009, Prinz, 2007). Although these diverse outcomes are crucial consequences of how people understand and experience their emotions, little empirical work has sought to clarify how people understand specific types of threats to be different – such as those that should be disgusting and those that should evoke fear. Both fear and disgust are evident very early in development, so a clearer understanding of how children differentiate between these distinct manifestations of potential threat would contextualize the developmental costs and benefits of the wide range of preferences, beliefs, and behaviors that arise in response to each of these emotions.

Perceived threats that have the potential to result in personal harm may evoke disgust or fear, depending on an individual's interpretation of the situation. Although the adult literature has placed substantial focus on understanding the psychological and behavioral consequences of exaggerated fear reactions, less work has focused on disgust and surprisingly little research has investigated how children's understanding and experiences of these two important negative emotions develop. Individual differences in adults' emotional responses to perceived threats are linked to outcomes as diverse as political ideologies, racial biases, and even consumer behaviors (Banks & Hicks, 2015; Curtis, De Barra, & Aunger, 2011; Haidt, 2003; Lilienfeld & Latzman, 2014; Liu, Lin, Xu, Zhang, & Luo, 2015; Royzman, Cusimano, & Leeman, 2017; Rozin & Fallon, 1987; Prinz, 2007), but comparing how fear and disgust relate to children's responses to potentially threatening situations they encounter in everyday life has not been tested.

Despite the fact that both fear and disgust are felt early in development in response to potential threats, the majority of research on children's fear and disgust responses has focused primarily on dysregulation of either emotion and the links to mental health problems (Buss & Kiel, 2013; Kessler et al., 2005, 2007; Olatunji, Cisler, McKay & Phillips, 2010; Olatunji, Lohr, Sawchuk, & Tolin, 2007). Rarely are the joint or dissociable consequences of fear and disgust on children's developmental outcomes examined together, with the exception of one research group that largely focuses their work on understanding older children's (e.g., ages 9 -14) risk for animal phobias (de Jong, Andrea, & Muris, 1997; Muris, Huijding, Mayer, Leemreis, Passchier, Bouwmeester, 2009; Muris, Mayer, Huijding, & Konings, 2008). The purpose of this dissertation is thus to improve understanding of young children's experiences of fear and disgust. In particular, this work aims to clarify children's early understanding of these distinct threat-relevant emotions and investigate whether individual differences in children's understanding and experiences of fear and disgust carry developmental consequences for children's preferences, emotions, and beliefs about potential threats they encounter in their own lives.

Findings from the mental health literature suggest that attentional processes play a causal role in how children experience negative emotions (Amir, Beard, Burns & Bomyea, 2009; MacLeod & Mathews, 2012). For example, children who more rapidly orient their attention to a potential threat (e.g., an angry face) are more likely to demonstrate social anxiety symptoms later in life – tying early individual differences in attention to emotion dysregulation (Pérez-Edgar, Bar-Haim, McDermott, Chronis-Tuscano, Pine, & Fox, 2010; Schechner et al., 2012). Attention processes control whether evocative information is attended to initially and whether it is processed further or ignored (Perez-Edgar, Taber-Thomas, Auday, & Morales, 2014). Thus attention is believed to serve as a gateway to subsequent emotional and cognitive processing. Orienting attention towards an evocative stimulus (e.g., a novel toy) can increase children's emotional reactivity, sustaining attention on it can maintain reactivity, averting gaze away from a stimulus can reduce reactivity, and withdrawing gaze completely can produce an inactive state (Rothbart & Derryberry, 1981). Thus, attention patterns carry consequences for children's emotional responding.

A separate adult literature has also documented that people show different patterns of attention in response to different types of threats. For example, when presented with images of a fear-relevant threat, like a spider, people are faster both to notice/detect the threat and to disengage attention from it, compared with other types of evocative images (e.g., children crying). In contrast, when presented with a disgust-relevant threat like vomit or feces, slower attentional disengagement has been documented (Cisler, Olatunji, Lohr, & Williams, 2009; Van Hooff, Devue, Vieweg, & Theeuwes, 2013). Together, this work suggests not only that distinct attention patterns are reflective of different types of emotional experiences but also that individual differences in attention within each emotional situation (e.g., when being presented with a fear- versus disgust-relevant stimulus) may relate to the intensity with which children subjectively experience that negative emotion. Thus, one way to understand children's experiences of fear and disgust is to document the patterns of attention during emotionally challenging contexts and examine how these patterns relate to the intensity with which they experience disgust or fear. To date, no studies have compared how children's attention differs in disgust versus fear contexts, nor how children's attention patterns might relate to their experiences of these two threat-relevant emotions.

Children's patterns of attention in response to a fear or disgust elicitor and their individual differences in their experiences of fear and disgust should have consequences for development beyond the realm of mental health. For example, among adults, disgust sensitivity has been linked to avoidance of drinking tap water and rejection of novel wastewater reclamation technologies (Rozin, Haddad, Nemeroff, & Slovic, 2015; Schmidt, 2008). Health-related fears regarding the safety of tap water have been linked to recent surges in plastic bottled water sales throughout the United States (Gungor-Demirci, Lee, Mirzaei, & Younos, 2016), suggesting that individual differences in fearfulness play a role in these avoidance behaviors. Some literature suggests that avoidance of tap water and beliefs that tap water is unsafe to drink develop early.

Hispanic parents report greater illness-related concerns associated with drinking tap water and are significantly less likely to ever offer tap water to their children within the home, despite its lower cost, ubiquity, and dental-health benefits for children (Hobson et al., 2007). Hispanic and black children are, in turn, more likely to perceive a greater risk to drinking tap water (Onufrak et al., 2014). Among Hispanic youth, beliefs concerning water-fountain safety are associated with greater intake of sugary sweetened beverages at school (Onufrak et al., 2014) which is linked to obesity. Accumulating evidence thus suggests that children's emotional reactions to tap-water usage/wastewater reclamation attitudes and behaviors carry consequences for their health (e.g., dental health and obesity) and pose an environmental/societal cost. Work that illuminates how children's understanding and experiences of fear and disgust uniquely contribute to their water consumption attitudes and behaviors can help to refine campaigns and education programs aimed at increasing public acceptance of sustainable water solutions and healthy behaviors.

Comparisons of fear and disgust emotional responses are rare. Empirical studies comparing factors that influence differential responses to fear and disgust elicitors in childhood, such as the understanding of the differences between these two emotions, are even rarer. Thus, I first summarize the separate literatures on the functions of fear and disgust to provide theoretical support for my claims of their dissociation. A main aim of the current study is to investigate the basic foundational question of whether there are age-related differences in the extent to which children differentiate between fear and disgust in childhood. I chose to focus on children across ages 4-7 because there are substantial changes in cognitive abilities (e.g., attentional control, children's understanding of conservation) during this period which likely influence age-related differences in children's capacity to differentiate between fear and disgust.

The extent to which children differentiate between fear and disgust should reflect their appraisals of the types of threats they perceive (e.g., more or less disgusting or scary; equally disgusting and scary). Therefore, differentiation should relate to other indices of children's emotional experiences like how they direct their attention in a potentially threatening context and how intensely they feel fear and disgust. Thus, in the second section I review findings on the development of fear and disgust understanding in childhood. Discussion of the differences between fear and disgust and children's differentiation of these two emotions should serve as a guide for understanding differences in children's attentional patterns and emotional responding across disgust or fear relevant contexts.

Attention patterns (e.g., orienting, disengagement) differ based on whether people are exposed to fear or disgust relevant photos or words suggesting that fear and disgust can motivate different attention patterns (Cisler, Olatunji, Lohr, & Williams, 2009; Van Hooff, Devue, Vieweg, & Theeuwes, 2013). Attention processes can serve as a gateway to subsequent emotional responding and cognition so how people's attention is managed in an emotional context should also reflect individual differences in their emotions and thoughts (Perez-Edgar et al., 2014; Perez-Edgar et al., 2017; Raymond, Fenske, & Tabassoli, 2003; Todd, Cunningham, Anderson, & Thompson, 2012; Ochsner & Gross, 2005). For example, maintaining attention on a potentially threatening item should sustain or enhance negative emotions whereas withdrawing attention from the item should reduce negative emotions. Thus, children’s attention patterns should in general differ across a disgust or fear context but also, individual differences in children’s attention patterns (e.g., how long they look at something, how quickly they turn attention towards or away from it) should relate to individual differences in their emotional responding – the intensity and extent to which each child feels different emotions. A secondary aim of this dissertation was thus to compare children’s attention patterns in a fear or disgust-relevant context to determine whether they differ and examine whether they relate to children’s emotional responding. I therefore also investigated how individual differences in children’s attention processes in a fear or disgust context related to individual differences in their subjective experiences of fear and disgust. In the third section I therefore review research findings on attentional processes relevant to emotion experiences with an emphasis on what is known about how attention patterns vary in response to fear and disgust elicitors.

Finally, there is growing interest in understanding how threat-relevant emotional responses motivate attitudes and behaviors influencing practical aspects of daily functioning (Lilienfeld & Latzman, 2014). In the fourth and final section I review the emerging literature that indicates the roles of fear and disgust in public acceptance of waste-water reclamation technologies and water consumption behaviors (Gungor-Demirci, Lee, Mirzaei, & Younos, 2016; Rozin, Haddad, Nemeroff, & Slovic, 2015; Schmidt, 2008). I argue that the factors that influence fear and disgust responses in childhood should also play a role in the development of water-related preferences, emotions, and beliefs. Thus, a final study aim is to examine whether the specific facets of children's experiences of fear and disgust that I chose to contextualize and clarify – differentiation of fear and disgust, attention patterns in a disgust or fear context, and individual differences in the intensity of children's fear and disgust experiences -- relate to children's drinking water preferences, emotions about drinking tap water, and their beliefs about whether or not tap water is contaminated.

How Do Fear and Disgust Differ?

Fear and disgust share a negative valence but are discrete emotions. Discrete emotions are more than just distinct subjective feelings (e.g., feeling "disgusted" or "afraid"); they are triggered by distinct appraisals with relevance for different types of goals (Campos, Mumme, Kermoian, & Campos, 1994; Ellsworth & Scherer, 2003). For example, cues that signal a disease-carrying stimulus (e.g., a slobbering dog) appraised as posing a pathogenic contamination risk (e.g., bacteria transmission) threaten health-related survival goals (e.g., illness) and evoke disgust. Stimuli that are appraised instead as posing a risk of immediate bodily harm (e.g., a growling dog) threaten immediate physical safety/survival goals (e.g., being bitten) and evoke fear. Different appraisal-goal connections trigger distinct patterns of coordinated responses (e.g., behavioral responses, expressions, cognitive processing) that result in a brief change in state– reflecting the experience of a discrete emotion.

Functions of fear and disgust. Fear and disgust belong to the "basic" discrete emotion category in that they evolved to help organisms deal with similar types of commonly experienced situations and are experienced and expressed universally (Ekman, 1992; 1999). To maintain species survival goals, evolutionary accounts hold that discrete emotions were shaped by natural selection processes which fine-tuned appraisal and response systems so that people could adapt to different environmental circumstances and challenges (Nesse & Ellsworth, 2009; Scherer, 2001). Fear and disgust are believed to have evolved in response to different predicaments – both are responses to threat, but threats that differ in kind. Thus, they should differ with respect to the cues that elicit them but there also may be some overlap in the evoked patterns of their concomitant processes (e.g., attentional, motivational, behavioral responding).

Fear. Fear evolved as part of the mammalian defense system (Ohman, 2008) and is an adaptive response to the appraisal of an immediate, acute threat of *bodily damage* (e.g., predator, aggressive conspecifics, physical events like falling) that triggers rapid mobilization of the body's resources to protect itself from physical pain and impending harm (Muris, 2010; Nesse & Ellsworth, 2009; Plutchik, 2003). Fear can be thought of as a post-stimulus reaction, a response to an already present and immediate threat in situations that are perceived as difficult to control (nimh.nih.gov, n.d.; Ohman, 2008; Rachman, 1998). In order for fear to have provided an adaptive benefit, the coordinated concomitant processes that accompany fear must motivate response patterns that support efficient escape and removing oneself from the situation – in other words, fear should promote harm avoidance in this type of acute, immediate threat context. The majority of empirical findings suggest that fear engages responses that allow for rapid visual detection of threats at early stages of attention processing, and initiates rapid circumvention of harm through processes that engage escape and avoidance behaviors.

Disgust. In contrast to fear, which helps protect the body from immediate physical damage (e.g., tissue or organ damage), disgust appears to have initially evolved to protect against the threat of oral ingestion or exposure to toxic chemicals (e.g., distaste) and then to further protect against the threat of contaminated materials with disease/infection potential (Curtis, de Barra, & Aunger, 2011; Rozin, Haidt, & McCauley, 2008). Disgust protects against contact with such materials by promoting an urge to distance oneself from the offensive content. This can include increasing physical distance or engaging in hygiene behaviors to avoid contamination contact (e.g., using toilet paper, wearing gloves, washing hands; Oaten et al., 2009). In this way, disgust can function as a means of illness/disease/pathogen prevention (Porzig-Drummond, Stevenson, Case, & Oaten, 2009). *Core* disgust is evoked in response to cues (e.g., rotting smell, mold, sores, mushy textures, colors) that specifically signal a pathogenic threat and functions to repel and prompt avoidance of these threats. There is general consensus that core disgust elicitors include body products (e.g., vomit, feces), contaminants (e.g., mud, dirt, molds) and small animals (e.g., maggots, cockroaches). Some theorists also believe that death, body envelope violations (e.g., mutilation), contact with strangers, and hygiene disgust elicitors (e.g., hair) serve a pathogen avoidance function and should be considered in the core disgust category (Tybur, Lieberman, Kurzban, & DeScioli, 2013) whereas others believe these encompass a category of disgust elicitors known as "*animal reminder disgust*" that reflect an evolutionary broadening of disgust elicitors to include those that serve as reminders of our animal nature (Rozin, Haidt, & McCauley, 2008). Regardless of whether disgust in response to these types of elicitors functions to remind us of our animalistic nature or minimize our contact with disease carrying stimuli, we know that children as young as 2-3 years of age will demonstrate behavioral avoidance of disgust elicitors that fall under these categories (body products, contamination, small animals, death, body envelope violations, stranger contact, and hygiene disgust; Stevenson et al., 2010) and I therefore focus on this category of disgust elicitors in this investigation. Note that sociomoral disgust represents a final category of moral and sex-related disgust elicitors that I will not examine, because this may be qualitatively different from the other disgust elicitor categories (Chapman & Anderson, 2012) and is not consistently present in early childhood.

The distinct functions of fear and disgust suggest that fear should evoke a cascade of processes supporting rapid detection of visual cues and recognition that these cues signal an impending threat, to motivate quick behavioral responses. For example, detection and interpretation of sharp bared teeth as a signal of an impending attack by a vicious predator – a fear relevant context -- should require very little effort and happen almost immediately in order to promote efficient escape/avoidance of harm. Utilizing greater cognitive resources and time to decide whether a behavior or animal is predatory/aggressive or not can be incredibly costly (e.g., evolutionary fitness; processing an oncoming animal as a dog instead of a wolf when out hiking and failing to escape in time) whereas the survival cost of making rapid threat-detection decisions and generalizing fear-cues to other similar stimuli is low (e.g., mistakenly identifying a dog as a wolf when out hiking and protecting yourself is much less problematic).

In contrast, the threats that evoke disgust are less imminent. Disgust cues may not demand immediate visual detection and rapid responses to the same extent as fear cues. If disgust did initially serve to prevent ingestion of harmful substances, then it might be evolutionarily adaptive for disgust to prompt a slower behavioral response and more delayed, careful information processing to allow time to consider the benefits and consequences of engaging with the threat. For example, determining whether something is edible or contains a contaminated element (e.g., food can still be eaten despite a bruise or speck of dirt) likely requires more cognitive processing, which would prompt a more delayed visual disengagement and behavioral avoidance response. This added time for more in-depth inspection and appraisals and a cost-benefit analysis before responding may be beneficial for survival. Many disgust elicitors might not result in immediate death but induce mild sickness, a risk that might be worth it under certain conditions (e.g., lack of fresh water, hunger, famine). Furthermore, greater cognitive processing supports the ability to recognize, identify, and recall cues that signal which substances or foods are safe to eat or not when encountering them again in the future. Indeed, whereas fear prompts response biases and an increased likelihood to classify a benign stimulus as threatening, disgust relates to an enhanced recognition effect for visual stimuli (Wiens, Peira, Golkar, & Ohman, 2008). Thus, fear and disgust are both threat-relevant emotions but signal different types of threats that vary along several important dimensions (e.g., severity of the threat, consequence of engaging with the type of threat, controllability of threat), and are associated with different visual attention, appraisals and behavioral patterns.

Avoidance behaviors associated with fear and disgust. Behavioral responses to emotional situations can be divided into two main motivational systems, responses more driven by the behavioral approach system, which includes tendencies to approach/move towards something, and those more driven by the behavioral inhibition system, which includes tendencies to avoid/withdraw and move away from something (Carver, 2006; Gray, 1981). These approach and inhibitory motivational systems are governed by different underlying neurobiological circuitry (Carver, 2006) and the extent to which they are enacted varies across emotions (Gable, Neal, & Threadgill, 2016; Harmon-Jones, Price, Gable, & Peterson, 2014). Negative emotions that are accompanied by avoidance behaviors, like fear and disgust, prompt greater and predominant activation of the behavioral inhibition system (Carver, 2006; Gable, Neal, & Threadgill, 2016). In addition to these broad approach/inhibition motivation systems that underlie behavioral responses to emotions, another dimension of emotion, *motivational intensity,* reflects the extent to which the emotion evokes tendencies for action and also influences typical behavioral responses.

Fear and disgust are both avoidance-related emotions (activating the behavioral inhibition system), but are also both high in motivational intensity in that they both motivate a strong tendency for avoidance actions (Gable & Harmon-Jones, 2010; Keltner, Gruenfeld, & Anderson, 2003). With respect to underlying motivation systems, fear is associated with a strong activation of the behavioral inhibition system (Carver, 2004). Although fear can be accompanied by freezing and attack responses, its most characteristic actions center on avoidance and escape behaviors, which support the goal of circumventing harm (Ohman & Mineka, 2001). Much less work has examined the extent to which behavioral inhibition systems underlie disgust although there is some support for their connection (Gable, Neal, & Threadgill, 2016). Few studies have compared activation of motivational systems or avoidance responses (e.g., increasing physical distance, behavioral avoidance, freezing behaviors) across fear and disgust contexts. Although avoidance of both disgust- and fear-eliciting stimuli is adaptive for survival, fear might require more rapid and extreme response actions than disgust-relevant stimuli by nature of the different kinds of threats the stimuli pose. Thus, it is possible that fear would give rise to greater behavioral avoidance responses like increasing physical distance from evocative stimuli than does disgust.

Children's Understanding of Fear and Disgust

Disgust and fear are both negative, high-intensity emotions that are evoked in response to a perceived threat, but a large part of what distinguishes these two negative emotional experiences is awareness of the type of threat posed and its ramifications (e.g., immediate bodily harm vs. pathogenic/contamination threat). Whereas children might perceive both fear and disgust elicitors as threats (e.g., something bad to avoid) – as demonstrated by children's early (e.g., toddlerhood) *behavioral* avoidance of both fear and disgust elicitors (Buss & Goldsmith, 1998; Kiel & Buss, 2011; Stevenson et al., 2010) -- findings from a broad literature suggest that a certain level of cognitive sophistication may be required before children can fully appreciate the nuances that support full-fledged awareness of how disgust differs from fear.

Development of fear and disgust elicitors. The ontogeny of children's appraisals of items or situations as fear or disgust evoking reflects shifts in children's emotion understanding and coincides with changes in children's cognitive development. These developmental patterns support the idea that a fuller understanding of fear develops before disgust across the transition from early to middle childhood.

What evokes fear? Although a few studies have examined children's behavioral responses to different elicitors, the majority of work on the development of typical fears in childhood has relied on parent-reports and child interviews (Gullone, 2000). Findings suggest that the ontogeny of children's fearful responses (and then appraisals) to common fear elicitors corresponds to problems that children face at different maturational stages (Muris, 2010) beginning with those that concern physical harm/danger and are most evolutionarily relevant to survival. For example, loud noises and the presence of strangers elicit fear responses in infancy (e.g., startle, behavioral avoidance), when children face developmental challenges including biological regulation, attachment with social partners, and object permanence. Across toddlerhood (age 2-3) as children make gains in locomotion and begin imaginary play, fears of animals and imaginary creatures develop. Thus, by three years of age children already demonstrate fear responses to several types of evolutionarily-relevant elicitors that signal a danger to bodily harm. In early childhood (~ age 3 to 6 years) increasing autonomy and self-regulation abilities coincide with fear of the dark and storms. And as they enter middle childhood (~ 6 to 7 years), children's abilities to infer causation increase, as does their ability to anticipate outcomes – fears of death and bodily harm by more modern threats (e.g., being hit by a car, war) become more common (Burnham, 2005). Thus, fear responses to elicitors that pose concrete threats to bodily harm exhibit precocious development, perhaps reflecting implicit learning through children's own experiences. The early emergence of fears in response to concrete elicitors that have immediate consequences and can be informed by personal experiences (e.g., pain from falling or being bitten by an animal) suggests that a rudimentary understanding of fear requires little cognitive processing and experience to learn. Across childhood, the range of fear elicitors expands, demonstrating the increasing role of cognitive processing to incorporate fears that are more abstract and are elicited by more hypothetical understanding of "what if" situations (antecedents) and consequences (e.g., death, for a review, see Burnham, 2005, or Gullone, 2000).

What evokes disgust? Although infants make disgust facial expressions when presented with putrid smells, supporting the view of disgust as a universal, primary emotion (Steiner, 1979), less work has focused on the development of responses to disgust elicitors in childhood. Interestingly, investigations of feral humans demonstrate that they do not show signs of disgust (Malson, 1964/1972), implicating the role of social learning processes in disgust responding because if they are not taught, disgust responses do not appear to develop. Beyond irritant smells, which irritate chemoreceptors in the nose and elicit distaste, human infants also do not reject pathogenic disgust-relevant elicitors (e.g., feces, vomit) or avoid typical "disgust elicitors" until around 2.5 to 3 years of age.

Stevenson and colleagues (2010) sought to illuminate the developmental sequence of disgust responses by utilizing both parent-report and behavioral methods. They divided elicitors into the three main categories proposed by Rozin, Haidt, and McCauley (2008) -- core disgust (e.g., dirt/filth and mold, stinky smells, body products like feces and vomit, small animals like maggots and cockroaches), animal reminder disgust (e.g., body envelope violations, death, hygiene), and sociomoral disgust (e.g., swearing at an elderly person, littering). Using parent-report assessments, the authors found that disgust responses to core disgust elicitors were evident by an average age of 3 years, and animal-reminder elicitors evident by age 4, with sociomoral disgust demonstrating a protracted development, emerging around age 7. As well, children were shown stimuli representing the different categories of disgust elicitors to examine coherence between behavioral avoidance of these stimuli and parent-report measures (e.g., to investigate whether disgust responding followed the same sequence as reported by parents; core first, then animal, followed by sociomoral). An important finding was that the developmental sequence depended on the method. Disgust facial expressions suggested that core elicitors prompt disgust by age 2.5 and age 6.8 for animal-reminder elicitors, yet both core and animal-reminder elicitors prompted behavioral avoidance by age 2.5. By contrast, self-report measures suggested that children develop dislike for core disgust elicitors by age 2.5, animal elicitors by age 4.5 and sociomoral elicitors by age 6.8. Thus, as early as 2.5 years of age, children are demonstrating avoidance responses of disgust elicitors and by 6.8 years of age, children are demonstrating avoidance responses, some facial disgust expressions, *and* reporting that they dislike both core and animal-reminder disgust categories. This suggests that as they approach middle childhood, children appear to demonstrate more complex disgust responses, supporting the idea that their understanding of disgust is improving.

Understanding of fear and disgust. Emotion understanding reflects children's comprehension of facial expressions and situations, awareness of what causes different emotions, and abilities to label, communicate, and predict one's own and others' emotions (Denham, 1986; Denham, Zoller, & Couchoud, 1994). Children's emotion understanding supports their comprehension of emotion concepts (e.g., understanding what sadness, happiness, and fear are) which develops rapidly over childhood. Prior work reveals that children acquire emotion concepts in a stage-like manner (Widen, 2013). Emotion differentiation models suggest that children first *understand* emotions with respect to their broader dimensions such as positive vs. negative and low vs. high arousal (e.g., very good and very bad) but rapidly begin to differentiate between the specific categories of basic emotions (e.g., sadness, happiness, anger, surprise, fear, disgust) across the period that spans preschool to the beginning of middle childhood (Stein & Levine, 1989; Widen & Russell, 2008).

Previous work with two- to five-year-old children revealed that accuracy in labeling facial expressions and situations evoking happiness, sadness, and anger emerges before accuracy for fear and disgust -- with labeling of disgust emerging latest (Widen & Russell, 2003). A paper that reviewed the literature on children's emotion understanding suggested that accuracy in labeling fear expressions increases rapidly across ages 2 – 6 whereas accuracy in labeling of disgust expressions increases more rapidly after age 5 (see Widen, 2013 for a review). Thus, recognition of (and broader understanding of) disgust may follow a more protracted developmental course. In two studies, two- to five-year-old children were told stories about made up characters describing typical causes and consequences of different categories of emotional experiences (walking down the street and being chased by a dog) and their task was to provide an emotion label for what the character was feeling. Children demonstrated the lowest accuracy for labeling disgust situations, followed by fear-relevant situations (Widen & Russell, 2010a, 2010b) suggesting that recognition of the situations that evoke disgust (compared to fear, anger, or sadness) develops last among the basic negative emotions.

In another study, 4- to 10-year-old children were presented with either photos with facial expressions (e.g., a scared face) or stories that described the causes and consequences specific to an emotion (e.g., Fear: "Joan was walking down the street when a big dog started growling and chasing her. Joan screamed and ran away as fast as she could") and asked to label the basic emotion that matched the facial expression or story (Widen & Russell, 2010). Children were more likely to correctly label fear and disgust specifically when presented with stories describing the antecedents and consequences of emotional situations, rather than the facial expressions. This indicates that children's understanding of the differences between emotions is deepening as a result of their developing awareness and comprehension of the antecedents and consequences of experiences. This understanding appears to be driven less by children's ability to correctly identify cues (such as facial expressions) that signal how one should feel – a skill that develops later.

Together, the literature described above suggests that concepts of fear develop before concepts of disgust, and children do not begin to differentiate more fully among the different basic negative emotions until closer to middle childhood. Importantly, nuanced understanding of emotions and therefore feelings of fear and disgust requires understanding of the causes/antecedents and consequences of different emotional experiences – cognitive abilities that are developing rapidly across the transition from early to middle childhood (for a review see Widen, 2013). The antecedents and consequences of fear-relevant stimuli are relatively less complex to understand than those of disgust stimuli, which might be why conceptual understanding of fear appears to emerge earlier than disgust. For example, common fear elicitors include threats that represent a potential for bodily harm. The consequences (pain) can be felt immediately once in contact with a fear elicitor, thus learning an association between a potentially harmful stimulus and pain (e.g., the consequence), resulting in fear, can happen through one's own personal experience (e.g., via classical and operant conditioning) and can develop implicitly requiring little cognitive effort or awareness (Ohman, 2008; Raio, Carmel, Carrasco, & Phelps, 2012). Although early fears can also be influenced by social learning processes (e.g., infants use social referencing to decide whether an ambiguous situation is safe, Klinnert, Emde, Butterfield, & Campos, 1986), social learning mechanisms are not *necessary* for many types of typical fears to develop or for children to demonstrate a fear response (e.g., freezing).

In contrast, core disgust is often evoked in response to pathogenic threats with less immediate harm consequences than fear (e.g., they can make you ill) and the consequences of contact with a disgust-elicitor are often not immediate or visible. An appraisal of a disgust elicitor as serving a pathogenic threat requires a connection between the stimuli or disgust cue and later illness (e.g., if you ingest mold you could be sick hours later). Disgust might therefore require more delayed and careful processing (Wiens, Peira, Golkar, & Ohman, 2008) than fear to grasp its negative consequences (e.g., consuming a substance can result in eventual illness, slow deterioration due to substances that cannot be seen) and thus requires greater cognitive sophistication to recognize and understand what it means to be disgusting than recognizing and understanding what makes one afraid. Among adults, disgust facilitates significantly better memory recall for items than fear, which is not accounted for by response biases (e.g., difference is not due to false alarms), supporting the idea that disgust requires and promotes greater cognitive processing than fear (Chapman, Johannes, Poppenk, Moscovitch, & Anderson, 2013).

Previous scholars have suggested that an adult-like feeling of disgust requires understanding of the antecedents of a disgusting situation and their consequences (Rozin & Fallon, 1987). Children therefore need to understand the concepts of contagion (e.g., coming in to contact with something that has germs on it can make you sick) and conservation of matter (e.g., germs can still be on a tissue after someone has used it even if they cannot actually be seen) – cognitive abilities that do not begin to come online until children are around 4 to 5 years of age (Hejmadi, Rozin, & Siegal, 2004; Siegal, 1988). This might explain why children under the age of five have difficulties differentiating disgust from fear (Widen & Rusell, 2013) – in part because they do not yet have the cognitive capacities to comprehend conservation of matter.

However, Stevenson and colleagues (2010) demonstrated that even children without understanding of contagion or conservation of matter demonstrate behavioral avoidance of disgust elicitors, similar to adults. Stevenson also showed that responses to disgust elicitors can be transmitted from mother to child and that mothers use exaggerated responses to disgust elicitors when with young children. Thus, children may demonstrate avoidance behaviors, not because they understand and appraise the items as "disgusting," specifically, but because they have been socialized to think that the item is bad and should be avoided. It is important to point out and consider that just because children avoided something does not mean that they understood or were aware of the properties of these elicitors that made them "disgusting." Given the research on children's development of emotion understanding described above, another plausible explanation could be that young children have some implicit understanding that disgust elicitors pose a threat and are "bad" and thus avoid them or have negative reactions to them, but this does not provide evidence of understanding of what it means to feel "disgust" specifically. Indeed, the ontogeny of responses to disgust elicitors – first behavioral avoidance, then facial expressions and reported dislike – suggests that more full-fledged understanding of what disgust is and feels like is developing alongside children's abilities to grasp conservation. Children's understanding of contagion or conservation may still be necessary precursors of the full knowledge of what makes an item disgusting – knowledge that should help children differentiate disgusting from scary items. But whether knowledge of contagion and conservation of matter is required to be able to understand the nuances of what makes something disgusting but not scary has not been tested.

With the exception of distaste responses which are documented in infancy (e.g., a puckering face when a noxious substance is placed on the tongue or under the nose; Rosenstein & Oster, 1988), determinations of what is disgusting and behavioral reactions to disgust elicitors varies considerably by culture. To illustrate, some cultural groups create new products to distance themselves from contact with fecal matter (e.g., gloves, toilet paper, doggie bags) whereas others use animal feces in their construction of their living structures; some exterminate cockroaches whereas others eat them as food. From an evolutionary perspective, disgust responses likely reflect different environmental demands (e.g., selection pressures) that humans face across the globe (Tybur, Lieberman, Kurzban, & DeScioli, 2013). Implicit assessments of the cost/benefits of contact with potential disease-carrying stimuli influence what is considered "disgusting" across cultures and again suggest that sophisticated understanding of the antecedents and consequences of potential disease-carrying stimuli is required for a complete full-fledged disgust experience. For example, the idea of eating the rotting flesh of a dead animal (e.g., a stimulus with smell, sights, textures that signal disease potential) might evoke strong disgust in areas where food is bountiful but individuals who live in areas where food is scarce and preparing food is more difficult might care more about the nutrients and calories that this food source can provide and disgust is less likely to be evoked. Environmental circumstances thus constrain implicit cost/benefit analyses and how much weight is given to the consequences of engaging with a pathogenic threat (e.g., risking illness from drinking dirty water vs. dying of thirst), impacting appraisals of pathogenic risk and what is therefore disgusting.

Together, the above literature provides some evidence that a fuller understanding of what it means to feel fear vs disgust depends on children's level of cognitive development. Specifically, children's abilities to differentiate disgust from the other negative emotions appears to increase more rapidly after age 5. In early and middle childhood, children's conceptual understanding of fear and disgust improves and should be reflected in the extent to which they can differentiate between the experience of these two threat-relevant emotions. Whether children's understanding of contagion and conservation of matter are necessary precursors for differentiating between feelings of fear and disgust has not been examined.

Earlier I explained how different negative emotional experiences are associated with different concomitant processes (e.g., attentional, motivational, behavioral). A question remains as to whether the extent to which children differentiate between their experiences of fear and disgust relates to attentional processing patterns in a fear or disgust context that are stereotypic of that emotion context (e.g., quicker attention orienting and disengagement in a fear context; slower disengagement in a disgust context).

Visual Attention Processes Relevant to Emotional Responding

A main goal of this dissertation is to investigate how children's attention patterns vary across fear and disgust contexts and relate to their emotional responses. Attention is considered the gateway to further emotional and cognitive responding because attention controls what information is selected for further processing (e.g., stored in memory, learning) and thus also what is ignored (Perez-Edgar et al., 2014; Perez-Edgar et al., 2017; Raymond, Fenske, & Tabassoli, 2003; Todd, Cunningham, Anderson, & Thompson, 2012; Ochsner & Gross, 2005). Because fear and disgust signal different types of threats, attention processing for each emotion context should be specific, to allow responses that are most adaptive for each threat. Indeed, findings from several studies suggest differences in attention patterns within fear and disgust contexts.

Attention orienting processes in fear and disgust. Two attention-related processes that carry consequences for emotional responding and have been shown to differ in response to fear versus disgusting stimuli are attention orienting (directing attention towards a target stimulus) and disengagement (the ability to disengage attention from a target stimulus), which differ across fear and disgust emotion contexts.

Fear. People show rapid tendencies to associate threat-relevant stimuli like snakes and spiders with fear (DeLoache & LoBue, 2009; LoBue & DeLoache, 2008), and an automatic bias to orient attention more quickly to these types of threat-relevant information, thus exhibiting shorter latencies to fixate attention on a fear-relevant stimulus (LoBue & DeLoache, 2008, LoBue, Rakison, & DeLoache, 2010). Snakes and spiders are both agentic threats that have the potential to puncture skin, causing bodily damage, and thus pose an immediate threat to survival. This faster detection of fear-related content is in line with the view that fear instantiates processes that support rapid responding to promote survival in threat-relevant situations and is in line with empirical work demonstrating that fearful expressions enhance visual sensory processing. More rapid attention orienting, allowing quick detection of fear-relevant stimuli would suggest that fear elicitors are processed more rapidly and require less effort to assess the threat they pose.

Using an innovative computer-based visual search task, LoBue (2009, 2010) found that both adults and young children display more rapid attention orienting (and thus detection) of various categories of fear-relevant stimuli. LoBue (2009) presented 5-year-old children and adults with a 3x3 array of emotional faces. On each screen, participants were instructed to find a target face (e.g., angry and thus threat-relevant) among 8 distractor faces (e.g., neutral, sad, happy). She found that all ages demonstrated faster detection of threat-relevant target angry and frightening faces than less threat-relevant happy or sad faces, thus suggesting faster attentional orienting to threat-relevant stimuli in early childhood. Findings were replicated in other studies utilizing other stimuli that pose evolutionary threats, revealing that even preschoolers show superior attention orienting to target snakes (LoBue & DeLoache, 2008) than threat-irrelevant targets.

This facilitated attention orienting is also typical when detecting spiders (LoBue, 2010). In one study, preschool aged children and adults were presented with a similar 3x3 array involving spiders, cockroaches, and mushrooms. Findings suggest that attention orienting to spiders is more rapid than orienting to both cockroaches and mushrooms, for which reaction times did not differ. This last part is particularly interesting, as cockroaches are often included as disgust-relevant stimuli but in this study were not categorized as such. So, this finding might also suggest that whereas fear-relevant stimuli are attended to and thus detected more quickly, even in early childhood -- this rapid detection might not be true for disgust-relevant stimuli.

Disgust. Parallel to fear-related stimuli, other work using a computerized Stroop color naming task suggests that disgust-relevant information might also evidence biased attention. After priming students with disgust, threat, or neutral stories, Charash and McKay (2002) presented them with disgust (e.g., vomit), threat (e.g., fear, coma, tumor) and neutral words (pedal, moonlit). Participants were asked to match the color of the presented words (5 different options—red, blue, green, brown, and purple) by responding to buttons of different colors on a keyboard. Students demonstrated longer latencies to respond to the word's color when presented with disgust words than neutral words. Latencies for responding to fear and disgust words did not differ, yet people were not slower to respond to the fear words than neutral words. Thus, the authors concluded that findings indicate the presence of an attentional bias for disgust-related words. Yet, it is important to point out that some of the fear-related stimuli used in this study could also prompt disgust (e.g., tumor) and, in contrast to LoBue's visual search tasks, which present visually threatening stimuli, the stroop relies on semantic attention (e.g., the meaning of the words) which likely taps attention processes beyond orienting. Furthermore, the longer latencies to respond when disgust-relevant words were presented likely reflects a difficulty *disengaging* attention from the emotional content associated with the meaning of disgust words and not faster orienting.

Attention disengagement processes in fear and disgust. The research described above suggests that attentional resources are allocated towards faster detection (e.g., orienting) of fear-related than disgust-related threat relevant images and opens the possibility that disgust holds attention longer than fear. Van Hooff, Devue, Vieweg, and Theeuwes (2013) sought to specifically compare attentional disengagement from fear and disgust related images. Participants were asked to respond to a target that appeared around a central fear, disgust, or neutral image. By varying the presentation time between onset of the central image and target (200, 500, 800, and 1100 ms), the authors determined that participant reaction times to the fastest targets (200 ms) were longer after disgust images. These findings suggest that disgust facilitates slower attentional disengagement than fear images, yet this still occurs at very early stages of attention processing. The authors explained the lack of fear-related disengagement effect by suggesting that for the disgust images, further attentional resources were needed to fully assess the threat posed by the stimuli, whereas fear-related threat processing is more rapid and requires less effort.

In sum, fear is associated with more rapid orienting (e.g., shorter latencies to orient attention) and shifting of attention toward threat and quicker disengagement from threat, whereas disgust is associated with slower disengagement of attention, supporting the different functions of fear and disgust. To date I know of no studies that have compared attentional processing across fear and disgust contexts in childhood. Furthermore, the majority of studies have utilized computer-based paradigms and examine attention processes at early stages of visual processing. Therefore, a question remains as to whether or not these differences in attention processes would be documented in response to exposure to disgust- or fear-relevant stimuli in real life.

Attention Processes Relevant to Individual Differences in Emotion Experiences

Although the above research findings suggest that different emotions draw different patterns of attentional processing, a substantial body of research also demonstrates that individual differences in how people attend to emotion-related stimuli or information also has significant influences on emotional responding (Van Bockstaele et al., 2014).

Individuals with anxiety-related disorders believed to be the result of dysregulated fear systems demonstrate distorted attentional processing of emotional content in that they are even faster to detect threat-relevant information and slower to disengage attention from it than people without disorder (Ohman, 2008) – linking dysregulated attentional and emotional responding together (e.g., exaggerated or inappropriate fear responses). Furthermore, modulating these abnormal attention tendencies produces decreases in stress reactivity and anxiety symptoms (Bar-Haim, 2010; Hakamata et al., 2010; MacLeod & Clarke, 2015), illustrating that controlling attention can alter emotional reactivity. According to theoretical models, deployment of attentional resources which encompass distraction strategies and the ability to direct attention towards or away from emotional content is a primary component of the emotion regulation process (Gross, 1998). A broad literature therefore supports the control of visual attention as an important component of emotion regulation -- the set of processes by which people change the experience, timing, duration, and expression of emotions (Gross & Thompson, 2007; Mauss et al., 2007) to support their goals (Koole, 2009). Thus, findings across different literatures support the notion that attention serves as a gateway to emotional processing and thus, individual differences in attention in an emotional context should relate to individual differences in children's emotional experiences.

Developmental changes in attention processes should relate to children's emotional experiences. Eye gaze is connected to early emotional responding (Sheese, Rothbart, Posner, White, & Fraundorf, 2008). Children's abilities to orient their attention towards internally motivated stimuli (e.g., goals) develops rapidly in infancy (Colombo, 2001). Orienting attention towards an evocative stimulus can increase emotional reactivity, sustaining attention can maintain reactivity, averting gaze away from a stimulus can reduce reactivity, and complete withdrawal of gaze can produce an inactive state (Rothbart & Derryberry, 1981). Thus, children's abilities to control their visual attention and direct it towards or away from stimuli that are personally salient develops very quickly in early life, and attention to emotional stimuli carries consequences for emotional responding.

At ages 3-4, children still make use of orienting attention networks but attentional processes become more strongly influenced by the executive control of attention (Rothbart, Sheese, Rueda, & Posner, 2011) which allows for conflict resolution among sources competing for attention. Executive functioning skills like working memory, cognitive flexibility, goal setting, and planning that develop rapidly across childhood and underlie self-regulation (Anderson, 2002) coincide with this enhanced executive attention. Although the executive control of attention continues to strengthen until early adulthood, certain executive attention skills like conflict inhibition evidence substantial growth across early childhood (3 to 5 years) and up until middle childhood (~ age 7; Rueda, Posner, & Rothbart, 2004; 2005). Conflict inhibition encompasses the ability to resolve attentional conflict when presented with stimuli that conflict or compete for attentional resources (Rothbart, Posner, & Rueda, 2005). Conflict inhibition therefore reflects competencies in sustaining attention on stimuli that are in-line with internal goals and ignoring stimuli that are not. By age 7, children's conflict inhibition performance begins to mirror adult performance which suggests a dramatic shift in how attentional resources are allocated and reflects a strengthening of control processes that support self-regulation (Rothbart & Rueda, 2005). Executive attentional control abilities like inhibiting distracting emotional information to pursue a task (e.g., learn in a classroom or complete an assignment) are important for appropriate, healthy emotional responding. In childhood, greater executive control of attention is linked to lower levels of negative emotionality (Rothbart, 2011). Interestingly, the initial age of onset for many types of anxiety related disorders that are believed to have their roots in dysregulated fear and disgust responding (e.g., phobias, separation anxiety), is 7 years of age (Kessler et al., 2007). This work suggests that children's attention profiles before this middle childhood period might work to shape trajectories of subsequent emotional responding.

Applications: Rejection of Tap Water

Individual differences in children's responses to fear and disgust-relevant stimuli should carry far-reaching consequences for developmental science. Threat-relevant emotions are powerful motivators of attitudes and behaviors in general and the way fear and disgust elicitors are felt and managed underlies differences in important aspects of everyday life, such as adults' hygiene behaviors, political ideologies and moral thinking (Banks & Hicks, 2015; Curtis, De Barra, & Aunger, 2011; Haidt, 2003; Lilienfeld & Latzman, 2014; Liu, Lin, Xu, Zhang, & Luo, 2015; Royzman, Cusimano, & Leeman, 2017; Rozin & Fallon, 1987; Prinz, 2007). In particular, an expanding literature suggests that fear and disgust underlie people's attitudes towards water reuse schemes and technologies and relate to whether or not they accept or reject the use or consumption of recycled and tap water in the home (Massoud, Kazarian, Alameddine, & Al-Hindi, 2018; McLeod, Bharadwaj, & Waldner, 2015; Wester, Timpano, Cek, & Broad, 2016). Feelings of disgust and greater concerns that tap water is contaminated and can lead to illness are linked to stronger rejection and avoidance of tap water and beliefs that tap water is bad (McLeod et al., 2015; Rozin, Haddad, Nemeroff, & Slovic, 2015; Wester et al., 2016). Furthermore, fears of illness or concerns over the health risks of drinking tap water are also related to rejection of water reuse solutions and contribute to consumer preferences for bottled water (Doria, 2006; Friedler et al. 2006; Gungor-Demirci, Lee, Mirzaei, & Younos, 2016; Massoud, Kazarian, Alameddine, & Al-Hindi, 2018), suggesting that fears play a role in recycled water-related beliefs and consumption behaviors.

The literature to date therefore suggests a role of fear and disgust in the perception that recycled/reused water poses a threat and explains in large part why people reject more efficient, cost-effective methods for generating potable water. Thus, individual differences in people's threat-relevant emotions limits the practical application of safe and sustainable water efficiency and conservation schemes, creating a societal problem.

The world's supply of potable fresh water is dwindling. Municipal tap-water systems in the United States are considered some of the safest in the world and provide sustainable drinking water solutions to the public (Gungor-Demirci, Lee, Mirzaei, & Younos, 2016). Despite this, bottled water sales within the past decade have soared (Hu, Morton, & Mahler, 2011). Water bottling from fresh water sources and sales of bottled water continue, even in regions experiencing severe drought (e.g., Arrowhead in California) massively contributing towards the world's plastic waste problem. Fear and disgust have therefore separately been linked to concerns of illness over drinking reused/recycled water, rejection of water reuse schemes, avoidance of tap water consumption, and the decision to consume bottled water instead, suggesting that feelings of fear or disgust towards recycled water pose an environmental threat. Furthermore, there are individual differences in the extent to which people accept or reject recycled water. Some people are okay drinking tap water, others are okay drinking tap water after engaging in some water treatment/hygiene behaviors such as using at-home filtration systems, and still a portion of people completely refuse and are unwilling to consume tap water (for reviews, see Po, Kaercher & Nancarrow, 2003; Russell & Lux, 2006). The extent to which people completely rely on bottled water for consumption, the extent of their illness related concerns over drinking tap water, the intensity of their negative emotions towards thoughts of drinking tap water, and the extent to which they are okay with drinking tap water after some filtering (or not) are all likely related to individual differences in how people experience fear and disgust. To date, I know of no studies that have examined how *both* individual differences in disgust and fear relate to concerns about the safety of drinking tap water and drinking water preferences.

As well, little is known about how and when *children's* concerns about drinking tap water or their preferences for bottled water develop, and whether they are related to early differences in children's understanding and experiences of fear and disgust. It is important to clarify children's beliefs about the safety of drinking tap water, because illness-related concerns about tap water are linked to water consumption *behaviors* among children from lower-income, minority families (Hobson et al., 2007), posing a public health issue. Black and Hispanic and lower income youth (ages 9 – 19) are more likely to report greater health concerns about tap water (Onufrak et al., 2014). Among Hispanic youth, greater negative emotions about tap water are linked to greater consumption of sugary beverages (Onufrak et al., 2014), which is in turn linked to obesity (Bogart et al., 2013). Less research has sought to understand whether young children also demonstrate these beliefs about tap water and whether their developing beliefs are linked to their understanding and experiences of fear and disgust. Determining whether tap water avoidance is more strongly related to fear or disgust reactions and when these associations and preferences for bottled water emerge in childhood can pinpoint which concerns and emotions to target in educational campaigns aimed at improving children's tap-water acceptance – and at what ages to introduce these types of programs to encourage sustainable water-related beliefs as they develop.

The Current Study

The overarching goal of this dissertation is to improve understanding of children's experiences of low intensity fear and disgust – emotions children are likely to experience often in daily life that should carry consequences for how they feel, think about, and respond to potential threats in the real world. The conceptual model I have developed posits children's understanding of these two negative emotions to be measurably different, as are the patterns with which they orient their attention towards or away from fear and disgust elicitors. The elements of emotion understanding and attentional processes that are the focus of this dissertation thus reflect underlying differences in how children experience fear and disgust. These correlates of emotional experience in early and middle childhood should carry consequences for everyday beliefs and behaviors across multiple settings of their lives (e.g., at home, at school), such as children's rejection of tap water and preferences for bottled water. An investigation of these interrelations is especially crucial in middle childhood, because symptoms of disorders that are linked to irrational contamination and illness related beliefs (e.g., obsessive compulsive disorders and phobias) first onset around age 7 (Kessler et al., 2007). So, children's early understanding of and attention to fear and disgust may relate to developing beliefs about real-world concerns like water consumption. In turn, these emerging beliefs may carry critical long-term health consequences for children across development (e.g., chronic dehydration, risk for obesity, dental decay), emphasizing the importance of understanding experiences of fear and disgust in the years leading up to middle childhood.

My first aim focused on clarifying children's fear and disgust understanding by documenting individual differences in their differentiation of fear and disgust -- the extent to which children demonstrate an awareness that these two emotions are different. Specifically, I asked whether children's differentiation of fear and disgust in early to middle childhood was related to (a) age, (b) their understanding of contagion and conservation of matter (competencies believed to underly full-fledged disgust experiences), and/or (c) individual differences in children's responses to fear and disgust experiences. Ages of the sample spanned 4 to 7 years to bridge the transition from early to middle childhood. By age 5, children demonstrate good accuracy in their ability to differentiate situations and facial expressions of fear from other negative emotions like sadness and anger, and after age 5 children's accuracy in differentiating disgust from other negative emotions in recognition tasks improves linearly (Widen & Russell, 2010a,b; Widen, 2013). Yet, children do not demonstrate coherent disgust responses across multiple emotion channels (e.g., facial expressions, affective liking/disliking, and behavioral avoidance) until around age 7 (Stevenson et al., 2010). Thus, the older children in this sample were expected to demonstrate greater differentiation between fear and disgust. But, prior theoretical work suggests that a full-fledged experience of disgust requires an understanding of contagion and conservation (Hejmadi, Rozin, & Siegal, 2004; Rozin & Fallon, 1987; Siegal, 1988). These concepts might be pre-requisites for being able to distinguish between what it means to feel fear and disgust or even understand when people would feel disgust (e.g., pathogenic threat potential) vs. fear (e.g., immediate pain/bodily harm potential). Thus, above and beyond children's biological age, their understanding of contagion and contamination should be associated with the extent to which they differentiate between feelings of fear and disgust. In addition, whether or not emotion differentiation related to individual differences in the intensity of children's subjective emotional responses to fear and disgust has not been investigated and was explored.

Finally, my research methodology allowed me to test two other research questions which to my knowledge have not otherwise been investigated. Children completed a standard fear interview (the Koala Fear Questionnaire, KFQ; Muris et al., 2003) and a standard disgust interview (the Disgust Emotion Scale for Children, DES-C; Muris, Huijding, Mayer, Langkamp, Reyhan, & Olatunji, 2012) but I modified both so that for each item children rated the intensity with which they felt *both* fear and disgust. This design element allowed me to test whether children differentiate between fear and disgust more strongly when presented with items that are traditionally "fear" evoking compared to items that are traditionally "disgust" evoking. In addition to asking children about whether hypothetical elicitors made them feel scared and disgusted via interview, I also presented children with 10 potentially threatening items in person (e.g., a needle, spider, blood, moldy bread) and asked them to rate how disgusted or scared each made them feel. This added element allowed me to compare children's differentiation of fear and disgust for hypothetical items from the interviews versus in-person potential threat stimuli -- two contexts that varied in terms of the imminence of the potential threat.

My second aim was to examine whether attentional processes during emotional contexts (e.g., orienting, sustained attention, and disengagement during fear and disgust episodes) (a) varied by the specific emotion that characterized the context, and (b) related to individual differences in emotion differentiation and experience. Prior work provides some evidence that attention processes vary across fear and disgust emotion contexts (Charash & McKay, 2002; Van Hooff, Devue, Vieweg, & Theeuwes, 2013). Attention has also been linked to underlying differences in children's emotional experiences (Pérez-Edgar, Bar-Haim, McDermott, Chronis-Tuscano, Pine, & Fox, 2010; Schechner et al., 2012). Thus, attention processes should play a prominent role in children's responses to different emotion elicitors and how they experience emotions. Children demonstrate rapid detection of threat-relevant stimuli (LoBue & DeLoache, 2008). Findings from work utilizing computer paradigms suggest that fear is associated with rapid attention orienting (e.g., shorter latencies to orient attention) and shifting (e.g., quicker attentional disengagement) whereas disgust has been associated with a slower attentional disengagement than fear (LoBue & DeLoache, 2008; Van Hooff, Devue, Vieweg, & Theeuwes, 2013). Together, this work suggests that different attention patterns would be expected when comparing a fear and disgust context. To my knowledge, no prior research has investigated whether key components of children's attention (e.g., orienting, sustained attention, disengagement) vary across a scary versus disgusting context.

I also investigated how children's attention patterns (e.g., attention orienting, sustaining attention, disengaging attention) related to their differentiation and experiences (via reported intensity and behavioral avoidance) of fear and disgust. Work with phobic adults suggests that dysregulated fear is associated with even faster orienting biases to threat-relevant information (Ohman, 2008). Work on attention regulation suggests that sustaining attention on a negative stimulus can increase or maintain negative emotional intensity and withdrawing attention can extinguish it (Rothbart & Derryberry, 1981). Thus, latencies to orient attention should relate to individual differences in the experiences of emotion (e.g., intensity and avoidance behaviors) as should the length of overall fixation duration (e.g., sustained attention), and the latencies to disengage attention. Although attention processes should relate to emotional experiences, whether specific components of attention are more strongly related to individual differences in the experience of disgust or fear has not been tested and was explored.

The third aim of this dissertation was to determine whether these three aspects of emotion development – differentiation reflecting nuanced emotion understanding, attention processes reflecting the extent to which emotional content is processed, and individual differences in the intensity with which children experience fear and disgust – have implications for children's beliefs about threats they encounter in everyday life. To my knowledge, no work has tested how these factors might relate to beliefs about the suitability of consuming tap water in childhood. Water consumption behaviors carry public and environmental health consequences and some research, most of which has been done with adults, suggests that consumption behaviors and water preferences may be tied to people's concerns that tap water is contaminated. Furthermore, prior researchers have theorized that whether children comprehend contagion and conservation of matter underlies their understanding of disgust and carries consequences for water-related beliefs. Thus, children who understand contagion or conservation of matter would be more likely to prefer bottled water and believe that tap water can make you sick (e.g., it is contaminated).

Work with adults has linked rejection of recycled water solutions and purchases of bottled water to experiences of threat-relevant emotions like fear and disgust (Massoud, Kazarian, Alameddine, & Al-Hindi, 2018; McLeod, Bharadwaj, & Waldner, 2015; Wester, Timpano, Cek, & Broad, 2016). I therefore sought to test whether and to what extent different facets of children's emotional development (differentiation, attention, and subjective experience) predicted their drinking water preferences (e.g., tap vs. bottled water), emotions about drinking tap water, and beliefs that tap water is contaminated.

In this study, children were interviewed about the subjective intensity of their fear and disgust experiences, their understanding of contagion and conservation, and their water-related consumption preferences, emotions and contamination beliefs. Children participated in a novel free-play task with a potential threat -- either an evocative disgusting (dirty trash can) or scary (roaring dinosaur) stimulus -- while aspects of their attention were measured. Children were also presented with a series of evocative stimuli in person and the intensity of their feelings of fear and disgust as well as their approach behaviors towards these stimuli were assessed.

Hypotheses

Research question 1: Are there age-related differences in children's differentiation of fear and disgust?

Hypothesis 1 a) I predicted that age would be positively correlated with greater differentiation between disgusting and scary stimuli, demonstrating more sophisticated emotion understanding with increasing age.

Hypothesis 1 b) I predicted that the extent to which children differentiate between fear and disgust would relate to their understanding of both contagion and conservation, such that children who demonstrated understanding of contagion or understanding of conservation would show greater differentiation. I also explored whether these predicted associations would hold, partialling age.

Though I had no other specific hypotheses for this research question, I also explored 1 c) whether the extent to which children differentiated between fear and disgust related to individual differences in the intensity with which they experienced disgust or fear; and 1 d) whether children's differentiation of fear and disgust when presented with standard "fear" items substantially differed from their differentiation of fear and disgust when presented with standard "disgust" items. Finally, I explored 1 e) whether the extent to which children differentiated between fear and disgust in a hypothetical interview task differed from the extent to which they differentiated between fear and disgust when presented with fear/disgust relevant items in person.

Research Question 2: Do attention patterns vary across fear and disgust contexts or relate to children's emotional responding?

Hypothesis 2 a) I predicted that children would demonstrate different attention patterns depending on the emotion context. Compared to children in the disgust context (the free-play with the garbage can), I expected that children in the fear context (the free-play with the dinosaur) would more quickly orient their attention to the novel stimulus and demonstrate a shorter first fixation period (i.e., a shorter duration of their first look towards the evocative stimulus), suggesting quicker disengagement.

I explored 2 b) whether children would fixate on the novel stimulus for differing lengths of time in the disgust or fear context (sustaining attention).

Hypothesis 2 c) I expected that for children in the fear context, a pattern of attention that is typically exhibited in response to fear elicitors – faster attention orienting (shorter latencies to orient attention towards the evocative stimuli) and quicker attentional disengagement (shorter first fixation period) would relate to greater differentiation of fear from disgust. For children in the disgust context, I expected that faster orienting of attention towards the evocative stimuli and *slower* disengagement from the evocative stimuli, which are characteristic of attention patterns in response to a disgust elicitor, would predict greater differentiation of fear from disgust.

I additionally explored 2d) the relative contributions of each attention component in explaining the variance in children's emotion differentiation.

Hypothesis 2e) Regardless of condition, I predicted that children who more quickly *oriented* to the evocative stimulus would report greater intensity of felt fear and disgust and avoidance of the evocative items presented to them. Similarly, children who *sustained attention* on the evocative stimulus longer or were slower to *disengage* attention from the stimulus would report greater intensity of felt emotion as well as demonstrate avoidance. In contrast, I predicted that longer latencies to first orient attention, a shorter duration of sustained visual attention, or quicker attentional disengagement from the evocative stimulus would relate to lower reported fear and disgust intensity and greater behavioral avoidance.

I also explored 2 f) the relative contributions of each attention component in explaining the variance in children's subjective experiences of fear and disgust.

Research question 3: Do aspects of children's emotional development relate to their water-related preferences, emotions, and beliefs?

I explored 3 a) whether the extent to which children differentiated between fear and disgust related to their drinking water preferences, negative emotions about tap water, and beliefs that tap water is contaminated (e.g., it can make you sick).

Hypothesis 3 b) Regardless of condition, I predicted that attention patterns from the free play context that are characteristic of more exaggerated negative emotional responding -- quicker attention orienting towards the evocative stimuli, or greater overall attention sustained on the evocative stimuli, or slower attentional disengagement -- would relate to greater preferences for bottled water, greater negative emotions towards drinking tap water, and the belief that tap water is contaminated.

Hypothesis 3 c) I also predicted that children who reported more intense experiences of fear or disgust or demonstrated fewer approach behaviors when in the presence of potentially threatening stimuli would report greater preferences for bottled water, greater negative emotions about drinking tap water, and believe that tap water can make people sick.

I explored 3 d) whether individual differences in reported fear or disgust intensity more strongly related to children's water-related preferences, emotions, and beliefs but because very little work has compared how fear and disgust influence behaviors, I advanced no specific hypotheses about these associations.

Methods

Participants

Sixty-nine mother-child dyads participated in a single 2.5-hour session at the Emotion Regulation Lab as part of a larger study of children's emotion development. Children (35 girls) ages 4 to 7 years (4.245 – 7.749 years: *M*age = 5.999; *SD* = .962) visited the lab with their mother. The larger study from which this sample was drawn tests specific questions about the nature of mother-child emotion socialization processes, thus only mother-child dyads participated (Brand & Klimes Dougan, 2010; Shewark & Blandon, 2015). For compensation, mothers received $25 and children selected a small toy prize.

A priori power analysis using G*Power suggested that a sample size of 49 participants was needed to detect a moderate effect size of 80% power and an $\alpha = .05$ with the planned multiple regression analyses (Faul, Erdfelder, Buchner, & Lang, 2009). Published findings from previous ambulatory eye-tracking work with children of a similar age range that also examined the effect of a dichotomous predictor (e.g., two groups) on different indices of attention using linear multiple regression reported an observed $R^2 = .25$, and this effect size was used as the basis for my power analyses (Fu, Nelson, Borge, Buss, & Perez-Edgar, 2019). As well, I conducted a power analysis based on a two-tailed independent samples t-test comparison of two group means (children assigned to the fear or disgust free-play conditions) with alpha = .05 and power = .80, which indicated that a sample size of 29 children per group would be needed to detect mean differences of medium-to-large effect sizes (Cohen, 2003). Thus, I likely had adequate power to test the hypothesized associations of interest in this dissertation.

My sample reflected the ethnic and socioeconomic diversity of the surrounding Inland Empire region. Children's race was reported as Hispanic (30.4%), Caucasian (23.2%), Black (5.8%), Asian (1.4%) and Multiracial (37.7%). Race for one child was reported as "other". Reported annual family incomes ranged from less than $5,000 to above $200,000. Roughly 25% of the sample reported an annual family income of less than $35,000 and 5% reported family income above $100,000. Roughly 50% of the sample reported an annual family income of $60,000 or less. Approximately 20% of mothers completed high school or had less education, 27.5% of mothers had graduated from college, and 23.2% had completed some graduate training or had more education. Fathers' education was reported by mothers; roughly 52.2% were reported as having completed high school or less education, 14.5% had graduated from college, and ~16% completed some graduate training or more education. Because this study incorporated eye-tracking methodologies to track visual attention processes, children who wore glasses or who were diagnosed with developmental disabilities or attention deficit disorders were not eligible for participation.

Design

This study employed a between-subjects design to test primary attention differences across scary and disgusting novel free-play tasks. Dyads were randomly assigned to one of the two experimental conditions (disgust or fear free-play) with the restriction that an approximately even number of girls and boys of similar ages were assigned to each.

Procedure

The study was approved by the university's institutional review board. Mother-child dyads visited the UCR Emotion Regulation lab one time for the study. Upon arrival to the lab, mothers provided written consent and children provided their assent to participate. The entire visit was video-recorded for later offline coding. The full procedures for the study are presented in Appendix A, but see Appendix B for the subset of procedures that are the focus of this dissertation.

Emotion intensity rating training. First, children received training on self-reporting their emotions using 3 separate 4-point cartoon face scales that asked about fear, disgust, and happiness. These scales were used throughout the visit during interviews to capture children's intensity of fear and disgust. The "scared" and "happy" scales have been used in prior work with children of similar ages, but the "grossed out or disgusted" scale was created in a similar style for this study (Davis, Parsafar, Quinones-Camacho, & Shih, 2017; Parsafar & Davis, 2018; see Appendix C for face scales). The scales for fear, disgust, and happiness each began with a neutral face followed by 3 faces of increasing emotional intensity (1= not at all/neutral, 2 = a little, 3= pretty much, 4 = very). Children saw each scale one at a time while the experimenter explained the anchors (See Appendix D for exact procedure). Only the "scared" and "grossed out or disgusted" scales were used here.

Children were also asked if they understood what “grossed out” or “disgusted” meant. If not, the researcher provided an example (e.g., “it’s like if something makes you feel eww and yucky, like throw up or poo poo”) and switched to using either the term “icky” or “yucky” throughout the entire visit whenever disgust emotion ratings were collected (e.g., not at all icky, a little icky, pretty much icky, very icky). Then, children were given a comprehension check question for each face scale to ensure they understood the scale and how to report their emotion intensity (e.g., “which face would you point to if you felt A LITTLE scared?”). If participants responded incorrectly, each anchor of the scale was explained again and they were given another practice question. This was repeated until children successfully answered the comprehension check. Children who demonstrated initial difficulty with the scales (e.g., pointed to the wrong face during the practice question) were also asked to say their anchor response out loud as they reported their emotions throughout the visit (e.g., they were asked to say “not at all scared” as they pointed to the not at all scared face) and scoring was based on the verbal response they provided to ensure that younger children’s subjective reported emotional experience was captured, even if they may have had difficulties with navigating the face scales.

Fear and disgust sensitivity interviews. Next, using the emotion scales, children rated the intensity with which a number of common fear or disgust elicitors made them feel both fear and disgust. Specifically, children were interviewed about items from the Koala Fear Questionnaire (KFQ; Muris et. al., 2003) and the Disgust Emotion Scale for Children (DES-C; Muris, Huijding, Mayer, Langkamp, Reyhan & Olatunji, 2012). These ratings were used to assess the intensity with which children reported subjective experiences of fear and disgust. The correlations between the fear and disgust ratings for each of these scales were also later used to calculate an emotion differentiation score.

The KFQ is a 31-item measure designed to assess 4- to 12-year-old children's fearfulness in response to top fear elicitors in childhood. Children see a cartoon image of each item and rate the intensity with which the item makes them feel fearful on a scale of 1-3 scale and the scores across all items were summed to compute a total. Higher total scores represent greater fearfulness – more intense feelings of fear (see Appendix E for a list of items). Note that although the original measure comes with a 1-3 koala cartoon face scale, for consistency across the interview measures I had children report their emotions to the KFQ items using the face scales used by our lab.

The DES-C (Muris et al., 2012) is a 30-item measure designed to assess 8- to 12-year-old children's disgust sensitivities to core disgust elicitors across five domains: animals, body violations, rotting foods, death, and odors. Each item is rated on a 5-point scale (0 = no disgust at all ; 4 = extreme disgust) and scores are summed so that higher total scores indicate more intense feelings of disgust (see Appendix F for a full list of the items).

I made four changes to these original measures: First, because I originally planned to combine children's ratings from the KFQ and DES-C to create total fear and total disgust intensity scores, I asked a research assistant to create cartoon black and white sketches to accompany each item/situation in the DES-C to parallel how the KFQ is presented (see Appendix F). Second, I adjusted some language in the DES-C to be more age-appropriate for younger children (e.g., "handling an injection needle" was changed to “handling (or holding) an injection needle, like the kind a nurse uses”). Third, for all items across the two measures, I asked children to report the intensity with which they would feel fear as well as disgust, using the four-point emotion rating scales from our lab to assess this. Fourth, based on published psychometric papers on these two validated questionnaires and in order to shorten the length of this task, I omitted several items. For the KFQ these were items that did not correlate well with the total score on the scale (e.g., dogs, chickens, birds, and telling something in front of the class). For the DES-C I omitted items that loaded onto the “odors” factor/domain because my interest was specific to associations between visual attention processes and fearfulness/disgust sensitivity. An exception to this was “the smell of throw-up” (original was “the smell of vomit”) which also loaded onto the body violation domain. One additional DES-C item that did not load onto any factor/domain in prior work was not included (e.g., an alley cat). Finally, if an item was asked about in the KFQ (e.g., snakes) it was not repeated in the DES-C.

For each interview, children were first shown a black-and-white cartoon drawing of each item/situation on the scale (e.g., a drawing of a snakes). The experimenter labeled the image (“these are snakes.”) and asked the child to report how “scared” and then how “grossed-out or disgusted” the item made them feel using the face scales. Children were always asked about fear before disgust. The list of items presented to children from each measure are given in Appendices E and F.

Contagion and Conservation. Because children’s understanding of contagion and conservation may underlie an “adult-like” disgust response, I next interviewed children about their understanding of these principles. The contagion and conservation tasks were similar to those used by Stevenson and colleagues (2010). To assess contagion understanding, children were first shown a cartoon drawing of a gender-matched sick child in bed and told the child had a bad cold. They were asked whether the child got the cold because he/she was naughty (shown a cartoon of the same child facing a wall on a timeout) or because the child played with a friend who had a bad cold (shown a cartoon of another child sick in bed; see Appendix G).

The conservation task was also adapted from Stevenson et al (2010) but instead of doing the task in person, children were shown color photographs to reduce task time. Children saw a series of photos of a glass of water (see Appendix H). First, a single glass of water (picture 1; "here is a glass of water"), then the glass of water with a teaspoon of sugar about to be poured in (picture 2; "Now a teaspoon of sugar is being added"), then the glass of water with the sugar being stirred in (picture 3; "and it is getting stirred together"), and finally the glass of water with the sugar dissolved (picture 4; "I want to know what you think, why can't we see the sugar anymore?"). Children responded to this open-ended question and were then directly asked, "Did it break into tiny pieces that we can't see, or did it just turn into plain water?"

Water Interview. Children were interviewed to assess their beliefs and emotions about tap and bottled sources of water (see Appendix I). First children were shown two side-by-side photos; a glass of water being filled directly from a kitchen faucet and a generic single serving of bottled water. They were asked whether one type of water is better to drink than the other or if they are both the same. Children were then asked what water is better to drink when they are REALLY THIRSTY. If children chose a single "better" water source they were shown the emotion rating scales and asked follow-up questions about how ["scared", "grossed out or disgusted", happy] they would feel if all they had to drink was the undesirable water source before the experimenter continued to the final questions in the survey. If instead children responded that both water sources are the same (e.g., one is not better than the other) to drink when they are REALLY THIRSTY the interviewer skipped to the final few questions in the survey. The final questions asked *all* children whether water from the tap could make people sick, whether water from the bottle could make people sick, or whether both could make someone sick. They were then asked to describe how each endorsed source of water could make someone sick. The final two questions asked whether water could make someone sick if it "had dirt in it" and whether water could make someone sick if it "had germs in it."

Eye-tracker placement. To examine individual differences in children's attention orienting, sustained attention, and disengagement from a mildly evocative fear or disgust relevant stimulus, mobile head-mounted eye tracking equipment was used. The positive science eye tracker (www.positivescience.com) consisted of headgear that was velcroed onto an elastic headband that fit around the widest circumference of the child's head so it did not move while they walked about. Children were told that they were going to wear the headband like a ninja and that the headband had special cameras on it. The headgear consisted of two mini cameras, one situated below the right eye with an attached infra-red diode that illuminated the eye and recorded the child's eye movements. The other camera faced outward and was mounted on the headband above the right eye to record the scene (e.g., what the child was viewing; 100° diagonal field of view). A cable from the back of the headgear connected to a small recording device that was placed in a small backpack that children wore throughout the study. This setup allowed participants to be mobile while wearing the eye-tracking device. This equipment has previously been used with children in the same age range as well as with adults (Franchak & Adolph, 2010).

Calibration. To improve the accuracy of children's gaze fixations measurement, children were first asked to complete a calibration paradigm where they were instructed to fixate their gaze on known, marked locations on a poster board. The calibration paradigm was presented to children as a game for which they could win a sticker prize. The experimenter told children that the two rules of the game were that they could not touch the headgear and that they had to keep their heads very still but follow the experimenter's finger with just their eyes. The experimenter then directed the child's attention to 9 different spots on a calibration board (first presented horizontally and then vertically), one at a time, which was approximately 1.5 meters away from the child. After calibration, children were told that they would next enter a room full of toys and would be allowed to play as long as they did not touch the headgear while the experimenter worked on paperwork.

Free-play. The purpose of this free-play was to examine different components of children's attention in a mild fear or disgust-relevant context. The free-play room contained large building blocks, a fire truck, a bowling set, some stuffed animals, and a magnet board with colorful letter and animal magnets stuck to it. A clear shelf was mounted on the left-hand corner of the room about 38 inches above the floor (see Appendix J for room setup photo).

Children were assigned to experience either a “fear” or “disgust” free play episode. For the fear free-play episode a 12-inch brown remote-controlled dinosaur was placed on the shelf and for the disgust free-play episode a 12-inch brown remote-controlled garbage can was placed on the same shelf. All other toys were identical in the two conditions. The brown dinosaur had red glowing eyes, an open mouth, and bared sharp looking teeth. Upon a remote click from the experimenter it would move its head and roar for about 10 seconds. The brown garbage can had slime and dirty hand markings smeared on it and fake shrubbery with flies stuck to it. Upon a remote click from the experimenter the lid would open and close and the sound of flies buzzing was played for about 10 seconds.

The free-play consisted of 3 phases in which the child was alone in the free-play room. Visual attention was tracked continuously with the eye-tracker and children’s behaviors (e.g., touching the dinosaur, what children did in the room) were video recorded by an overhead room camera. Phase 1 began when the child entered the room and ended two minutes later when the evocative stimulus became active. Phase 2 was the ~10 second period when the evocative stimulus was active. Phase 3 started when the evocative stimulus ceased movement and sound, and ended two minutes later.

Phase 1: Free play. Following a similar procedure described by Goldsmith’s LabTAB (Goldsmith et al., 1999), children entered a room with toys set up in specific locations around the room (same location for each participant) and were allowed to explore and play for two minutes. Once children entered the room, the experimenter started a timer and remained by the door working through some paperwork on a clipboard. The experimenter did not interact with the child during the free-play.

Phase 2: Evocative stimulus. After the experimenter timed two minutes, they activated the fear or disgust stimulus (see Appendix K for photos) using a remote control (e.g., the dinosaur began to roar and move its head; the trashcan lid opened and closed and the sound of a fly buzzing was played). The stimulus activity lasted roughly 10 seconds.

Phase 3: Free play. After the stimulus stopped (ceased sound and movement) the experimenter began timing another two minutes. When the two minutes ended the experimenter came back into the room and ended the free-play session.

Children next completed a series of tasks with their mothers that were not included as part of this dissertation (see Appendix A for procedures for the larger study).

Behavioral avoidance tasks (BATs). Mother-child dyads later participated in a behavioral avoidance (BAT) paradigm together (see Appendix L for procedure and list of items). For this dissertation I focused on the child's behavior. The purpose of the BATs was to assess individual differences in children's reports of fear and disgust intensity (e.g., emotion ratings similar to the KFQ and DES-C interviews) and emotion-related behaviors (approach/avoidance) when presented with 1 control item (a neutral item – specifically, a rock) and 9 common fear and disgust elicitors.

Children were invited to stand next to their mother in the back of the testing room on marked spots. Stimuli were housed in a cart in the front of the room that was closed on three sides, hiding them from view. Children could not see what the objects were until they were brought out one at a time and placed on a small platform atop the cart by an experimenter. The experimenter presented each stimulus while labeling it (e.g., “here is some moldy bread”) and then asked children a series of questions about the objects. They were first asked to evaluate each item with the fear and disgust emotion rating scales (e.g., how “scared” and “grossed out or disgusted” the item made them feel). As in the KFQ and DES-C interviews, the order of emotion ratings was always fear and then disgust, for each item. Children were invited to come take a closer look, touch, and hold the stimuli. Before the next item was brought out, children returned to their marked spot at the back of the room. Children were first presented with a control item (the rock) followed by the 9 evocative stimuli which were either used in prior behavioral avoidance tasks or are common fear or disgust elicitors in childhood (Danovitch & Bloom, 2009; Hejmadi, Rozin, & Siegal, 2004; Markovitch, Netzer, & Tamir, 2015; Muris et al., 2003, 2012; Stevenson et al., 2010).

Data Reduction and Coding

Emotion intensity ratings. Children’s emotion ratings were recorded throughout the visit by the experimenter on an iPad. Responses corresponded to increasing intensity values ranging from 1 to 4 (not at all = 1, a little = 2, pretty much = 3, very = 4). The sum total of fear ratings that children provided were used in analyses to assess subjective fear intensity and the sum total of disgust ratings that children provided were used to assess subjective disgust intensity. For each measure (e.g., KFQ, DES-C, combined KFQ and DES-C interview scores, and the BATs), higher totals (calculated as the sum of fear ratings) indicated greater/more intense experiences of fear and higher total (sum) disgust ratings indicated greater/more intense feelings of disgust. Fear and disgust total scores were created from the KFQ and DES-C interviews separately. Separate fear and disgust sum scores from the KFQ and DES-C interviews were also combined to create one total interview fear intensity score and total interview disgust intensity score, and these were used in analyses. Separate total fear and disgust ratings from the BATs were also created. Thus, there were eight different indicators of individual differences in children's subjective fear and disgust intensity; total fear ratings from the KFQ, total fear ratings from the DES-C, total disgust ratings from the KFQ, total disgust ratings from the DES-C, total sum fear ratings from the KFQ and DES-C interviews combined, total sum disgust ratings from the KFQ and DES-C interviews combined, total fear ratings from the BATs, and total disgust ratings from the BATs.

Contagion and Conservation task. To examine whether understanding of contagion and conservation are necessary components that support differentiation among fear and disgust, I used children's responses to contagion and conservation interview questions. *Contagion*. Children who reported correctly that the child caught a cold from playing with a friend who had a cold received a score of 1 (0 for incorrect), which indicates contagion understanding.

Conservation of matter. Children who reported correctly that the sugar turned into tiny pieces that could no longer be seen received a score of 1 (0 for incorrect) which indicates conservation understanding.

Water-related preferences, emotions, and beliefs. My third research aim was to understand how individual differences in disgust/fear differentiation, attention processes in a disgust or fear context, and individual differences in the intensities with which children experience fear or disgust might predict children's preferences for bottled water, negative emotions towards tap water, and beliefs that tap water is contaminated (e.g., can make you sick). Children's responses to the question of whether water from the sink is better to drink or water from the bottle is better to drink was assessed first. Responses that water from the sink was better to drink received a score of 0, indicating that children preferred tap water, whereas responses that bottled water was better to drink received a score of 1, indicating that children did not prefer tap water. Responses that both types of water were better to drink also received a score of 0, representing neither type of water being preferred to the other.

The next question assessed children's thoughts about which water source would be better to drink in situations where they may be in need of water (e.g., when they are really thirsty). In other words, the question assessed whether they would still prefer a particular source of water even if they were really thirsty. Children who responded that tap water would be better to drink or that both types of water would be better to drink received a score of 0, representing children who preferred tap water if they were really thirsty. Children who responded that bottled water would be better received a score of 1, representing children who still preferred bottled water over tap water even in a situation of extreme thirst.

The next two questions were only asked for children who said that one source of water (e.g., either bottled water or sink water) was better to drink when they were REALLY thirsty (but not for children who said that both sources of water were better). Children were first asked to rate how scared they would feel if they only had the undesirable water source to drink if they were really thirsty (e.g., the source that was NOT chosen as better) on the 4-point scales such that higher scores indicated greater fear of drinking that undesirable source of water even in situations of extreme thirst. This was followed by a second question asking children how disgusted they would feel if they were REALLY thirsty but only had the undesirable water to drink using the 4-point disgust scale. Thus, if children originally said that *bottled* water was better to drink if they were really thirsty then they would be asked these follow-up emotion questions about how scared and disgusted they would feel if they only had *sink* water (e.g., the non-preferred water source) to drink if they were really thirsty. Because my primary interest was in understanding negative emotions about tap water, I only coded children's emotion ratings if sink water was indicated as the non-preferred water source (e.g., if children said that bottled water was better to drink if they were really thirsty). Higher scores to the fear question thus indicated greater fear at the thought of drinking tap water even in situations of extreme thirst and higher scores to the disgust question indicated greater disgust at the thought of drinking tap water even in situations of extreme thirst.

The last question assessed children's beliefs about which water sources could be contaminated (e.g., make someone sick). All children were asked whether water from the bottle, water from the sink, or both sources could make someone sick. Children who said water from the sink could make someone sick received a score of 1, representing children who believed that only tap water could be contaminated whereas children who said water from the bottle or both or neither received a score of 0, representing children who did not believe that tap water or tap water alone could make someone sick.

Data Processing and Reduction

Eye-tracking Calibration. The eye-tracking data were coded for different components of visual attention. Offline coding using Yarbus software (positive science) was used to identify the locations and therefore targets (from the scene camera) of children's eye gaze angle with respect to the location of their pupil and the reflection from their corneas (using the eye camera) to tell what they were looking at. To do this, offline coding of the calibration paradigm in Yarbus allowed researchers to mark a minimum of 9 known target location (e.g., points on the calibration board) from the scene video as the child's attention was directed towards it. Yarbus software then rendered frame by frame eye movement time series data with the gaze target (e.g., what the child was looking at) indicated in the scene video by a blue circular cursor with a 4 degree radius (see Appendix M for an example of what this calibration procedure and generated video looked like).

Eye-tracking Data Processing. Datavyu software was then used to score gaze fixations on the fear (dinosaur) or disgust (trashcan) stimuli during the free-play. Coding was done separately frame by frame for the three phases of the free-play. Each video frame captured 33.3 ms on average, with a 1.5 degree spatial resolution. Coding for Phase 1 (before the fear or disgust stimulus was activated) began from the first frame wherein children had a complete un-occluded view of the free-play room and continued until Phase 2, the stimulus phase, began (e.g., the start of the first frame when the stimulus was activated). Phase 2, The Stimulus Phase thus began starting from the first frame when the stimulus was activated (sound and motion) until the stimulus ceased sound and motion (~10 seconds). Coding for Phase 3 began with the first frame after the stimulus stopped (e.g., ceased sound and motion) and continued for exactly two minutes afterwards.

Fixations were coded as any time the blue circular cursor from the eye camera (4 degrees) touched the target stimulus for at least two frames. Gaze was considered to be off of the stimulus when the circular cursor was no longer touching the target stimulus for at least two frames, unless gaze was off of the stimulus due to blinking or rubbing of the eyes (e.g., eye blinking did not count as gaze being off the stimulus if when the eyes were back open the gaze remained directly back on the stimulus).

The coded data were used to derive several measures of attentional processes. First, I computed the latency (in milliseconds) to first orient attention to the target stimulus after it was activated by remote control (e.g., after sound and motion began) by subtracting the start time of Phase 2 (when the stimulus became active) from the frame when the child first fixated on the target stimulus (e.g., the blue cursor is on the stimulus for at least two frames). Thus, shorter latencies reflect quicker attention orienting towards the evocative stimulus. Second, I computed the total duration children spent looking at the evocative stimulus by summing together the total number of milliseconds the child spent fixating on the stimulus throughout phases 2 (stimulus phase) and 3 and dividing it by the total duration of phases 2 and 3 combined. Thus, larger values indicated a greater total looking duration at the evocative stimulus once it became activated. Third, to assess the amount of time it took children to disengage their attention from the evocative stimulus I used the duration of the *first* gaze fixation following the stimulus onset (e.g., following the start of Phase 2). I standardized this score so that positive values would reflect longer than average latencies to "disengage" attention and negative scores would reflect shorter than average latencies to "disengage" attention. These three measures of attention (latency to first orient attention upon stimulus activation, total looking duration throughout the free-play episode, and time to disengage attention after first gaze following stimulus activation) were used as separate indexes of attention orienting, total looking duration, and attentional disengagement, respectively, in analyses.

Free-play Touch/play. Offline coding of behavioral data was conducted to assess whether (score of 1) or not (score of 0) children touched/played with the novel evocative stimulus during the free-play (e.g., did they directly engage with the dinosaur or trashcan?). I sought to control for this behavior in analyses, given that a child who is actively touching/ playing with the stimulus would maintain their visual gaze on it – adding noise to my assessment of how attention alone is managed differently in an evocative context.

Behavioral avoidance tasks. To further assess behavioral components of children's emotional experiences, and avoidance in particular, for *each* behavioral approach invitation children received a score of 0 if they did not accept the invitation (e.g., did not touch the item) and a score of 1 if they did accept the invitation (e.g., did touch the item). Children were first asked if they would like to approach the cart to take a closer look. This was followed by a question of whether they would want to touch the item, and finally they were asked if they would want to hold the item (or drink it, for the contaminated juice question). Thus, for each item children could receive a score that ranged from 0 to 3. The scoring procedure was repeated for each item and summed across all 10 items so scores could range from 0 (complete avoidance) to 30 (complete invitation acceptance/approach). I then subtracted each child's score from 30 for reverse scoring so that lower scores would indicate maximal approach (e.g., the child approached the cart, touched, and held all items) and higher scores would indicate maximal avoidance (the child declined to ever approach the cart) with higher scores indicating greater avoidance.

Emotion Differentiation. To assess the extent to which children differentiated between fear and disgust, children's fear intensity ratings were correlated with their disgust intensity ratings. Four separate differentiation scores (e.g., four different correlation values) were thus computed for each child – a differentiation score using fear and disgust ratings from items on the KFQ interview, a separate differentiation score using ratings to items from the DES-C interview, a separate differentiation score using ratings to items from both the KFQ and DES-C interviews combined, and another differentiation score using ratings to items from the BATs. Higher (positive) correlation magnitudes therefore indicated that the child provided more similar fear and disgust ratings for that assessment measure (e.g., for the KFQ), reflecting less differentiation. In contrast, both smaller positive correlation magnitudes and more negative indicated that children were differentiating more between the two emotions (provided different fear and disgust ratings for the individual items across the different measures).

Missing Data. Attention data were missing for 3 children due to equipment malfunction, 2 children due to emergency bathroom breaks, and 1 additional child who refused to wear the eye tracker. Differentiation scores could not be computed for children who lacked variability in their self-report responses, but this prevalence of this problem varied by measure (n = 1, KFQ; n = 6, DES-C, n = 13, BATs). Emotion intensity data were not missing for any child (the experimenter skipped one item on the KFQ for one child, but a sum was still computed, and this child was included in analyses). Data from the question asking children whether they believed that water from the sink or bottled could make them sick was missing for 3 children due to audio recording equipment malfunction, 2 children because the experimenter skipped the question, and 1 child who said they could not answer the question. Analyses make use of all available data and thus sample size varies.

Chapter 3

Results

Results for this dissertation are organized into 2 sections. First, I report results from preliminary analyses that tested correlations among gender and the main variables of interest. I also report the results of manipulation checks (e.g., whether children found the garbage can to be disgusting and the dinosaur to be scary), and general descriptive information about the variables of interest. In the second section I answer each of my research questions in turn.

Preliminary Analyses

Descriptive information, including frequencies, means, and standard deviations for the main variables are presented in Table 1. In Table 2 correlations among children's gender, the differentiation variables (e.g., from the KFQ, the DES-C, both interviews combined, the BATs), the emotion intensity variables (e.g., total fear and disgust ratings from the KFQ, the DES-C, both interviews combined, the BATs), and avoidance scores from the BATs are given. In Table 3 I present correlations among children's gender, the attention variables (e.g., orienting, total looking duration, disengagement), contagion and conservation of matter understanding, and the water-related variables (e.g., preferences, emotions and beliefs).

Gender. As can be seen from Table 1, there were no significant associations among children's gender, the differentiation variables, the emotion intensity variables, and the behavioral avoidance scores, all r's < .235, all p's > .064. Table 2 reveals a significant point-biserial correlation between gender and total looking duration, $r = -.268$, $p = .034$ such that girls spent a greater proportion of free-play time looking at the evocative stimulus. Girls also demonstrated quicker attentional disengagement from the evocative stimulus, $r = -.272$, $p = .039$. No other significant associations with gender emerged, all r's < .225, all p's > .147. Gender was not a focus of this dissertation and thus is not discussed further.

Manipulation check. A subsample of children (N = 40) drawn from both free-play conditions rated the two novel stimuli to provide a manipulation check (i.e., Did the dinosaur evoke fear? Did the trashcan evoke disgust?) at the end of the study. Children were shown separate color photographs of the dinosaur and the trashcan, and were asked, "If this [dinosaur/ trashcan] were in the room with you, how [scared/disgusted] would you feel?" Children rated the intensity of fear and disgust that each made them feel with the cartoon face scales. A one-sample t-test revealed that children rated the photograph of the dinosaur as making them feel significantly more scared than a rating of 1 (not at all scared), $t(39) = 3.127$, $p = .003$, $M = 1.530$, $SD = 1.062$, suggesting that the dinosaur stimulus successfully evoked fear. A one-sample t-test revealed that children rated the trashcan as making them feel significantly more disgusted than a rating of 1 (not at all disgusted), $t(39) = 7.977$, $p < .001$, $M = 2.680$, $SD = 1.328$, suggesting that the trashcan free-play stimulus evoked disgust. Paired samples t-tests revealed no differences in children's fear ($M = 1.525$, $SD = 1.062$) and disgust ratings ($M = 1.600$, $SD = 1.128$) for the dinosaur stimulus, $t(39) = -.650$, $p = .520$. But, children reported significantly more intense disgust ($M = 2.675$, $SD = 1.328$) than fear ($M = 1.975$, $SD = 1.291$) for the trashcan, $t(39) = -3.009$, $p = .005$. Thus, the novel stimuli used in the free-play episodes effectively evoked the target negative emotions. However, the average reported emotion intensities were relatively low, and the trashcan stimulus appeared to evoke discrete disgust more effectively than the dinosaur stimulus evoked discrete fear; these issues will be considered in the discussion.

Notable associations. In this section of preliminary analyses, I describe several interesting associations and patterns among study variables that were not a part of my research questions, to fully illuminate the relations among emotional understanding, attentional processes, and water-related preferences, emotions, and beliefs.

Differentiation scores represent the extent to which children's ratings of fear correlated with their ratings of disgust (stronger positive correlations indicate less differentiation between the two emotions whereas weaker or negative correlations indicate greater differentiation). I examined the relation between various differentiation scores (e.g., from the interviews, from the BATs) to explore whether these were convergent or divergent across the task types. Greater differentiation between fear and disgust in response to typical disgust elicitors from the DES-C interview was related to greater differentiation in response to items presented during the BATs, $r = .278$, $p = .042$. Similarly, greater differentiation between fear and disgust on the KFQ interview was associated with greater differentiation between fear and disgust on the DES-C, $r = .438$, $p < .001$. Thus, children demonstrated more consistent differentiation across items presented hypothetically in the interviews. Interestingly, the extent of convergence between the hypothetical and in-person differentiation scores depended on the type of elicitors children were asked about. Differentiation of fear and disgust in response to typical *fear* elicitors from the KFQ, however, did not relate to differentiation of fear and disgust in response to items presented during the BATs. This suggests that perhaps the BAT items evoked greater disgust than fear, explaining the greater consistency in differentiation across the DES-C (e.g., disgust items) and BATs (e.g., items on both perhaps evoked stronger disgust) than across the KFQ (e.g., fear items) and BATs. To probe this further, I ran a paired samples t-test with fear and disgust ratings from the BATs and found that children did indeed report greater disgust ($M = 21.855$, $SD = 7.574$)

than fear ($M = 19.043$, $SD = 6.848$), $t(68) = -4.388$, $p < .001$, $d = .528$, in response to the in-person items.

Higher reported ratings of fear on any index (e.g., KFQ, DES-C, both interviews combined, BATs) were related to higher ratings of disgust on any index (e.g., KFQ, DES-C, both interviews combined, BATs). However, the intensity with which children reported feeling disgust or fear (across any index) was not related to behaviorally approaching or interacting with the items from the BATs. Interestingly, quicker attention orientation towards the evocative stimulus after it became active was related to longer time spend looking at it during the free-play, $r = -.297$, $p = .018$, consistent with an attentional pattern reflective of hypervigilance to threatening information.

Age was positively associated with better understanding of contagion, $r = .284$, $p = .018$, and conservation of matter, $r = .478$, $p <.001$, and preferences for bottled water over tap water, $r = .237$, $p = .050$. However, age was not related to beliefs that water from the sink (but not water from the bottle) could make children sick, $r = .149$, $p = .243$, suggesting that this belief was held consistently regardless of age. Related, roughly half of the sample believed that tap water (but not bottled water) could make you sick (49.3%). Age was also inversely associated with feelings of fear about having only tap water to drink when really thirsty, $r = -.310$, $p = .043$, but did not relate to feelings of disgust about having only tap water to drink when really thirsty, $r = -.228$, $p = .141$. This could be because regardless of age, children in general felt tap water is disgusting or could be because very few children felt tap water is disgusting. I ran a paired-samples t-test to investigate whether children reported more intense disgust or fear when asked to imagine having only tap water to drink if they were really thirsty. Children reported feeling greater disgust (*M* = 2.698, *SD* = 1.389) than fear (*M* = 2.163, *SD* = 1.326), *t*(42) = -2.222, *p* = .032, d = .342 suggesting that the lack of association between age and disgust is because children across ages 4-7 perceive tap water to be similarly disgusting.

Understanding of contagion was associated with a preference for bottled water over tap water, *r* = .292, *p* = .015. Understanding of conservation of matter was associated with less intense feelings of fear at the thought of being really thirsty and only having tap water to drink, *r* = -.353, *p* = .020, but there was no relation between understanding of conservation of matter and feeling disgusted at the thought of being really thirsty and only having tap water to drink, *r* = -.111, *p* = .479. Reporting greater fear at the thought of being really thirsty and only having tap water to drink was associated with reporting more intense disgust in response to this thought as well, *r* = .325, *p* = .034. And, a preference for bottled water over tap water was associated with the belief that water from the sink (but not water from the bottle or both water from a sink and bottle) could make children sick, *r* = .293, *p* = .020. Of note, roughly 65% of the 4-to-7-year-old sample reported a preference for bottled water (i.e., said that water from a bottle is better to drink than tap water) and close to 50% held the belief that tap water (but not bottled water) was contaminated and could make you sick. Only 4% of children lacked understanding of contagion, whereas roughly 62% of children did not demonstrate understanding of conservation of matter.

Table 1. *Frequencies, Means, & Standard Deviations*

Gender			34 boys	35 girls
			No	Yes
Contagion			3.00	66.00
Conservation			43.00	26.00
Bottled Water is Better			24.00	45.00
Tap Water Can Make You Sick			29.00	34.00
Touch the Stimulus?			56.00	12.00
	Min	Max	*M*	*SD*
Exact Age	4.245	7.749	5.999	0.962
KFQ Differentiation	-0.630	1.000	0.218	0.307
DES-C Differentiation	-0.770	0.900	0.071	0.402
Interviews Differentiation	-0.615	1.000	0.165	0.340
BATs Differentiation	-0.364	1.000	0.275	0.387
KFQ Total Fear	27.000	103.000	72.246	17.772
DES-C Total Fear	20.000	80.000	50.232	16.269
Interviews Total Fear	47.000	178.000	122.478	31.157
KFQ Total Disgust	27.000	101.000	53.594	18.467
DES-C Total Disgust	20.000	80.000	52.797	16.687
Interviews Total Disgust	47.000	179.000	106.391	31.799
BATs Total Fear	10.000	33.000	19.043	6.848
BATs Total Disgust	10.000	37.000	21.855	7.574
BATs Avoidance	0.000	30.000	12.087	8.027
Tap Water Fear	1.000	4.000	2.163	1.326
Tap Water Disgust	1.000	4.000	2.698	1.389
Latency to Orient	0.165	130.973	16.366	35.447
Total Looking Duration	0.000	0.494	0.081	0.099
Disengagement	0.068	14.382	1.674	2.474

Table 2. *Associations among gender, age, differentiation, fear and disgust totals, and avoidance*

	1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*	*13*	*14*
1. Gender	1													
2. Age	0.003	1												
3. KFQ Differentiation	0.028	-0.138	1											
4. DES-C Differentiation	-0.235^{t}	-0.083	0.438**	1										
5. Interviews	-0.157	-0.212^{t}	0.781**	0.848**	1									
6. BATs Differentiation	-0.072	-0.053	0.256^{t}	0.278*	0.364**	1								
7. KFQ Fear Total	0.195	-0.047	0.036	-0.149	-0.203^{t}	0.097	1							
8. DES-C Fear Total	0.118	-0.119	-0.023	0.192	0.099	0.207	0.675**	1						
9. Interviews Fear Total	0.173	-0.089	0.008	0.016	-0.062	0.174	0.923**	0.907**	1					
10. KFQ Disgust Total	0.124	-0.218^{t}	0.243*	0.208	0.225^{t}	0.358**	0.656**	0.682**	0.730**	1				
11. DES-C Disgust Total	0.112	0.026	-0.072	0.103	-0.006	0.072	0.644**	0.799**	0.785**	0.635**	1			
12. Interviews Disgust	0.131	-0.113	0.105	0.180	0.129	0.262^{t}	0.719**	0.816**	0.836**	0.914**	0.894**	1		
13. BATs Fear Total	0.143	-0.051	-0.136	-0.045	-0.178	0.410**	0.519**	0.424**	0.517**	0.446**	0.413**	0.475**	1	
14. BATs Disgust Total	0.116	0.127	-0.210^{t}	-0.211^{t}	-0.312**	0.236^{t}	0.591**	0.398**	0.545**	0.362**	0.588**	0.519**	0.732**	1
15. BATs Avoidance	-0.054	-0.139	0.046	-0.241^{t}	-0.068	-0.119	0.080	-0.037	0.026	-0.014	-0.154	-0.089	0.009	-0.071

Note. ^{t}p <.10, *p <.05, **p <.01

Table 3. *Associations among gender, attention, contagion, conservation and the water variables*

	1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*
1. Gender	1								
2. Latency to Orient	0.086	1							
3. Total Looking Duration	-0.268*	-0.297*	1						
4. Disengagement	-0.272*	-0.099	0.187	1					
5. Contagion Understanding	-0.068	0.043	-0.335**	-0.102	1				
6. Conservation of Matter Understanding	0.049	-0.001	0.025	-0.161	0.019	1			
7. Bottled Water is Better	-0.111	-0.093	0.062	0.075	0.292*	0.128	1		
8. Fear of Drinking Tap Water	-0.038	-0.010	-0.249	-0.067	-0.057	-0.353*	-0.049	1	
9. Disgusted by Drinking Tap Water	0.225	0.018	-0.087	0.137	-0.209	-0.111	0.026	0.325*	1
10. Tap Water Can Make You Sick	0.052	-0.228^t	0.072	0.174	0.014	0.171	0.293*	-0.216	0.285^t

Note. $^t p < .10$, $*p < .05$, $**p < .01$

Research Question 1: Are there age-related differences in children's differentiation between fear and disgust?

Hypothesis 1a) I first ran a series of bivariate correlations to examine whether age would relate to children's differentiation between fear and disgust. Separate differentiation scores were generated from responses to (1) the KFQ, (2) the DES-C, (3) both interviews combined, and (4) the BATs. Differentiation scores were created by correlating each child's reported fear intensity and each child's reported disgust intensity for each measure. Thus, lower values represent greater differentiation between fear and disgust. As depicted in Table 4, there were no significant associations between age and children's differentiation scores from any index, suggesting that children differentiated between fear and disgust to a similar extent regardless of age.

Hypothesis 1b) I next used bivariate correlations to test my expectation that children's understanding of contagion and conservation of matter would relate to differentiation between fear and disgust (Table 4). I also explored these same associations in age-partialled correlations (Table 5). Again the 4 separate differentiation scores were used. Note that although I had specific hypotheses about how understanding of contagion would relate to emotion differentiation, because only 3 children in this sample failed to demonstrate an understanding of contagion I was not able to test this hypothesis and did not pursue further analyses with contagion. As depicted in Table 4, there were no significant associations between children's understanding of conservation of matter and differentiation scores from any index.

Partial correlations (Table 5) also revealed no significant associations between understanding of conservation of matter and the extent to which children differentiated between fear and disgust, when controlling for children's age, all r's < .094, p's > .505.

Table 4. *Associations among age, differentiation, contagion and conservation understanding*

	1	2	3	4	5	6
1. Age	1					
2. Contagion Understanding	0.284*	1				
3. Conservation Understanding	0.478**	0.019	1			
4. KFQ Differentiation	-0.138	0.090	-0.170	1		
5. DES-C Differentiation	-0.083	-0.024	-0.082	0.438**	1	
6. Interviews Differentiation	-0.212^t	0.015	-0.202^t	0.781**	0.848**	1
7. BATs Differentiation	-0.053	-0.122	0.033	0.256^t	0.278*	0.364**

Note. $^t p$ <.10, *p <.05, **p <.01

Table 5. *Age-partialled associations among differentiation, contagion and conservation understanding*

Control Variable		*1*	*2*	*3*	*4*
Age	1. Understanding of Conservation	1			
	2. KFQ Differentiaiton	-0.012	1		
	3. DES-C Differentiation	-0.053	0.417**	1	
	4. Interviews Differentiation	-0.094	0.789**	0.836**	1
	5. BATs Differentiation	0.074	0.230^t	0.278*	0.337*

Note. $^t p$ <.10, *p <.05, **p <.01

Hypothesis 1c) For this set of exploratory analyses (see Table 6) I examined how children's total fear and total disgust (summed) ratings from (1) the KFQ, (2) the DES-C, (3) both interviews combined, and (4) the BATs each correlated with their 4 emotion differentiation scores (from the KFQ, the DES-C, the interviews combined, and from the BATs). I also examined the extent to which the differentiation scores related to children's behavioral avoidance score from the BATs.

I assessed differentiation by asking children to rate how scared *and* how disgusted they felt in response to typical fear elicitors using a standard fear assessment (the KFQ) and in response to typical disgust elicitors using a standard disgust assessment (the DES-C). My original plan was to combine children's responses to items from both interview measures and generate a single differentiation value from all items asked about in both the KFQ and DES-C, (hereafter: "the interviews combined"). However, because each interview was meant to elicit responses to a specific emotion context (e.g., fear for the KFQ and disgust for the DES-C), I was able to explore and compare the extent to which children demonstrate differentiation of fear and disgust in response to fear and disgust *elicitors*. In other words, the fear-focused items on the KFQ allowed me to also explore the extent to which children's differentiation of fear and disgust in response to fear-related threat items (e.g., a KFQ differentiation value) related to the reported intensity with which they felt both fear and disgust. Similarly, I was able to explore how differentiation of fear and disgust in response to disgust-related threat items related to children's reported intensity of both fear and disgust.

As can be seen in Table 6, less differentiation between fear and disgust in response to standard fear elicitors (the KFQ) was associated with greater reported disgust in response to standard fear elicitors, $r = .243$, $p = .046$. Less differentiation of fear and disgust when presented with items in person was also associated with greater reported disgust to standard fear elicitors (the KFQ), $r = .358$, $p = .007$. Less differentiation of fear and disgust when presented with items in person was marginally associated with greater reported disgust across the interviews combined, $r = .262$, $p = .051$. Less differentiation of fear and disgust when presented with items in person was associated with greater reported fear when presented with items in person, $r = .410$, $p = .002$. Greater differentiation of fear and disgust in response to the interviews combined, was associated with greater intensity of disgust to items presented in person $r = -.312$, $p = .010$.

Table 6. *Associations among differentiation scores, fear and disgust intensity, and approach behavior from the BATs.*

	1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*
1. KFQ Differentiation	1											
2. DES-C Differentiation	0.438**	1										
3. Interviews	0.781**	0.848**	1									
4. BATs Differentiation	0.256^{t}	0.278*	0.364**	1								
5. KFQ Fear Total	0.036	-0.149	-0.203^{t}	0.097	1							
6. DES_C Fear Total	-0.023	0.192	0.099	0.207	0.675**	1						
7. Interviews Fear Total	0.008	0.016	-0.062	0.174	0.923**	0.907**	1					
8. KFQ Disgust Total	0.243*	0.208	0.225^{t}	0.358**	0.656**	0.682**	0.730**	1				
9. DES-C Disgust Total	-0.072	0.103	-0.006	0.072	0.644**	0.799**	0.785**	0.635**	1			
10. Interviews Disgust	0.105	0.180	0.129	0.262^{t}	0.719**	0.816**	0.836**	0.914**	0.894**	1		
11. BATs Fear Total	-0.136	-0.045	-0.178	0.410**	0.519**	0.424**	0.517**	0.446**	0.413**	0.475**	1	
12. BATS Disgust Total	-0.210	-0.211^{t}	-0.312**	0.236^{t}	0.591**	0.398**	0.545**	0.362**	0.588**	0.519**	0.732**	1
13. BATs Avoidance	-0.046^{t}	0.241^{t}	0.068	0.119	-0.080	0.037	-0.026	0.014	0.154	0.089	-0.009	0.071

Note. ^{t}*p* <.10, **p* <.05, ***p* <.01

Hypothesis 1d) I next used a paired samples t-test to compare whether children's differentiation of fear and disgust in response to items from the *fear* measure (the KFQ) (*M differentiation* = .202, *SD* = .293) diverged from differentiation scores on the *disgust* measure (e.g., DES-C) (*M differentiation* = .071, *SD* = .402). I found a significant difference, $t(62) = 2.741$, $p = .008$, $d = .345$, such that children showed greater differentiation between fear and disgust when asked about items from the disgust measure. I followed this up with a paired t-test to check whether the KFQ evoked more fear (*M* = 72.246, *SD* = 17.772) than disgust (*M* = 53.594, *SD* = 18.467) and found that children self-reported greater fear to items on the KFQ, $t(68) = 10.294$, $p < .001$, $d = 1.24$. In addition, I checked whether the DES-C evoked more disgust (*M* = 52.797, SD = 16.687) than fear (*M* = 50.232, *SD* = 16.269). and found that children self-reported greater disgust to items on the DES-C, $t(68) = -2.040$, $p = .045$, $d = .245$.

Hypothesis 1e) I also used a paired samples t-test to examine whether children showed greater differentiation between fear and disgust in response to hypothetical (the interviews) versus in-person (the BATs) items. Children showed greater differentiation when asked about hypothetical items (M = .136, SD = .315) compared to in-person items (M = .275, SD = .387), $t(55) = -2.599$, $p = .012$, d =.347, suggesting that the "imminence" of the potential threats may have played a role in children's appraisals of the two threat-relevant emotions; items presented hypothetically pose less of an immediate threat than those presented in person. I followed this up with a paired samples t-test to examine whether the BATs items evoked more disgust (M = 21.855, SD = 7.574) than fear (M = 19.044, SD = 6.848), and found that they did, $t(68) = -4.388$, $p < .001$, $d = .528$.

Research Question 2: Do attention patterns vary across fear and disgust contexts or relate to children's emotional responding?

Hypothesis 2a and 2b) I used a repeated measures ANCOVA to assess the extent to which the three attention components of interest – how quickly children oriented to the evocative stimulus after it was activated (orienting), the proportion of free-play time children looked at the evocative stimulus (total looking duration), and how quickly children disengaged their attention after first looking at the evocative stimulus once it was activated (disengagement)-- would vary based on the emotion free-play context children experienced (disgust or fear). I controlled for whether or not children ever touched the evocative stimulus to account for the fact that some children may have been looking at it for much longer durations because they were playing with it. There was no between-person effect of free-play condition, $F(1, 55) = .787$, $p = .379$. Thus, contrary to hypotheses, I found no evidence that attention patterns varied across fear and disgust emotion contexts.

Hypothesis 2c and 2d) I next ran hierarchical multiple regression analyses for each free-play context separately to examine whether emotion differentiation was predicted by the three attention components. Bivariate correlations are provided in Table 7. The model-building process for the regressions examining the dinosaur (Table 8) and trashcan (Table 9) conditions was identical. I used differentiation scores from the KFQ, the DES-C, the interviews combined, and the BATs as separate dependent variables in four separate models. In the first step of all models I controlled for whether or not children touched the evocative stimulus. My independent variables were entered into the second step of the model and were the three attention measures (e.g., orienting, total looking duration, and disengagement). No models or effects within the model steps were significant for any analysis.

Table 7. *Associations among differentiation scores and attention*

	1	*2*	*3*	*4*	*5*	*6*	*7*
1. KFQ Differentiation	1	0.484**	0.851**	0.331^{t}	-0.011	0.054	0.159
2. DES-C Differentiation	0.402*	1	0.843**	0.308	-0.070	0.086	0.140
3. Interviews Differentiation	0.716**	0.858**	1	0.470**	0.005	0.099	0.193
4. BATs Differentiation	0.221	0.182	0.263	1	-0.307	-0.030	0.261
5. Orienting	0.092	-0.199	-0.143	-0.219	1	-0.427*	-0.090
6. Total Looking Duration	-0.180	-0.149	-0.103	-0.106	-0.209	1	0.378*
7. Disengagement	-0.142	0.020	-0.009	0.068	-0.178	0.104	1

Note. $^{t}p < .10$, $*p < .05$, $**p < .01$

Note. Dinosaur/fear condition data are below the diagonal and trashcan/disgust condition data are above the diagonal.

Table 8. Dinosaur/Fear Free-play: Attention Did Not Predict Differentiation

KFQ Differentiation	*R*	*MSE*	*F* Δ	*df1*	*df2*	*p*
1	0.044	0.300	0.052	1.000	27.000	0.821
2	0.332	0.300	0.975	3.000	24.000	0.421
	B	*SE*	*t*	*p*	95% CI LB	95% CI UB
Constant	0.185	0.065	2.823	0.009 **	0.050	0.319
Ever Touch?	-0.029	0.125	-0.229	0.821	-0.284	0.227
Constant	0.149	0.087	1.721	0.098 t	-0.030	0.328
Ever Touch?	0.079	0.172	0.461	0.649	-0.275	0.433
Orienting	0.008	0.007	1.084	0.289	-0.007	0.023
Total Looking Duration	-0.471	0.626	-0.753	0.459	-1.763	0.820
Disengagement	-0.034	0.059	-0.577	0.570	-0.155	0.087
DES-C Differentiation	*R*	*MSE*	*F* Δ	*df1*	*df2*	*p*
1	0.039	0.432	0.039	1	25	0.845
2	0.218	0.45	0.354	3	22	0.786
	B	*SE*	*t*	*p*	95% CI LB	95% CI UB
Constant	0.046	0.097	0.476	0.638	-0.153	0.245
Ever Touch?	-0.037	0.190	-0.197	0.845	-0.428	0.354
Constant	0.093	0.140	0.660	0.516	-0.198	0.384
Ever Touch?	0.084	0.260	0.323	0.750	-0.455	0.623
Orienting	0.001	0.011	0.126	0.901	-0.022	0.024
Total Looking Duration	-1.071	1.172	-0.914	0.371	-3.501	1.359
Disengagement	0.017	0.089	0.194	0.848	-0.167	0.201
Interviews Differentiation	*R*	*MSE*	*F* Δ	*df1*	*df2*	*p*
1	0.113	0.355	0.35	1	27	0.559
2	0.182	0.372	0.168	3	24	0.917
	B	*SE*	*t*	*p*	95% CI LB	95% CI UB
Constant	0.155	0.077	1.999	0.056 t	-0.004	0.314
Ever Touch?	-0.087	0.147	-0.592	0.559	-0.390	0.215
Constant	0.138	0.107	1.286	0.211	-0.084	0.359
Ever Touch?	-0.069	0.213	-0.323	0.749	-0.508	0.370
Orienting	0.005	0.009	0.573	0.572	-0.013	0.024
Total Looking Duration	-0.162	0.776	-0.208	0.837	-1.763	1.439
Disengagement	0.016	0.073	0.213	0.833	-0.135	0.166
BATs Differentiation	*R*	*MSE*	*F* Δ	*df1*	*df2*	*p*
1	0.223	0.362	1.103	1	21	0.305
2	0.48	0.352	1.408	3	18	0.273
	B	*SE*	*t*	*p*	95% CI LB	95% CI UB
Constant	0.126	0.088	1.430	0.167	-0.057	0.308
Ever Touch?	0.181	0.172	1.050	0.305	-0.177	0.538
Constant	0.255	0.114	2.225	0.039 *	0.014	0.495
Ever Touch?	0.470	0.230	2.046	0.056 t	-0.013	0.952
Orienting	-0.011	0.009	-1.190	0.250	-0.029	0.008
Total Looking Duration	-1.951	0.995	-1.962	0.065 t	-4.041	0.138
Disengagement	-0.028	0.071	-0.394	0.699	-0.176	0.121

Note. ^{t}p <.10, **p* <.05, ***p* <.01

Table 9. Trashcan/Disgust Free-play: Attention Did Not Predict Differentiation

KFQ Differentiation	*R*	*MSE*	*F* Δ	*df1*	*df2*	*p*
1	0.118	0.312	0.382	1.000	27.000	0.542
2	0.401	0.305	1.396	3.000	24.000	0.268
	B	*SE*	*t*	*p*	95% CI LB	95% CI UB
Constant	0.276	0.060	4.602	0.000	0.153	0.399
Ever Touch?	-0.141	0.229	-0.618	0.542	-0.610	0.328
Constant	0.177	0.102	1.730	0.096^{t}	-0.034	0.387
Ever Touch?	-0.119	0.264	-0.450	0.656	-0.663	0.426
Orienting	0.007	0.004	1.898	0.070^{t}	-0.001	0.016
Total Looking Duration	0.375	1.003	0.374	0.712	-1.694	2.444
Disengagement	0.047	0.072	0.662	0.514	-0.100	0.195
DES-C Differentiation	*R*	*MSE*	*F* Δ	*df1*	*df2*	*p*
1	0.019	0.424	0.009	1	24	0.926
2	0.248	0.439	0.457	3	21	0.715
	B	*SE*	*t*	*p*	95% CI LB	95% CI UB
Constant	0.111	0.087	1.280	0.213	-0.068	0.289
Ever Touch?	0.029	0.312	0.093	0.926	-0.615	0.673
Constant	0.158	0.152	1.035	0.312	-0.159	0.474
Ever Touch?	0.050	0.382	0.131	0.897	-0.744	0.844
Orienting	-0.008	0.009	-0.948	0.354	-0.026	0.010
Total Looking Duration	-0.107	1.452	-0.074	0.942	-3.126	2.912
Disengagement	0.073	0.115	0.632	0.534	-0.167	0.312
Interviews Differentiation	*R*	*MSE*	*F* Δ	*df1*	*df2*	*p*
1	0.113	0.355	0.350	1	27	0.559
2	0.182	0.372	0.168	3	24	0.917
	B	*SE*	*t*	*p*	95% CI LB	95% CI UB
Constant	0.155	0.077	1.999	0.056^{t}	-0.004	0.314
Ever Touch?	-0.087	0.147	-0.592	0.559	-0.390	0.215
Constant	0.138	0.107	1.286	0.211	-0.084	0.359
Ever Touch?	-0.069	0.213	-0.323	0.749	-0.508	0.370
Orienting	0.005	0.009	0.573	0.572	-0.013	0.024
Total Looking Duration	-0.162	0.776	-0.208	0.837	-1.763	1.439
Disengagement	0.016	0.073	0.213	0.833	-0.135	0.166
BATs Differentiation	*R*	*MSE*	*F* Δ	*df1*	*df2*	*p*
1	0.405	0.353	4.127	1	21	0.055
2	0.483	0.365	0.541	3	18	0.660
	B	*SE*	*t*	*p*	95% CI LB	95% CI UB
Constant	0.461	0.077	5.987	0.000	0.301	0.622
Ever Touch?	-0.531	0.261	-2.031	0.055^{t}	-1.074	0.013
Constant	0.520	0.216	2.408	0.027*	0.066	0.973
Ever Touch?	-0.264	0.403	-0.655	0.521	-1.111	0.583
Orienting	0.006	0.023	0.256	0.801	-0.042	0.054
Total Looking Duration	-1.551	2.206	-0.703	0.491	-6.186	3.084
Disengagement	0.118	0.102	1.153	0.264	-0.097	0.333

Note. ^{t}p <.10, *p <.05, **p <.01

Hypothesis 2e and 2f) I next ran 9 hierarchical regression analyses, collapsing across free-play contexts, to examine the extent to which individual differences in fear intensity, disgust intensity, and behavioral avoidance would each be predicted by the 3 components of attention. The bivariate correlations are provided in Table 10. Three regression models (Table 11) predicted fear intensity from the interviews quantified three ways: as 1) total fear ratings from the KFQ, 2) total fear ratings from the DES-C, and 3) total fear ratings from both interviews combined. Three similarly-constructed models predicted disgust intensity from the interviews quantified in the same ways (Table 12). And, 3 additional regression models predicted emotion responding from the BATs quantified three ways: 1) total fear ratings from the BATs, 2) total disgust ratings from the BATs, and 3) total avoidance behaviors from the BATs (Table 13).

For all 9 models, I entered whether children touched the evocative stimulus as a covariate in the first step. The attention measures (orienting, total looking duration, and disengagement) were entered into the second step of the model. As can be seen in Tables 10-12, none of the models were significant. Including the attention variables did not improve the model fit. Although the models overall were not significant, orienting appeared to be an important predictor. I thus ran follow-up “trimmed” regression analyses where I retained the covariate in the first step of the model but dropped the non-significant attention variables – total looking duration and disengagement -- to test whether orienting alone might relate to the differentiation, reported emotion intensity, and avoidance behavior outcomes of interest. These models remained non-significant even after trimming the non-significant predictors. Furthermore, the orientation variable did not improve the fit of any model and was no longer a significant predictor when considered alone.

Table 10. *Associations among attention and emotion responding variables*

	1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*
1. Orienting	1										
2. Total Looking Duration	-0.297*	1									
3. Disengagement	-0.099	0.187	1								
4. KFQ Fear Total	0.039	-0.092	-0.141	1							
5. DES-C Fear Total	-0.030	-0.121	-0.100	0.675**	1						
6. Interviews Fear Total	0.007	-0.118	-0.135	0.923**	0.907**	1					
7. KFQ Disgust Total	-0.058	-0.184	-0.032	0.656**	0.682**	0.730**	1				
8. DES-C Disgust Total	-0.045	-0.143	-0.047	0.644**	0.799**	0.785**	0.635**	1			
9. Interviews Disgust Total	-0.057	-0.183	-0.044	0.719**	0.816**	0.836**	0.914**	0.894**	1		
10. BATs Fear Total	0.013	-0.172	0.019	0.519**	0.424**	0.517**	0.446**	0.413**	0.475**	1	
11. BATs Disgust Total	0.073	-0.104	0.004	0.591**	0.398**	0.545**	0.362**	0.588**	0.519**	0.732**	1
12. BATs Avoidance	-0.079	-0.093	0.215	-0.080	0.037	-0.026	0.014	0.154	0.089	-0.009	0.071

Note. ^{t}p <.10, *p <.05, **p <.01

Table 11. *Attention Did Not Predict Fear Intensity from the Interviews*

KFQ Fear	*R*	*MSE*	*F* Δ	*df1*	*df2*	*p*
1	0.025	17.418	0.034	1.000	56.000	0.854
2	0.296	17.107	1.684	3.000	53.000	0.181
	B	*SE*	*t*	*p*	95% CI LB	95% CI UB
Constant	72.417	2.514	28.804	0.000**	67.380	77.453
Ever Touch?	-1.117	6.055	-0.184	0.854	-13.246	11.012
Constant	76.321	3.481	21.926	0.000**	69.339	83.302
Ever Touch?	1.777	7.166	0.248	0.805	-12.596	16.150
Orienting	-0.373	0.192	-1.946	0.057^{t}	-0.757	0.011
Total Looking Duration	-21.374	28.141	-0.760	0.451	-77.819	35.071
Disengagement	-2.551	2.311	-1.104	0.275	-7.186	2.084
DES-C Fear	*R*	*MSE*	*F* Δ	*df1*	*df2*	*p*
1	0.119	15.574	0.8	1	56	0.375
2	0.328	15.232	1.848	3	53	0.150
	B	*SE*	*t*	*p*	95% CI LB	95% CI UB
Constant	50.542	2.248	22.483	0.000**	46.038	55.045
Ever Touch?	-4.842	5.414	-0.894	0.375	-15.687	6.004
Constant	54.509	3.099	17.587	0.000**	48.293	60.726
Ever Touch?	-2.309	6.381	-0.362	0.719	-15.107	10.489
Orienting	-0.378	0.171	-2.218	0.031*	-0.720	-0.036
Total Looking Duration	-20.966	25.058	-0.837	0.407	-71.225	29.294
Disengagement	-1.526	2.058	-0.741	0.462	-5.653	2.602
Interviews Fear	*R*	*MSE*	*F* Δ	*df1*	*df2*	*p*
1	0.077	29.7	0.333	1	56	0.566
2	0.341	28.794	2.199	3	53	0.099
	B	*SE*	*t*	*p*	95% CI LB	95% CI UB
Constant	122.958	4.287	28.679	0.000**	114.369	131.547
Ever Touch?	-5.958	10.326	-0.577	0.566	-26.643	14.726
Constant	130.830	5.859	22.331	0.000**	119.079	142.581
Ever Touch?	-0.533	12.061	-0.044	0.965	-24.724	23.659
Orienting	-0.751	0.322	-2.330	0.024*	-1.398	-0.104
Total Looking Duration	-42.340	47.366	-0.894	0.375	-137.344	52.665
Disengagement	-4.076	3.890	-1.048	0.299	-11.878	3.725

Note. $^{t}p < .10$, $*p < .05$, $**p < .01$

Table 12. *Attention Did Not Predict Disgust Intensity from the Interviews*

KFQ Disgust	*R*	*MSE*	*F* Δ	*df1*	*df2*	*p*
1	0.171	17.505	1.689	1.000	56.000	0.199
2	0.303	17.407	1.212	3.000	53.000	0.314
	B	*SE*	*t*	*p*	95% CI LB	95% CI UB
Constant	54.208	2.527	21.455	0.000**	49.147	59.270
Ever Touch?	-7.908	6.085	-1.300	0.199	-20.098	4.281
Constant	58.771	3.542	16.594	0.000**	51.667	65.875
Ever Touch?	-3.435	7.291	-0.471	0.639	-18.060	11.189
Orienting	-0.322	0.195	-1.651	0.105	-0.713	0.069
Total Looking Duration	-35.927	28.634	-1.255	0.215	-93.359	21.506
Disengagement	-0.142	2.351	-0.060	0.952	-4.858	4.574
DES-C Disgust	*R*	*MSE*	*F* Δ	*df1*	*df2*	*p*
1	0.100	16.377	0.565	1	56	0.455
2	0.326	15.996	1.898	3	53	0.141
	B	*SE*	*t*	*p*	95% CI LB	95% CI UB
Constant	52.979	2.364	22.413	0.000**	48.244	57.714
Ever Touch?	-4.279	5.693	-0.752	0.455	-15.683	7.125
Constant	57.863	3.255	17.778	0.000**	51.335	64.391
Ever Touch?	-0.353	6.701	-0.053	0.958	-13.793	13.087
Orienting	-0.398	0.179	-2.224	0.030*	-0.758	-0.039
Total Looking Duration	-32.588	26.314	-1.238	0.221	-85.368	20.192
Disengagement	-0.623	2.161	-0.288	0.774	-4.957	3.712
Interviews Disgust	*R*	*MSE*	*F* Δ	*df1*	*df2*	*p*
1	0.152	30.437	1.327	1	56	0.254
2	0.344	29.724	1.906	3	53	0.140
	B	*SE*	*t*	*p*	95% CI LB	95% CI UB
Constant	107.188	4.393	24.399	0.000**	98.387	115.988
Ever Touch?	-12.188	10.580	-1.152	0.254	-33.382	9.007
Constant	116.634	6.048	19.285	0.000**	104.504	128.765
Ever Touch?	-3.789	12.451	-0.304	0.762	-28.762	21.185
Orienting	-0.720	0.333	-2.164	0.035*	-1.388	-0.053
Total Looking Duration	-68.514	48.896	-1.401	0.167	-166.587	29.559
Disengagement	-0.765	4.015	-0.190	0.850	-8.818	7.289

Note. $^t p < .10$, $*p < .05$, $**p < .01$

Table 13. *Attention Did Not Predict Emotional Responding During the BATs*

BATs Fear	*R*	*MSE*	*F* Δ	*df1*	*df2*	*p*
1	0.062	6.972	0.219	1.000	56.000	0.642
2	0.274	6.906	1.358	3.000	53.000	0.266
	B	*SE*	*t*	*p*	95% CI LB	95% CI UB
Constant	19.333	1.006	19.211	0.000**	17.317	21.349
Ever Touch?	-1.133	2.424	-0.468	0.642	-5.988	3.722
Constant	21.321	1.405	15.172	0.000**	18.502	24.139
Ever Touch?	1.089	2.893	0.376	0.708	-4.714	6.891
Orienting	-0.119	0.077	-1.540	0.129	-0.274	0.036
Total Looking Duration	-17.810	11.361	-1.568	0.123	-40.597	4.977
Disengagement	0.278	0.933	0.298	0.767	-1.594	2.149
BATs Disgust	*R*	*MSE*	*F* Δ	*df1*	*df2*	*p*
1	0.026	7.405	0.037	1	56	0.848
2	0.206	7.451	0.769	3	53	0.516
	B	*SE*	*t*	*p*	95% CI LB	95% CI UB
Constant	21.604	1.069	20.214	0.000**	19.463	23.745
Ever Touch?	0.496	2.574	0.193	0.848	-4.660	5.652
Constant	23.206	1.516	15.308	0.000**	20.166	26.247
Ever Touch?	2.231	3.121	0.715	0.478	-4.029	8.491
Orienting	-0.102	0.083	-1.223	0.227	-0.269	0.065
Total Looking Duration	-13.782	12.257	-1.124	0.266	-38.366	10.801
Disengagement	0.071	1.006	0.070	0.944	-1.948	2.089
BATs Avoidance	*R*	*MSE*	*F* Δ	*df1*	*df2*	*p*
1	0.129	7.900	0.949	1	56	0.334
2	0.338	7.709	1.940	3	53	0.134
	B	*SE*	*t*	*p*	95% CI LB	95% CI UB
Constant	17.625	1.140	15.456	0.000**	15.341	19.909
Ever Touch?	2.675	2.746	0.974	0.334	-2.826	8.176
Constant	15.909	1.568	10.143	0.000**	12.763	19.055
Ever Touch?	1.942	3.229	0.601	0.550	-4.535	8.419
Orienting	0.132	0.086	1.529	0.132	-0.041	0.305
Total Looking Duration	10.796	12.681	0.851	0.398	-14.639	36.230
Disengagement	-1.819	1.041	-1.747	0.086ᵗ	-3.908	0.269

Note. ^{t}p <.10, **p* <.05, ***p* <.01

Research Question 3: Do aspects of children's emotional development relate to their water-related preferences, emotions, and beliefs?

Because tap water can pose a potential threat that does not correspond to a specific discrete emotion context, it was less important to consider differentiation scores and emotion intensity rating scores from the KFQ (e.g., fear eliciting items) and DES-C (e.g., disgust eliciting items) separately. Furthermore, I did not have hypotheses about how children's emotion differentiation or intensity of reported disgust or fear in response to fear (e.g., KFQ) or disgust (e.g., DES-C) elicitors, specifically, would relate to water-related preferences, emotions, and beliefs. So, instead of using differentiation and emotion rating scores from all 4 indexes (e.g., KFQ, DES-C, interviews combined, BATs) to answer my final research question I used differentiation and emotion rating scores from the interviews combined and the BATs only.

Hypothesis 3a) I first ran bivariate correlations (Table 14) to examine whether the extent to which children showed differentiation of fear and disgust related to their a) preference for bottled water, emotional self-reports of ratings of b) disgust and c) fear at the thought of only having tap water to drink if they were very thirsty, and d) belief that tap water but not bottled water could make children sick (e.g., is contaminated). As can be seen from Table 14, I found that less differentiation of fear and disgust from the hypothetical items (the interviews) related to greater reported fear intensity at the thought of only having tap water to drink, $r = .510$, $p = .001$. Furthermore, less differentiation of fear and disgust in response to the in-person items from the BATs was also related to greater reported fear intensity at the thought of only having tap water to drink, $r = .431$, p

= .010. Together, these correlations suggest moderate associations between children's early understanding of emotions and their feelings about tap water. Interestingly, differentiation scores were not related to the extent to which children reported feelings of disgust in response to the thought of only having tap water to drink if they were really thirsty. No associations between differentiation and water-related preferences or beliefs were found.

Table 14. *Associations among differentiation, emotion intensity, and water-related preferences, emotions and beliefs*

	1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*
1. Interviews Differentiation	1									
2. BATs Differentiation	0.364**	1								
3. Interviews Fear Total	-0.062	0.174	1							
4. Interviews Disgust Total	0.129	0.262^{t}	0.836**	1						
5. BATs Fear Total	-0.178	0.410**	0.517**	0.475**	1					
6. BATs Disgust Total	-0.312**	0.236^{t}	0.545**	0.519**	0.732**	1				
7. BATs Avoidance	0.068	0.119	-0.026	0.089	-0.009	0.071	1			
8. Bottled Water is Better to Drink	-0.027	-0.121	-0.206^{t}	-0.232^{t}	0.108	0.022	-0.019	1		
9. Fear from Drinking Tap Water	0.510**	0.431**	0.438**	0.467**	0.404**	0.293^{t}	-0.035	-0.049	1	
10. Disgust from Drinking Tap Water	-0.001	0.028	0.411**	0.510**	0.573**	0.516**	-0.117	0.026	0.325*	1
11. Water from the Sink Can Make You Sick	-0.004	0.076	-0.160	-0.045	0.157	0.074	0.266*	0.293*	-0.216	0.285^{t}

Note. ^{t}p <.10, *p <.05, **p <.01

Hypothesis 3b) Using separate regression models I next examined whether specific attention patterns (i.e., orienting, total looking duration, disengagement) predicted a) children's preference for bottled water and b) the belief that tap water only (but not bottled water) could make them sick. For these analyses, I collapsed across free-play conditions. Because both dependent variables were dichotomous, logistic regression was used (Table 15). In addition, I examined how attention patterns predicted the intensity of children's a) disgust and b) fear at the thought of only having tap water to drink if they were really thirsty using hierarchical multiple regression (Table 16).

The model building process for the logistic and hierarchical multiple regression models was the same. Whether or not children ever touched the evocative stimulus was controlled for in Step 1. In Step 2 I added the attention predictors (orienting, total looking duration, disengagement). As can be seen in Table 15, none of the attention variables related to an increased likelihood of reporting that bottled water is better to drink, or that water from the tap could make someone sick. Similarly, the models with attention predicting children's reported disgust or fear at the thought of only having tap water to drink were not significant.

Table 15. *Attention did not predict children's preferences for bottled water or beliefs that tap water can make them sick*

DV: Bottled Water is Better to Drink									
								95% CI	95% CI
		B	*S.E.*	*Wald*	*df*	*p*	Exp(B)	*LB*	*UB*
Step 1	Did Children Touch the Stimulus?	1.140	1.066	1.143	1	0.285	3.127	0.387	25.278
	Orienting	-0.033	0.026	1.621	1	0.203	0.968	0.920	1.018
	Total Looking Duration	-2.208	3.703	0.356	1	0.551	0.110	0.000	155.851
	Disengagement	0.179	0.362	0.243	1	0.622	1.196	0.588	2.433
	Constant	0.899	0.447	4.040	1	0.044*	2.458		
DV: Tap Water Can Make You Sick									
								95% CI	95% CI
		B	*S.E.*	*Wald*	*df*	*p*	Exp(B)	LB	UB
Step 1	Did Children Touch the Stimulus?	0.608	1.007	0.365	1	0.546	1.837	0.255	13.223
	Orienting	-0.004	0.023	0.024	1	0.878	0.996	0.953	1.042
	Total Looking Duration	-1.716	3.549	0.234	1	0.629	0.180	0.000	188.465
	Disengagement	0.502	0.417	1.451	1	0.228	1.652	0.730	3.737
	Constant	0.482	0.443	1.182	1	0.277	1.619		

Note. ^{t}p <.10, *p <.05, **p <.01

Table 16. *Attention did not predict the intensity of children's water-related disgust or fear*

Fear from Drinking Tap Water	*R*	*MSE*	*F* Δ	*df1*	*df2*	*p*
1	0.002	1.346	<.001	1.000	34.000	0.992
2	0.392	1.297	1.874	3.000	31.000	0.155
	B	*SE*	*t*	*p*	95% CI LB	95% CI UB
Constant	2.194	0.242	9.071	0.000	1.702	2.685
Ever Touch?	0.006	0.649	0.010	0.992	-1.312	1.325
Constant	2.457	0.381	6.448	0.000	1.680	3.234
Ever Touch?	0.453	0.691	0.655	0.517	-0.957	1.863
Orienting	0.021	0.019	1.109	0.276	-0.018	0.059
Total Looking Duration	-5.701	3.422	-1.666	0.106	-12.680	1.278
Disengagement	0.040	0.208	0.194	0.848	-0.384	0.465
Disgust from Drinking Tap Water	*R*	*MSE*	*F* Δ	*df1*	*df2*	*p*
1	0.182	1.393	1.159	1	34	0.289
2	0.361	1.383	1.156	3	31	0.342
	B	*SE*	*t*	*p*	95% CI LB	95% CI UB
Constant	2.677	0.250	10.702	0.000	2.169	3.186
Ever Touch?	0.723	0.671	1.076	0.289	-0.642	2.087
Constant	2.842	0.406	6.994	0.000	2.013	3.670
Ever Touch?	0.905	0.737	1.228	0.229	-0.599	2.408
Orienting	0.020	0.020	1.001	0.324	-0.021	0.061
Total Looking Duration	-4.079	3.649	-1.118	0.272	-11.521	3.363
Disengagement	0.222	0.222	1.000	0.325	-0.231	0.675

Note. $^{t}p < .10$, $^{*}p < .05$, $^{**}p < .01$

Hypothesis 3c and 3d) Using bivariate correlations (Table 14), I next examined how different aspects of children's emotion responding related to their preferences for bottled water (e.g., bottled water is better to drink), the intensity of their reported fear and disgust over the thought of only having tap water to drink, and their belief that only sink water (but not bottled water) could make them sick. As a reminder, to capture individual differences in emotional responding I used the intensity of children's self-reported fear and disgust from the interviews combined as well as from the BATs. Children's total behavioral avoidance scores from the BATs were additionally used.

Higher fear scores from both interviews combined was associated with greater reported fear, $r = .438$, $p = .003$, and disgust intensity, $r = .411$, $p = .006$, at the thought of only having tap water to drink when children were really thirsty. Greater reported fear from the BATs was related to greater reported fear, $r = .404$, $p = .007$, and disgust, $r = .573$, $p < .001$, at the thought of only having tap water to drink. Greater reported disgust from the BATs was related to greater reported disgust at the thought of only having tap water to drink, $r = .516$, $p < .001$. Greater avoidance behaviors during the BATs (e.g., declining to approach, touch, and/or hold the stimuli) were associated with the belief that water from the sink (but not water from the bottle or both) could make people sick, $r = -.266$, $p = .035$. No relations with children's preferences for bottled over tap water were found, suggesting perhaps that underlying differences in negative emotional intensity are less strongly linked to preferences for bottled water. Thus, findings provide evidence that both children's negative emotional responses to hypothetical threats and threats presented in person are related to the negative emotions they feel about potential real-world threats like tap water. Findings also suggest that reporting greater fear might be reflecting an over-arching threat bias in general, since reporting greater fear to items presented both hypothetically and in-person was associated with greater reported feelings of both fear and disgust in response to the thought of drinking tap water.

Chapter 4

Discussion

A main goal of this dissertation was to improve understanding of children's experiences of low-intensity fear and disgust, which are common parts of their daily lives and should carry important consequences for how they feel, think about, and respond to potential threats in the real world. A secondary goal was to investigate how individual differences in the way children understand, attend to, and experience these distinct threat-relevant emotions relate to their preferences, beliefs, and emotional responses to a real-world *potential* threat. I focused on tap water, because the extent to which children view and respond to tap water as a potential threat can carry serious environmental and public health consequences. Specifically, I sought to a) document the extent to which children differentiated between fear and disgust when presented with potential threat items as a novel component of emotion understanding, b) investigate whether facets of children's attention (i.e., orienting, total looking duration, disengagement) differed across a disgust or fear context and related to individual differences in how children understand and experience fear and disgust, and c) examine whether individual differences in these important aspects of emotion development (emotion understanding, attention patterns in an evocative context, and subjective experiences of fear and disgust) related to children's water-related drinking preferences, negative emotions, and beliefs. Though several interesting findings emerged from this investigation, I did not find support for most of the primary hypotheses. Thus, I first summarize the findings for each research question briefly, and then proceed to a general discussion of the pattern of results.

My first research question was whether there are age-related differences in children's differentiation of fear and disgust. My hypothesis that older children would demonstrate more sophisticated emotion understanding and that I would thus see greater differentiation between their ratings of fear and disgust with increasing age was not supported. I had also hypothesized that children's understanding of contagion and conservation of matter – two markers of cognitive sophistication that are theorized to underlie disgust understanding -- would each relate to greater emotion differentiation. Neither related to differentiation, and this did not change when I accounted for children's age.

In addition to these specific hypotheses about the first research question, I explored associations between children's overall self-reported intensity of fear and disgust and children's differentiation of fear and disgust. Less differentiation in response to standard fear elicitors (in the KFQ interview) was associated with more intense reported disgust in response to these standard fear elicitors, but not more intense feelings of fear. Less differentiation of fear and disgust in response to potentially threatening stimuli presented to children in person (in the BATs) was associated with more intense disgust in response to standard fear elicitors (on the KFQ) but not more intense feelings of fear. Finally, less differentiation of fear and disgust in response to the potentially threatening stimuli presented to children in person was associated with higher reported fear intensity in response to those items. My paradigm allowed me to additionally explore whether children's reported feelings of fear and disgust were more differentiated when asked about standard fear-evoking items (the KFQ) compared to standard disgust-evoking items (the DES-C). I found that children demonstrated greater differentiation of fear and disgust in response to disgust elicitors than fear elicitors. Because I asked children how they would feel about typical fear and disgust elicitors both hypothetically, in the interviews, and in person, by presenting them with items during the BATs, I could also test whether differentiation of fear and disgust differed across “hypothetical” and “real-world” threats. I found that children demonstrated less differentiation of fear and disgust in response to the items presented in person (i.e., in the real world).

My second research question examined whether attention patterns vary across fear and disgust contexts, and whether these patterns relate to children’s emotional responding. I hypothesized that compared to children in the disgust context, children in the fear context would demonstrate faster attention orienting to the potentially threatening stimulus (e.g., roaring dinosaur or dirty trashcan) and quicker attentional disengagement from it, which was not supported. I also explored whether overall time spent looking at the potentially threatening stimulus would differ by the free-play emotion context and found no differences. Thus, none of the aspects of attention I investigated (e.g., attention orienting speed, total looking duration, or speed of attentional disengagement) differed across the two discrete emotion potential threat contexts. I had also hypothesized that for children assigned to the fear free-play condition (with the roaring dinosaur), attention patterns that are typical in response to fear-relevant stimuli (faster attention orienting and quicker attentional disengagement from the potentially threatening stimulus) would predict greater differentiation of fear and disgust in general. For children assigned to the disgust free-play condition (with the dirty trashcan) I predicted that a typical disgust attention pattern (faster attention orienting and slower disengagement from the potentially threatening stimulus) would predict greater differentiation of disgust from fear in general. Neither of these hypotheses were supported. Finally, I had also hypothesized that regardless of free-play condition assignment, patterns of attention that typically reflect exaggerated negative emotional responding and hypervigilance to potential threats in the environment (quicker attention orienting towards the potentially threatening stimuli, longer overall looking duration, or slower attentional disengagement) would relate to greater reported fear and disgust intensity in general as well as more avoidance behaviors in the BATs, but this was not supported either.

My last research question investigated whether each of the three facets of emotion development I tested – children's differentiation of fear and disgust, their attention patterns in a disgust or fear threat context, and the intensity of their subjective experiences of disgust or fear -- related to their preferences for bottled water, negative emotions towards the thought of drinking tap water, and beliefs that tap water is contaminated. I first explored whether children's emotion differentiation related to their water-related preferences, emotions and beliefs. I found that the less children's responses to items on the standard fear questionnaire (the KFQ) indicated differentiation of fear and disgust, the more intense fear they reported at the thought of only having tap water to drink if they were really thirsty. Similarly, the less children's responses to items on the standard disgust questionnaire (the DES-C) or items presented in person (the BATs) indicated differentiation of fear and disgust, the more intense fear children reported at the thought of only having tap water to drink if they were very thirsty. Yet, the extent to which children differentiated between fear and disgust did not relate to greater feelings of disgust at the thought of only having tap water to drink if they were really thirsty.

I next predicted that, irrespective of the threat context (the disgust or fear free-play), children who demonstrated attention patterns indicative of more exaggerated negative emotional responding and hypervigilance (e.g., quicker attention orienting towards the potentially threatening stimuli, greater overall time spent looking at the potentially threatening stimuli, or slower attentional disengagement from the potentially threatening stimuli) would report a preference for bottled water to drink, report more intense feelings of fear and disgust at the thought of only having tap water to drink even in situations of extreme thirst, and believe that drinking tap water (but not bottled water) could make them sick. My hypotheses were not supported. The unique components of children's attention in a potential threat context did not directly relate to their preferences, emotions or beliefs in response to a real-world potential threat.

My final prediction was that children who reported more intense feelings of disgust or fear throughout the visit (e.g., children who may be more fearful or disgust-sensitive) or who demonstrated greater avoidance behaviors when presented with evocative stimuli in person would be more averse to tap water – preferring bottled water, reporting more intense negative emotions towards the thought of only having tap water to drink, and believing that tap water (but not bottled water) was contaminated. Less differentiation of fear and disgust related to stronger feelings of both fear and disgust at the thought of only having tap water to drink. The intensity with which children reported feeling disgusted or scared throughout the visit did not relate strongly to children's preferences for bottled water. However, in support of hypotheses, both greater reported fear intensity and disgust intensity across different indices (e.g., the interviews combined, the BATs) predicted greater feelings of both fear and disgust in response to the thought of only having tap water to drink when children were really thirsty. In partial support of hypotheses, greater avoidance of interacting with the threat-relevant evocative items from the BATs predicted the belief that tap water only (and not bottled water) could make you sick.

Are There Age-Related Differences in Children's Differentiation Between Fear and Disgust?

Differentiation of fear and disgust was not significantly related to children's age. My first question tested whether children's age related to the extent to which their emotion self-reports indicated an underlying awareness of fear and disgust as different in contexts of potential threat. Contrary to expectations that I would find a linear developmental pattern of greater differentiation with increasing age, no significant associations emerged. This could mean that children across all ages of my sample indicated similar differentiation of fear and disgust, meaning that this fundamental aspect of fear/disgust understanding emerges early and is not meaningfully changing across ages 4 – 7.

An alternative explanation for the lack of linear association between age and differentiation could be that this sophisticated component of emotion understanding is more strongly related to individual differences in children's unique experiences and characteristics than their age. For example, parents socialize their children's emotions in part by discussing and reminiscing about emotional experiences with them. Greater parent-child discussion of emotional experiences, including use of more emotion language and discussion of the causes of emotions, predicts children's more sophisticated emotion understanding (Van Bergen & Salmon, 2010). Parent-child conversations foster children's language development, which is also linked to the sophistication in children's emotion understanding (De Stasio, Fjorilli, & Di Chiacchio, 2014; Pons, Lawson, Harris, & De Rosnay, 2003). Prior work reveals that 3 to 6-year-old children's verbal ability relates to their emotion understanding, and specifically to their ability to recognize emotions and understand the external causes of emotions (De Stasio et al., 2014). In addition, children's own unique characteristics (e.g., trait-level differences in psychophysiology, temperament) is also associated with their emotion competency. For example, individual differences in children's resting respiratory sinus arrhythmia (RSA), an important indicator of parasympathetic nervous system functioning, relates to children's emotion regulation capacities (Calkins, Graziano, & Keane, 2007; Santucci, Silk, Shaw, Gentzler, Fox & Kovacs, 2008). Children who have a higher resting RSA use more adaptive emotion regulation strategies than children with a lower resting RSA (Santucci et al., 2008). Furthermore, findings from a number of studies suggest that the extent to which parent emotion socialization practices relate to children's understanding, expression, and regulation of emotions is qualified by underlying differences in children's vagal tone, an important indicator of their parasympathetic nervous system functioning (Hastings & De, 2008; Perry, Calkins, Nelson, Leerkes, & Marcovitch, 2012). Thus, parent-child emotion socialization practices and individual differences in children's psychophysiology may be better markers of children's nuanced emotion understanding, and the extent to which they differentiate between fear and disgust, than their age.

Prior research reveals that after age 5, children demonstrate more accurate abilities to label specific situations and facial expressions as fear versus disgust, suggesting improvements in their comprehension of different threat emotion categories and the boundaries between them (Widen & Russell, 2003; Widen & Russell, 2010 a, b; Widen, 2013). These findings are why I hypothesized that there would be age-related increases in the extent to which children indicate differentiation of fear and disgust emotions. But, the majority of this prior work relies on paradigms that ask children to identify the emotion evoked by a situation or expression by selecting among a range of emotion labels, choosing one (Stein & Levine, 1989; Widen & Russell, 2008; Widen, 2013), thus testing their *explicit* knowledge of emotion differences (e.g., out of all these different emotions, the facial expression in this picture fits sadness better than fear, anger, disgust, or happiness). Had I explicitly asked children about both emotions, for example, by asking whether each elicitor was more fear or more disgust evoking (does this make you feel more scared or more disgusted?) or asked them to choose one emotion that captures how they feel out of several choices, I may have found a linear developmental pattern consistent with the emotion identification and labeling research findings. In contrast, I asked children to report both how disgusted and how scared each item made them *feel* and used the differences between their ratings to derive an implicit measure of differentiation. The extent to which children are reporting that an item or situation made them *feel* disgust or *feel* fear requires their awareness, insight, and understanding of their own subjective emotional experience which varies by person, even in adulthood. For example, enhancing adults' emotion awareness is an important component of many forms of mental health therapy (Cheung & Ng, 2019). Thus, another reason I may not have found age-related associations is because my derived measure of implicit differentiation may inadvertently capture myriad emotional processes. Some of these processes, like emotional awareness/insight, would be uniquely informed by individual children's personal characteristics and experiences.

In interpreting my emotion differentiation findings, it is also important to consider what the quantified scores on this measure actually represent. To calculate a measure of differentiation I relied on correlations between children's intensity ratings of fear and disgust, and several patterns of response are potentially obscured by this approach. For example, high differentiation scores (weaker positive correlations or negative correlations) could comprise low consistency in children's rated fear and disgust in response to the different elicitors, as well as more systematic reports of feeling one emotion more intensely than the other (more negative correlation values). In contrast, a low differentiation score (represented by a stronger positive correlation) could have resulted from children feeling either very little of any emotion, or very much of both emotions. In future work, it will be important to consider alternative computations of differentiation that can better pinpoint the specific pattern of children's responding, providing more nuanced information about whether a specific type of differentiation may be changing across childhood and relating more strongly to other aspects of emotion functioning.

To date, little empirical work has focused on understanding the conceptual boundaries between fear and disgust or the extent to which people report experiencing both emotions in response to a potential threat. In my study, low emotion differentiation scores may not have been a result of difficulty understanding the boundaries between discrete emotions, but instead could reflect children reporting that they felt both emotions concurrently. Interestingly, a few recent studies with adults proposes the existence of an unnamed emotion category that is akin to a blend of fear and disgust, evoked by stimuli that have the potential to both transmit disease and pierce the skin (e.g., such as snakes, insects, skin lesions, needles). This emotion state often gives people chills and people describe it colloquially as giving them the "heebie jeebies" or the "creeps," (Blake, Yih, Zhao, Sung, & Harmon-Jones, 2016; Harmon-Jones, Harmon-Jones, & Summerell, 2017). It is therefore possible that children who reported both fear and disgust were describing this subjective experience – one that we do not have a label for yet in English. Future work using an item-level analysis could test whether the extent to which children indicate differentiation of fear and disgust varies by the extent to which each item has potential to cause immediate physical pain and also spread disease.

Differentiation was not significantly related to understanding of contagion or conservation of matter. I had also hypothesized that components of children's cognitive development which were theorized to be important for a deep understanding of disgust, such as their understanding of contagion and conservation of matter (Hejmadi, Rozin, &

Siegal, 2004; Rozin & Fallon, 1987; Siegal, 1988, Siegal & Share, 1990; Stevenson et al., 2010) would relate to the extent to which they differentiated between fear and disgust, which was not supported. Partialling age also did not substantially change any associations between conservation of matter understanding and differentiation. The only study I know of that has tested the theoretical assumption that in order to have an understanding of disgust children need to understand both contagion (e.g., germs can be spread through contact) and conservation of matter (amount of matter remains the same, even if it appears different in shape or form) was done by Stevenson and colleagues (2010). Stevenson found that even toddlers engage in avoidance behaviors in the presence of typical disgust elicitors. Furthermore, older children who understood contagion and conservation of matter and those who did not demonstrated typical avoidance behaviors, suggesting that this level of cognitive sophistication is not needed to appraise a stimulus as a potential threat and avoid it. However, although behavioral avoidance suggests an item is perceived as aversive and potentially threatening, avoidance in response to a disgust elicitor does not mean that children felt "disgust". My null findings suggest that at least across the ages of 4 to 7, an understanding of contagion and conservation of matter – cognitive components that are important for understanding that coming into contact with contaminated items can spread pathogens and produce illness and infection – is not related to whether or not children report feeling different threat-relevant emotions (e.g., differentiation) in response to typical fear and disgust elicitors. Perhaps in future work, asking children *why* they find something disgusting (e.g., ability to spread germs and disease, resembles items that could carry germs/spread illness, reminds us of our animal nature) or scary (e.g., because it could hurt me, because it is dangerous) might better help clarify *why* children demonstrate more or less differentiation of threat-relevant emotion experiences.

Taken together, this set of null findings suggests that neither children's biological age nor components of their cognitive sophistication (i.e., contagion or conservation understanding), related to differentiation of fear and disgust. Investigating individual differences, like parent emotion socialization and psychophysiology, as well as assessing children's reasoning for reporting fear or disgust may be important for better clarifying what influences differentiation of threat relevant emotions across ages 4 to 7.

Differentiation did relate to the intensity of reported disgust or fear. Although I did not have specific hypotheses, I explored the extent to which children's differentiation of fear and disgust in response to discrete types of threats (e.g., fear elicitors from the KFQ and disgust elicitors from the DES-C) related to their reported feelings of fear and disgust throughout the study. Children who indicated less differentiation of fear and disgust in response to typical fear elicitors (e.g., the KFQ), meaning that they provided more consistent ratings of both fear and disgust, reported more intense feelings of disgust in response to these fear elicitors. This suggests that a pattern of low differentiation in response to the typical fear elicitors was due to children reporting them as evoking more intense feelings of both fear and disgust.

In general, children reported greater disgust than fear in response to the potentially threatening items presented to them in person (the BATs). Related to this, I found that children who indicated less differentiation of fear and disgust when asked about typical fear elicitors hypothetically (the KFQ) reported greater *fear* when presented with potentially threatening items in person (the BATs). Together, these findings indicate that children who are reporting more similar fear and disgust ratings in response to hypothetical fear elicitors are perhaps interpreting the items as posing a more substantial threat. Hypervigilance to interpret ambiguous situations as threatening is a marker of different forms of anxiety disorders (Richards, Benson, Donnelly, & Hadwin, 2014). So, less differentiated feelings of fear and disgust regardless of the immediacy of the threat posed (e.g., hypothetical or in person threats) could represent more threat-biased emotional responding, providing an early marker of risk for later anxiety development. I also found that less differentiation of fear and disgust when presented with threat relevant items in person related to greater reported fear in response to those items, suggesting that this differentiation pattern was due to children reporting intense feelings of both fear and disgust and interpreting the situation as posing a greater threat more broadly. In contrast, *greater* differentiation of fear and disgust in response to typical fear elicitors (e.g., the KFQ) related to greater reported disgust when presented with items in person (e.g., the BATs). Children overall reported greater disgust than fear in response to items from the BATs. Thus, children who were perhaps more "accurately" reporting stronger fear than disgust in response to typical (hypothetical) fear elicitors were also more accurately reporting that items from the BATs were more disgusting than scary, suggesting a more correct assessment of the types and extent of threats posed.

Differentiation in response to disgust elicitors was greater than differentiation in response to fear elicitors. Findings from the exploratory paired t-test comparisons I ran to test whether differentiation was greater in response to typical fear vs. disgust elicitors (the KFQ vs the DES-C) also supports the interpretation that children's appraisals of the severity of the threat posed played a role in the extent to which they differentiated fear and disgust. I found that children showed greater differentiation between fear and disgust in response to typical disgust elicitors (e.g., the DES-C) than in response to typical fear elicitors (e.g., the KFQ).

Disgust is a feeling evoked in response to a less immediate/impending threat than fear. People can engage in hygiene or health promoting behaviors to neutralize the threats that disgust elicitors pose, such as by wearing gloves, washing hands, or taking medicines (Curtis & Biran, 2001), making the perceived consequences of engaging with them less concerning than the consequences of engaging with things that typically elicit fear. Furthermore, some research suggests overlap between certain types of disgust and feelings of amusement (e.g., children are amused by poop or insects; Hemenover & Schimmack, 2007; McGraw & Warren, 2010). To the extent that disgusting items are perceived as less threatening (as they should be) or a disgusting item evokes positive feelings as well, then the perceived severity of threat the disgusting item poses should be reduced. It may be easier for children to be aware of and more clearly identify and distinguish between the specific threat relevant emotions they feel when the elicitor is perceived as posing less of a threat. This could be why differentiation was greater in response to typical disgust elicitors than fear elicitors.

Differentiation in response to hypothetical threats was greater than differentiation in response to items presented in person. Further support for the idea that differentiation is greater in response to the perception of a less severe threat comes from the finding that differentiation in response to items presented to children hypothetically (i.e., in the interviews) was greater than differentiation in response to the potentially threatening items they were presented with in person (e.g., from the BATs). In contexts where the potential consequences of engagement with the threat may be *perceived* to be more immediate and severe, children's responses indicated less differentiation of threat-relevant emotions. Of note, this also suggests that the extent to which a child appraises a potentially threatening situation as having a more severe or imminent consequence might explain individual differences in differentiation and the intensity of emotions that children feel. Furthermore, the extent to which children differentiate between fear and disgust in response to an ambiguous or potentially threatening situation likely reflects individual differences in their threat severity assessments or appraisals. Children who appraise an ambiguous or potential threat situation as posing a more severe threat demonstrate less differentiation of threat-relevant emotions.

Do attention patterns vary across fear and disgust contexts or relate to children's emotional responding?

Patterns of attention did not vary by threat context or relate to differentiation. Drawing on prior work examining components of attention using computer-based reaction-time tasks (Charash & McKay, 2002; Van Hooff, Devue, Vieweg, & Theeuwes, 2013), I hypothesized that children's attention would look different across a fear and disgust context (e.g., dinosaur or trashcan free-play). However, my prediction that children would demonstrate quicker attention orienting and disengagement in a fear context than in a disgust context was not supported. I found no differences in how quickly children oriented their attention towards the potentially threatening stimulus (e.g., dinosaur or trashcan), the overall proportion of time they spent looking at it, or in how quickly they disengaged their attention from the potential threat after first looking at it.

In a similar vein, I had also hypothesized that attention patterns that are more stereotypic of each type of threat would predict children's greater differentiation of fear and disgust. Thus, faster attention orienting and disengagement in the fear context (the dinosaur free-play), which is typical in response to fear elicitors (Charash & McKay, 2002; Van Hooff, Devue, Vieweg, & Theeuwes, 2013) would relate to greater differentiation of fear and disgust. In addition, faster attention orienting but slower disengagement in the disgust context (the trashcan free-play) would also predict greater differentiation. However, I found no support for these predictions either.

Because the majority of work on attention across fear and disgust contexts has used reaction times in computerized tasks, the first explanation I can forward for this lack of hypothesized effects is that in the real world there may not be large differences in how people direct their attention towards different types of threats. Second, the manipulation check suggests that a substantial proportion of children found both the dinosaur and the trashcan to be disgusting as well as scary. Whereas children found the garbage can more disgusting than scary, they rated the dinosaur as being equally disgusting and scary. Thus, children experienced similar emotions in the two contexts and the lack of free-play condition differences could be because both contexts evoked similar negative emotions and were perhaps thus appraised as being highly similar in terms of the severity/imminence of threat they posed.

An alternative explanation is that the paradigm (free-play; perturbation; free-play) evoked a stronger and more robust response across participants than the specific emotion evoked by the stimulus. In other words, children in both free-play conditions experienced an unexpected activation of a potentially threatening item in the room, and this task demand blotted out the more subtle discrete emotion effects of the novel stimuli. To the extent that children's appraisals of the threat severity of this situation were similar across conditions, and they were all responding to the recognition of a general threat instead of a nuanced distinction of the type of threat posed, there would be no attention pattern differences. Because the novel stimuli used in both free-play contexts were negatively valenced objects, I am unable to determine whether the novelty and unexpectedness of the active stimulus is what produced a similar attention pattern or whether the similar pattern was because children perceived the ambiguous contexts as similarly threatening. A comparison condition with a positive active stimulus (e.g., a colorful neighing unicorn) would help to determine whether the attention patterns did not differ because of novelty or because both situations were perceived as similarly threatening.

Attention patterns did not relate to children's self-reported fear and disgust intensity. Based on previous work on anxiety linking specific attention patterns to exaggerated negative emotional responding, I predicted that children who reported greater disgust or fear intensity would a) demonstrate quicker attention orienting towards the potentially threatening stimulus, or b) demonstrate a longer overall proportion of time spent looking at the potentially threatening stimulus or c) demonstrate slower attention disengagement after first looking at the potentially threatening stimulus (Pérez-Edgar, Bar-Haim, McDermott, Chronis-Tuscano, Pine, & Fox, 2010; Rothbart & Derryberry, 1981; Schechner et al., 2012). I did not find support for these hypothesized associations.

It is important to mention that the current study is the first to examine patterns of attention across different emotion contexts using an ambulatory mobile eye-tracking paradigm. The majority of work examining how attention patterns relate to individual differences in emotion responding have relied on computer-based paradigms that measure reaction time data recorded in milliseconds (Pérez-Edgar et al., 2010; Perez-Edgar et al., 2014; Schechner et al., 2012), and thus lack ecological validity. Studies that have examined attention using more ecologically valid novel free-play paradigms with evocative stimuli, similar to what I did, have primarily been conducted with toddlers and very young children. In this work, however, attention is captured more globally by recording how many seconds a child's head is directed towards or away from an evocative stimulus or by using a Likert scale to make a global assessment of attention. Thus, ecologically valid measures of children's attention in affective contexts often lack precision in their estimates of what, specifically, children's visual attention is focused on and for how long (Buss & Goldsmith, 1998; Kiel & Buss, 2011; Waters & Kershaw, 2015). Improving on these prior investigations, I used mobile eye tracking to measure millisecond level shifts in attention in a real-world context that allowed for precision in both the specific item children focused their visual attention on, when they did so, and how long. These measurement differences could explain in part why I did not find the previously documented associations between attention and children's emotional responding. One study with 5- to 7-year-old children published very recently did use mobile eye tracking in a real-world ambiguous threat context and investigated whether different patterns of attention would be demonstrated by children characterized as being more or less behaviorally inhibited (e.g., extreme shyness), a risk factor for development of social anxiety (Fu, Nelson, Borge, Buss, & Perez-Edgar, 2019). These authors measured some similar components and patterns of attention in a potential threat situation as I did and tested whether attention was linked to individual differences in children's negative emotionality and also found no associations.

Children's ability to manage, control, and direct their own attention in response to a threat is an important component of the emotion regulation process (Gross & Thompson, 2007; Gross, 1998; Gross 2015; Mauss et al., 2007). Disengaging attention from a negative emotional stimulus – distraction -- is a typical emotion regulation strategy that is demonstrated throughout childhood and is common in adulthood as well (Gross, 1998; 2015; Sillars & Davis, in prep, Zimmer-Gembeck & Skinner, 2011). But, the same attention pattern may represent poorer or more effective underlying emotion regulation. For example, longer time spent looking at the potentially threatening stimulus could have been because children were interested in it to begin with and were better able to regulate any negative emotions evoked from being initially startled by it once it became active. Yet, this same attention pattern also could have been because children felt threatened by the potentially threatening stimulus to such an extent that they were unable to withdraw their attention from it. Similarly, less time spent looking at the potentially threatening stimulus overall could be because children were able to effectively disengage their attention from the threat, reflecting better emotion regulation. However, this same attention pattern could arise from children feeling such intense negative emotions that they could not look at the stimulus. To the extent that the same attention pattern represents different underlying emotional experiences, and could widely be influenced by individual differences in children's effectiveness of emotion regulation, I would not find a main effect of the attention indices I used and fear or disgust intensity.

In future planned extensions of my dissertation work, I plan to use the recording from the overhead cameras to code a variety of children's behaviors from the free-play, such as the severity of behavioral distress (e.g., tense body posture, rigid motion), proximity to the stimulus (e.g., maintaining distance vs. remaining or moving closer), the vigor with which they played with the free-play toys (e.g., the extent to which children continued to actively play with the toys in the room after the stimulus became active), and the presence of smiling. I hope to leverage these indices of children's emotion experience and measures of their cardiac physiology to better contextualize and tease apart profiles of attention during these episodes. For instance, this approach would allow me to potentially distinguish between children who stared at the stimulus because they felt threatened by it versus those who stared at the stimulus because they found it amusing. These more nuanced attention regulation profiles will likely relate to aspects of children's emotional responding more broadly, such as the intensity with which individual children reported feeling disgust or fear.

Do Aspects of Children's Emotion Development Relate to Their Water-Related Preferences, Emotions, and Beliefs?

The perception of tap water as a potential threat should be heavily influenced by individual appraisals. That is, tap water does not represent a specific discrete emotion context. Unlike encountering a burglar (e.g., a fear context) or vomit (e.g., a disgust context) it is not clear that tap water ought to evoke any particular negative emotion (or any emotional reaction at all). Thus, to answer my last research question I used versions of the emotion and attention measures that collapsed across the discrete emotion contexts (emotion differentiation and overall fear and disgust ratings from the interviews combined; differentiation scores and fear and disgust ratings from the BATs).

Less differentiation was association with more intense negative emotions at the thought of only having tap water to drink. I first explored whether differentiation of fear and disgust related to drinking water preferences, negative emotions about tap water, and beliefs that water is contaminated (e.g., that it can make you sick). I found no associations between differentiation and children's preferences for drinking bottled water. The lack of association between this aspect of children's emotion understanding and their reports that bottled water is better could be that a preference for bottled water is likely related to a number of factors beyond just emotion-related appraisals. For example, preferences could be reflecting preferred tastes, convenience, or children merely enjoying the experience of drinking out of a water bottle.

I did find that less differentiation, regardless of the assessment measure I used to compute it (e.g., the interviews, the BATs), was associated with greater reported feelings of fear at the thought of being very thirsty and only having tap water to drink. Interestingly, less differentiation did not predict greater disgust at the thought of being very thirsty and only having tap water to drink. Children reported greater disgust than fear at the thought of only having tap water to drink if they were really thirsty. So, it is not the case that in general the thought of drinking tap water makes children more scared than disgusted. However, children who reported greater fear at the thought of only having tap water to drink if they were really thirsty also reported greater disgust.

Considering these findings along with the differentiation and emotion intensity results from my first research question suggests that children who are differentiating less between fear and disgust may be interpreting potential real-world threats as more imminent or severe, as evidenced by the greater reports of fear at the thought of drinking tap water – an emotion evoked in response to elicitors that pose a more immediate or severe threat to bodily harm. It is important to note that this follow-up question of how scared children would feel if they only had tap water to drink was only asked of children who had previously responded that even in situations of extreme thirst (e.g., "when you are REALLY thirsty") bottled water would be better than tap water. This suggests that having a threat-bias predicts stronger feelings of fear to tap water even in situations where children might be very thirsty and in need of water. Fear is a powerful motivator of avoidance behaviors. To the extent that these more extreme feelings of fear contribute to children's avoidance of drinking water, they may carry serious health consequences. Future work should therefore try to assess the real-world health-related consequences of children's underlying understanding of fear and disgust. Importantly, my findings reveal that fears of drinking tap water need to be addressed early in development.

Attention patterns were not significantly related to children's water-related preferences, emotions, or beliefs. I had hypothesized that attention patterns that typically characterize negative emotional responding (e.g., quicker attention orienting, longer total looking duration, or slower attention disengagement; Bar-Haim, 2010; Rothbart & Derryberry, 1981; Schechner et al., 2012) would relate to preferences for drinking bottled water, greater negative emotions towards drinking tap water, and the belief that tap water is contaminated, which was not supported. As explained earlier, I believe that a main reason why I did not see associations between children's attention patterns and their beliefs and emotions towards this real-world potential threat is because the same attention pattern could reflect different underlying emotion experiences. In order to more fully capture how attention patterns relate to emotion experiences, one approach would be to consider whether a given attention pattern was a result of more or less effective emotion regulation and separate out an attention outcome that is the result of more or less effective regulation. In future extensions of this work, I also plan to investigate whether unique attention regulation profiles can be established and to what extent these attention regulation profiles are reflective of how children are interpreting and appraising real world threats, which should therefore relate to their negative emotions and beliefs about tap water.

More intense feelings of fear and disgust related to stronger negative emotions about tap water

My final hypothesis was that greater reported fear or disgust intensity would relate to children's preferences for bottled water, more intense feelings of disgust or fear at the thought of only having tap water to drink in a situation of extreme thirst, and the belief that tap water only (but not bottled water) could make you sick. I did not find any associations between the intensity of children's reported fear and disgust and children's preferences for bottled water. Again, this is likely because a number of factors that are not heavily tied to children's negative emotional responses (e.g., taste preferences, convenience) are likely motivating preferences.

Greater disgust intensity and greater fear intensity, regardless of the assessment measure I used (e.g., the interviews, BATs) each independently predicted greater reported fear at the thought of only having tap water to drink if children were really thirsty as well as greater reported disgust. This suggests that children who have greater threat biases in general, as evidenced by relatively greater reported disgust or fear intensity in response to hypothetical (e.g., the interviews) and potential threats presented in person (e.g., the BATs) are attributing both threat relevant emotions to the experience of drinking tap water. Thus, even at very young ages, children's general threat-biases may already be playing a role in their appraisals of tap water as a substantial threat.

Interestingly, greater reported fear in response to the potentially threatening items presented to children in person (e.g., during the BATs, which were rated overall as more disgust-evoking) related to greater feelings of both fear and disgust towards the thought of only having tap water to drink if children were very thirsty. Yet, greater reported disgust to the potentially threatening items presented in person only predicted greater disgust towards the thought of only having tap water to drink. Mean level analyses revealed that in general, children found the BAT items to be more disgusting than scary. So, reporting greater fear in response to these items may be more reflective of a general threat bias whereas greater disgust in response to the BAT items may reflect more disgust sensitivity, specifically. I also found that greater avoidance of the potentially threatening items presented to children in person (e.g., BATs) related to the belief that water from the sink, but not water from the tap could make people sick. Although I did not assess the extent to which children actually avoid drinking tap water, this finding suggests that even young children are holding beliefs that drinking tap water can make them sick and this belief might relate to their avoidance of drinking tap water.

Thus, from young ages children are already developing beliefs that tap water is disgusting, scary, and can make them sick. The beliefs and emotions they feel towards this potential threat are related to individual differences in children's understanding of fear and disgust and individual differences in how intensely they feel each emotion, implicating a general role of threat bias in children's early attitudes towards tap water. The finding that less differentiation of fear and disgust related to stronger feelings of both fear and disgust at the thought of only having tap water to drink is important. The bulk of work on emotions underlying water-related beliefs and behaviors suggests that disgust underlies adult's rejection of novel wastewater treatment solutions and tap water (McLeod et al., 2015; Rozin, Haddad, Nemeroff, & Slovic, 2015; Wester et al., 2016).

My work suggests that both fear and disgust threat-relevant emotions may be important in understanding why some people have such strong reactions towards tap water and reject it. Furthermore, recent work suggests that among adults, more intense feelings of the emotional experience I described earlier as the "heebie jeebies", a blend of both fear and disgust, relates to their strongest opposition and rejection of genetically modified foods and novel technologies (Royzman, Cusimano, & Leeman, 2017). My findings with children in part parallel this work. To promote more sustainable water consumption behaviors and acceptance of cost effective and efficient water solutions, water education programs and campaigns may want to start early, targeting the emotions and threat appraisals of very young audiences.

Limitations

Several limitations of this study bear mention. First, it must be noted that the sample size is relatively small and findings must be interpreted with caution. Second, although I can infer from the correlations between my differentiation measure and children's fear and disgust intensities that much of the lower differentiation scores was from greater reported intensity of both emotions, the differentiation measure I used obscures understanding of how each unique differentiation situation (e.g., low reports of both emotions, high reports of both emotions, less systematic pattern of reporting each emotion, opposite patterns of reporting each emotion) might relate to other aspects of children's emotion understanding. Third, because my only measure of emotion understanding was the extent to which children reported fear and disgust in response to different types of elicitors I am unable to rule out that my results are due to children's difficulties with understanding the boundaries between fear and disgust. Future work should not only assess differentiation implicitly, like I did here, but also assess explicit differentiation and the extent to which children understand that a situation or a specific elicitor may be more disgust or fear evoking. An analysis of the extent to which each item that children were presented with has the potential to a) pierce the skin and b) spread disease, virus or infection would be fruitful to pursue. This item by item analysis combined with an assessment of the extent to which children rated each as being scary or disgusting might help pinpoint whether there are specific categories of evocative situations or stimuli that evoke both fear and disgust from most children. This could provide novel insight into the extent to which children demonstrate experiences and awareness of this potentially new "heebie jeebie" discrete emotion category and clarify to what extent children are aware of the boundaries of fear and disgust.

This study did not investigate how differences in children's characteristics and experiences relate to the extent to which they indicate differentiation of fear and disgust. Perhaps individual differences in children's psychophysiology or parent emotion socialization practices might more strongly relate to individual differences in the extent to which children are differentiating between their different emotions in early childhood than their age. I was also not able to establish whether greater or less emotion differentiation is the more adaptive pattern for children of these ages. It might be that greater differentiation in a disgust context but less differentiation in a fear or more powerful threat context, which reflects the general pattern that I found when comparing mean level differentiation across measures, is more adaptive. To assess whether there is a more adaptive differentiation pattern in childhood, future work could assess children's mental health symptoms and test whether different types of differentiation (e.g., more or less in response to specific emotion contexts, reporting more intense feelings of both emotions, reporting less intense of both emotions, etc) relate to more or less mental health symptoms. Given that fear and disgust are both believed to underlie certain categories of mental health problems, like obsessive compulsive disorder and specific phobias that can onset in childhood (Buss & Kiel, 2013, Kessler et al., 2005, 2007, Olatunji, Cisler, McKay & Phillips, 2010; Olatunji, Lohr, Sawchuk, & Tolin, 2007), understanding to what extent these different mental health symptoms are predicted by different differentiation patterns in response to different types of threat contexts (e.g., disgust, fear, "heebie jeebies") could pinpoint more fine-grained emotion understanding processes to target in intervention work.

Because my free-play paradigm only included two different negative emotion contexts I am unable to speak to whether I did not find attention differences because children did not feel substantially different emotions in response to the dinosaur versus trashcan or because the overall novelty and unexpectedness of the activated potentially threatening stimulus in the free-play paradigm produced a stronger negative emotional experience that obscured the influence of emotions that the stimulus evoked on its own. Future work comparing attention across different negative emotion contexts should also include a positive emotion condition to improve interpretability of findings and the ability to attribute the results to specific emotion contexts.

Finally, although I demonstrated that children can have strong negative emotional reactions to tap-water I did not assess the actual real-world health-related impact this might have on young children's lives. Future work should assess to what extent children's early fear and disgust towards the thought of drinking tap water impacts whether they actually drink water in everyday life.

Conclusions

This study made several novel contributions to the scientific understanding of children's emotion development. First, findings suggest that children differentiate between feelings of fear and disgust in response to potential threats from very young ages (e.g., 4 years). Second, children appear to differentiate more between fear and disgust in response to disgust elicitors than they do fear elicitors and, differentiate more in response to elicitors asked in an interview rather than presented in person. These patterns suggest that the appraisal of the severity or immediacy of the perceived threat might be playing a role in the extent to which children differentiate between fear and disgust, with less differentiation documented in contexts of greater potential threat severity. Third, I did not find any attention pattern differences across two different threat contexts in one of the first studies to use mobile eye tracking to examine links between attention and components of children's emotion responding. Finally, I found that early individual differences in children's understanding of fear and disgust (assessed via differentiation) related to their beliefs and emotions about drinking tap water. Children who showed less differentiation between their feelings of fear and disgust may be generating more severe appraisals of real-world potential threat situations, like drinking tap water. Greater avoidance of items that children generally deemed as being more disgusting related to the belief that only tap water could make children sick. Results from this dissertation thus suggest that feelings of fear and disgust about tap water and perceptions of municipal tap water as posing a substantial threat should be addressed very early in development in order to promote effective acceptance of more sustainable water reuse solutions among the general public.

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Appendix A

Full Procedures for Larger Study

1. Greeting & introduction
2. Consent and assent procedures
3. Emotion face scales training
4. Emotion self-report 1
5. Hedonic like/dislike scale training
6. Electrode placement for mom and child
7. Cardiac electrode acclimation
8. Dyadic cardiac baseline 1
9. Cardiac baseline 1
10. Emotion self-report 2
11. Computer tasks (Flanker & Posner)
12. Emotion self-report 3
13. Cardiac baseline 2
14. KFQ & DES-C interviews
15. Cardiac baseline 3
16. Emotion self-report 4
17. Contagion, conservation, and conformity interview
18. Tap water interview
19. Emotion self-report 5
20. Cardiac baseline 4
21. Eye-tracking placement/Calibration #1 & Cardiac baseline 5 for parent only
22. Free-play child alone
23. Emotion self-report 6
24. Free-play with parent
25. Emotion self-report 7
26. Calibration # 2 & eye-tracking removal
27. Dyadic free-play conversation task
28. Dyadic cardiac baseline 3
29. Emotion self-report 8
30. BAT tasks
31. Emotion self-report 9
32. Dyadic BAT conversation task
33. Dyadic cardiac baseline 4
34. Emotion self-report 10
35. Recovery -- 2 min sitting
36. Electrode removal
37. Prizes & debriefing

Appendix B

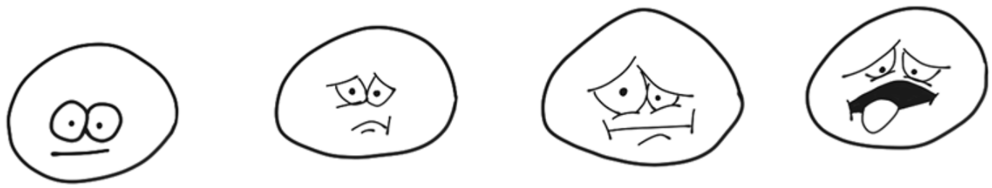
Procedure Order for Dissertation

1. Greeting & introduction
2. Consent and assent procedures
3. Emotion face scales training
4. KFQ & DES-C interviews
5. Contagion, conservation, and conformity interview
6. Tap water interview
7. Eye-tracking placement/Calibration #1
8. Free-play child alone
9. Calibration # 2 & eye-tracking removal
10. BAT tasks

Appendix C

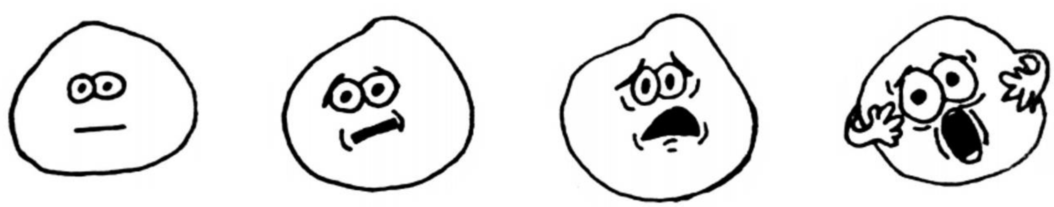
Emotion Report Scales

Grossed out/Disgusted:



Not at all | A little | Pretty much | Very

Scared:



Not at all | A little | Pretty much | Very

Appendix D

Emotion Report Scales Training Procedure

"Today we are going to play a lot of different games, and sometimes we will ask you to tell us what you are feeling".

Show SCARED face scale and say: "You can use these faces to tell me how scared you feel at different times today, ok? So, if you feel 'Not At All' scared, you point to this one (point to 1st face). If you feel 'A Little Scared' you point to this one (point to 2nd face). If you feel 'Pretty Much Scared' you point to this one (point to 3rd face). But if you feel 'Very' scared, you point here (point to 4th). Now you try it - show me where you point if you feel 'A LITTLE' scared." (Correct if wrong.)

Show DISGUST face scale and says: "You can use these faces to tell me how Grossed out or Disgusted you feel at different times today, ok? So if you feel 'Not At All' Grossed out or Disgusted , you point to this one (point to 1st face). If you feel 'A Little Grossed out or Disgusted ' you point to this one (point to 2nd face). If you feel 'Pretty Much Grossed out or Disgusted ' you point to this one (point to 3rd face). But if you feel 'Very' Grossed out or Disgusted , you point here. Now you try it - show me where you point if you feel 'VERY' Grossed out or Disgusted ." (Correct if wrong.)

Appendix E

Items from the KFQ

"Okay, now I am going to say a bunch of things. For each thing I say, I want you to show me how scared it makes you feel and then I will also ask you how disgusted or grossed out it makes you feel. So for example, if I say "eating a tasty pie", I want you to show me if that makes you feel not at all scared, a little scared, pretty much scared or very scared. [point to each corresponding face]. Ok? So now you show me. Eating a tasty pie. How scared does that make you feel?" [allow C to point to Koala face]. Great! Now, eating a taste pie, how disgusted does it make you feel?

1. A frightening movie
2. Rats or mice
3. Ghosts
4. Witches
6. Being teased by other kids
7. Lions
8. Getting sick
9. Getting lost and not seeing your parents anymore
10. Being hit by a car
11. Hearing your parents arguing
12. Being high in the sky
13. Snakes
14. Being in the dark
15. A man who wants to take you away (a kidnapper)
16. A burglar breaking into your house
17. Thunderstorms
19. Roller coaster
20. Scary dreams
21. Flying in an airplane
23. Fire
25. War
26. Spiders
27. Death
28. Getting a shot
29. Crocodiles
30. Blood
31. Parents getting divorced

Appendix F

Items from the DES-C

1. A glass of spoiled milk that has gone bad
2. A hamburger turned green with age
3. An old cup of coffee with green mold in it
4. A slice of bread with green mold on it (rotting foods)
5. A pile of rotting lettuce
6. Having blood drawn from your arm
7. Receiving a needle injection in the arm (body envelope)
8. A bottle with your blood
9. A small tube of your blood
10. Handling an injection needle, like the kind a nurse uses
11. Receiving a needle injection in the mouth like when you are at the dentist
18. The smell of throw up
20. The dead body of a dog that has been run over
21. A person hurt in a car accident
22. Seeing a surgery operation happen, like someone getting a new eye (body violation)
23. Pictures of hurt soldiers
24. A dead person that you don't know
25. A dead animal lying on the road for some time
28. The sight of a large slug
29. A piece of rotting steak

Appendix G

Contagion Task

[Show a cartoon image of a sick boy, Timmy, in bed]

"Here is a picture of Timmy. Timmy is not feeling good and has a bad cold. How do you think Timmy got the cold?

[Show a cartoon image of the same boy, Timmy, having a

"Do you think Timmy got sick because he was naughty?" [point to tantrum picture]

[Show a cartoon image of a different boy sick in bed]

"Or because he played with his friend who had a cold [point to picture of sick friend]?"

Appendix H

Water Conservation Task

Step 1. Here is a glass of water

Step 2. Now a teaspoon of sugar is being added.

Step 3. And it is getting stirred together.

Step 4. I want to know what YOU think. Why can't we see the sugar anymore? "Did it break into tiny pieces we can't see or did it just turn into plain water?"

Appendix I

Water Interview

[Start by showing children side by side images of water from the sink (tap water) and water from a bottle (bottled water)] Keep the images side by side on the table during the entire water interview.

E1: Both of these are pictures of water. This is water from the sink (point to picture). This is water from a bottle (point to picture).
I want to know what <u>you</u> think. Which water is better? Is water from the sink better to drink, is water from a bottle better to drink, or are they both the same? Point to which water you think is better: this one, this one, or both? [allow C to respond]

What about when you are REALLY thirsty? When you are REALLY THIRSTY, what do you think? Is water from the SINK better to drink (point to picture), is water from a bottle better to drink (point to picture), or are they both the same to drink? Point to which water you think is better when you are really thirsty: this one, this one, or both?
[allow C to respond[

If child picks both, jump to THOUGHTS ABOUT SICKNESS. If not, proceed.

"What if you were REALLY THIRSTY, but all you had to drink was [undesirable water source]. How SCARED would you feel if you only had ____(undesirable water source) water to drink when you were really thirsty (show <u>SCARED</u> scale)? Not At All (point), A Little (point), Pretty Much (point), or Very (point)? [c responds]

"What if you were REALLY THIRSTY, but all you had to drink was [undesirable water source]. How DISGUSTED would you feel if you only had ____(undesirable water source) water to drink when you were really thirsty (show <u>DISGUST</u> scale)? Not At All (point), A Little (point), Pretty Much (point), or Very (point)? [c responds]

PART 2. THOUGHTS ABOUT SICKNESS

Now I have one more question about what YOU think. Do you think water can ever make people sick? Can water from the sink make someone sick? Can water from a bottle make someone sick? Or can they both make someone sick? [allow C to respond].

Appendix J

Free-play Room Setup

Appendix K

Free-play Room Stimuli




Appendix L

Behavioral Avoidance Task Procedure

I am going to show you a bunch of things now and ask you some questions about them.

BAT 1. Rock.
Here is a rock. When you look at this rock, how ["scared", "grossed out or disgusted"] do you feel?" Would you like to come here to have a closer look? Would you like to touch this rock? Would you like to hold this rock? [return C back to seat]. Okay, I am going to ask you to go back and sit on your seat while I get the next thing ready.

BAT 2. Juice with Leaves.
Here is a cup of juice and here are some leaves. I am going to put these leaves in this cup of juice. When you look at this juice, how ["scared", "grossed out or disgusted"] do you feel? Would you like to come here to have a closer look? Would you like to touch this juice? Would you like to drink this juice if you were careful not to drink the leaves?

BAT 3. Used Tissue.
Here is somebody's used tissue. When you look at this tissue, how ["scared", "grossed out or disgusted"] do you feel?" Would you like to come here to have a closer look?
Would you like to touch this tissue? Would you like to hold this tissue?
[return C back to seat]. Okay, I am going to ask you to go back and sit on your seat while I get the next thing ready.

BAT 4. Maggot/Mealworms.
Here are a bunch of maggots. When you look at these maggots, how ["scared", "grossed out or disgusted"] do you feel? Would you like to come here to have a closer look?
Would you like to touch these maggots? Would you like to hold these maggots?
[return C back to seat]. Okay, I am going to ask you to go back and sit on your seat while I get the next thing ready.

BAT 5. Glass eye.
Here is a glass eye. When someone loses an eye, say in a bad accident, they put in a glass eye – into the eye socket – just like this one. [gesture by pointing to your eye].
When you look at this glass eye, how ["scared", "grossed out or disgusted"] do you feel?".
Would you like to come here to have a closer look? Would you like to touch this glass eye?

Would you like to hold this glass eye? [return C back to seat]. Okay, I am going to ask you to go back and sit on your seat while I get the next thing ready.

BAT 6. <u>Moldy bread.</u>
Here is some moldy bread. When you look at this moldy bread, how [“scared”, “grossed out or disgusted”] do you feel?” Would you like to come here to have a closer look?
Would you like to touch this moldy bread? Would you like to hold this moldy bread?
[return C back to seat]. Okay, I am going to ask you to go back and sit on your seat while I get the next thing ready.

BAT 7. <u>Dirty Diaper.</u>
Here is a diaper with poop in it. When you look at this diaper, how [“scared”, “grossed out or disgusted”] do you feel?”. Would you like to come here to have a closer look?
Would you like to touch this diaper? Would you like to hold this diaper? [return C back to seat]. Okay, I am going to ask you to go back and sit on your seat while I get the next thing ready.

BAT 8. <u>Needle.</u>
Here is a needle, like the kind that gives you a shot. When you look at this needle, how [“scared”, “grossed out or disgusted”] do you feel?” Would you like to come here to have a closer look? Would you like to touch this needle? Would you like to hold this needle?
[return C back to seat]. Okay, I am going to ask you to go back and sit on your seat while I get the next thing ready.

BAT 9. <u>Blood.</u>
Here is a bottle of blood. When you look at this bottle of blood, how [“scared”, “grossed out or disgusted”] do you feel?”. Would you like to come here to have a closer look?
Would you like to touch this bottle of blood? Would you like to hold this bottle of blood? [return C back to seat]. Okay, I am going to ask you to go back and sit on your seat while I get the next thing ready.

BAT 10. Spider.

Here is a spider. When you look at this spider, how [“scared”, “grossed out or disgusted”] do you feel?” Would you like to come here to have a closer look? Would you like to touch this spider? Would you like to hold this spider? [return C back to seat]. Okay, I am going to ask you to go back and sit on your seat while I get the next thing ready.

Appendix M

Calibration & Generated Video Example