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Anxious and Egocentric: How Specific Emotions Influence Perspective Taking

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People frequently feel anxious. Although prior research has extensively studied how feeling anxious shapes intrapsychic aspects of cognition, much less is known about how anxiety affects interpersonal aspects of cognition. Here, we examine the influence of incidental experiences of anxiety on perceptual and conceptual forms of perspective taking. Compared with participants experiencing other negative, high-arousal emotions (i.e., anger or disgust) or neutral feelings, anxious participants displayed greater egocentrism in their mental-state reasoning: They were more likely to describe an object using their own spatial perspective, had more difficulty resisting egocentric interference when identifying an object from others' spatial perspectives, and relied more heavily on privileged knowledge when inferring others' beliefs. Using both experimental-causal-chain and measurement-of-mediation approaches, we found that these effects were explained, in part, by uncertainty appraisal tendencies. Further supporting the role of uncertainty, a positive emotion associated with uncertainty (i.e., surprise) produced increases in egocentrism that were similar to anxiety. Collectively, the results suggest that incidentally experiencing emotions associated with uncertainty increase reliance on one's own egocentric perspective when reasoning about the mental states of others.

Keywords: anxiety, egocentrism, emotion, perspective taking, theory of mind

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To navigate the social world successfully, people must actively reason about what others see, know, believe, and desire. This capacity to consider others' mental states, commonly referred to as "theory of mind," is essential for communication and social coordination. Without direct access into others' minds, however, people frequently use intuitive strategies to guide their inferences about others' mental states. One such strategy entails consulting the contents of one's own mind (Goldman, 2006; Mitchell, 2009). Although one's own perspective can be a good proxy for making social predictions (Dawes, 1989; Hoch, 1987), people often rely too heavily on accessible self-knowledge during mental-state reasoning (e.g., Birch & Bloom, 2007; Keysar, Lin, & Barr, 2003; Sommerville, Bernstein, & Meltzoff, 2013). By failing to adjust for ways in which others' perspectives might differ from their own (Epley, Keysar, Van Boven, & Gilovich, 2004; Tamir & Mitchell, 2013), they set the stage for potential misunderstanding and conflict (Ross & Ward, 1996).

Many factors can affect the extent of egocentrism during mental-state reasoning; these include characteristics of both targets and perceivers. For instance, egocentrism tends to be greater with close others (e.g., friends and romantic partners) and those perceived as similar to oneself (e.g., ingroup members) than with strangers (Krienen, Tu, & Buckner, 2010; Savitsky, Keysar, Epley, Carter, & Swanson, 2011) or dissimilar others (Ames, 2004; Todd, Hanko, Galinsky, & Mussweiler, 2011). People also tend to be more egocentric when they are distracted by a concurrent task (Lin, Keysar, & Epley, 2010; Schneider, Lam, Bayliss, & Dux, 2012), under pressure to respond quickly (Epley et al., 2004), members of individualistic cultures (Wu, Barr, Gann, & Keysar, 2013; Wu & Keysar, 2007), or occupy high-power roles (Galinsky, Magee, Inesi, & Gruenfeld, 2006; Overbeck & Droutman, 2013).

In the current research, we explore a novel class of perceiver characteristics—specific incidental emotional states—on egocentrism during mental-state reasoning. Although numerous studies

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have shown that incidental emotions (i.e., those triggered by unrelated prior experiences; Bodenhausen, 1993) can color judgment and behavior in a wide range of situations (e.g., Bodenhausen, Sheppard, & Kramer, 1994; DeSteno, Li, Dickens, & Lerner, 2014; Keltner, Ellsworth, & Edwards, 1993; see Lerner, Li, Valdesolo, & Kassam, in press, for a review), research has seldom examined the effects of incidental emotions on perspective taking. In one notable exception, Converse, Lin, Keysar, and Epley (2008) found that positive affect, which can undermine the effortful processing required for overcoming egocentrism (Bodenhausen, 1993; Phillips, Bull, Adams, & Fraser, 2002), increased reliance on privileged knowledge when inferring a less-informed person's belief about an object's location. Yet, because Converse and colleagues focused on global (positive–negative) feeling states, the effects of *specific* incidental emotions—including emotions of the same valence—on perspective taking remain unknown.

The current research examines the influence of incidental experiences of anxiety, one of the most pervasive emotional states that people experience (Brooks, 2014; Brooks & Schweitzer, 2011), on perceptual and conceptual forms of perspective taking. We anticipate that incidental anxiety will increase reliance on one's own egocentric perspective, undermining understanding of others' mental states. Additionally, we explore a mechanism—uncertainty appraisal tendencies—through which anxiety may exert these egocentric effects.

Anxiety and Mental-State Reasoning

Anxiety is a discrete emotional state triggered by situations that are novel, threatening, or otherwise have the potential for negative outcomes (Brooks & Schweitzer, 2011). Anxiety is characterized by unpleasantness (i.e., negative valence) and high activity (i.e., physiological arousal) in Russell's (1980) circumplex model of affect, and by low certainty and low control in Smith and Ellsworth's (1985) appraisal framework. Although some theorists treat anxiety and fear as distinct (albeit closely related) emotional phenomena (see Öhman, 2008), following others (e.g., Brooks & Schweitzer, 2011; Gray, 1991), we conceptualize anxiety as encompassing fear as well as the related states of apprehension, nervousness, tension, and worry. Historically, anxiety research has focused on *trait* anxiety, a personality characteristic similar to neuroticism that reflects a general disposition to experience anxious feelings (Barlow, 2002; Eysenck, 1997). We focus instead on *state* anxiety, a more transitory emotional state that anyone can experience in the presence of a potential threat.

A sizable literature has shown how both trait and state anxiety shape intrapsychic aspects of cognition, such as attentional control, inferential reasoning, and risk preferences (e.g., Bishop, 2009; Darke, 1988; Eysenck, Derakshan, Santos, & Calvo, 2007; Fox, 1993; Raghunathan & Pham, 1999). Furthermore, although several studies have examined the effects of trait and state anxiety on social impression formation (e.g., Baron, Inman, Kao, & Logan, 1992; Curtis & Locke, 2007), little is known about whether and how anxiety affects social–cognitive processes involved in perspective taking.

Some recent clinical work has tested the relationship between trait anxiety and mental-state reasoning. For instance, some studies have found that adolescents high in attachment anxiety and adults meeting clinical criteria for social anxiety disorder (SAD) performed worse on a "theory of mind" task assessing the ability to discern others' emotional states from their eyes (Baron-Cohen, Wheelwright, Hill, Raste, & Plumb, 2001) than did more securely attached adolescents (Hünefeldt, Laghi, Ortu, & Belardinelli, 2013) and non-SAD adults (Hezel & McNally, 2014), respectively. Because these studies used correlational and cross-sectional designs, however, the causal effect of anxiety on mental-state reasoning, and the process(es) underlying this relationship, remain unexplored. Here, we examine whether and how incidental experiences of state anxiety triggered in one context affect reliance on egocentric information during perspective taking in an unrelated context.

We propose that anxiety-related states may be particularly relevant for perspective taking for several reasons. First, anxiety leads to decrements in executive function (Eysenck et al., 2007), a critical ingredient for resisting egocentric interference when reasoning about others' differing perspectives (Fizke, Barthel, Peters, & Rakoczy, 2014; Lin et al., 2010). Second, anxiety heightens self-focused attention (Easterbrook, 1959; Sarason, 1975), which itself can increase reliance on self-knowledge during social prediction (Fenigstein & Abrams, 1993). Third, anxiety is typically accompanied by a sense of uncertainty (Lazarus, 1991; Lerner & Keltner, 2000; Smith & Ellsworth, 1985), which itself is associated with greater reliance on accessible knowledge during judgment (Mussweiler & Strack, 2000; Tversky & Kahneman, 1974). Indeed, studies have found that enduring stressful, anxiety-inducing events—and the subjective experience of uncertainty that accompanies such events—can increase reliance on self-generated numeric anchors (Inbar & Gilovich, 2011; see also Kassam, Koslov, & Mendes, 2009). Given the substantial overlap in processes underlying adjustment from self-generated numeric anchors when making numeric judgments (Epley & Gilovich, 2001) and processes underlying adjustment from accessible self-knowledge when reasoning about others' mental states (Epley et al., 2004), it stands to reason that anxiety may operate similarly during mental-state reasoning as when making numeric judgments.

Together, this work led us to predict that anxiety would increase reliance on one's own egocentric perspective during mental-state reasoning. Testing this general hypothesis was the primary goal of the current research. A second goal of the current research was to examine a particular mechanism by which anxiety might increase egocentrism. We focused on the subjective feelings of uncertainty associated with anxiety.

Uncertainty Appraisal Tendencies and Egocentric Mental-State Reasoning

According to appraisal theories of emotion (see Ellsworth & Scherer, 2003, for a review), emotions can be differentiated along several cognitive dimensions beyond valence and arousal (e.g., certainty, control). For instance, anxiety and anger are both negative, high-arousal emotions, but they differ on the appraisal dimension of certainty. Whereas anger is characterized by appraisals of high certainty, anxiety is associated with appraisals of uncertainty about what is currently happening in one's environment and/or what will happen next (Lazarus, 1991; Smith & Ellsworth, 1985).

Building on these classic appraisal theories, Lerner and Keltner (Han, Lerner, & Keltner, 2007; Lerner & Keltner, 2000, 2001)

proposed that emotions and appraisals have a recursive relationship: Not only do particular cognitive appraisals (e.g., uncertainty) give rise to specific emotions (e.g., anxiety), but specific emotions activate specific cognitive and motivational processes, or *appraisal tendencies*, which, in turn, are responsible for the effects of specific emotions on judgment and behavior—even in contexts that are completely removed from the emotion-eliciting source (see also Raghunathan & Pham, 1999). On this view, anxiety increases the motivation to reduce uncertainty, and people often do so by selecting more certain options. Supporting this idea, studies have found that, when faced with two options that differ in terms of their risk and reward (e.g., a job with high pay but low job security vs. one with average pay but high job security), people experiencing anxiety tend to prefer the uncertainty-reducing, safer option (Raghunathan & Pham, 1999; Yip & Côté, 2013).

Extending this logic to the domain of perspective taking, we suggest that people are usually more certain about their own cognitions than the cognitions of others. Consequently, the motivation to reduce uncertainty triggered by anxiety should make people especially likely to rely on self-knowledge when inferring others' mental states, resulting in more egocentric inferences. In sum, we predicted that experiencing anxiety would increase egocentrism during mental-state reasoning, and that the uncertainty appraisal tendencies triggered by anxiety would help explain this increased egocentrism.

Overview of Experiments

We tested our key hypotheses—that anxiety would increase egocentrism and that uncertainty appraisal tendencies would drive this effect—across six experiments. In a first set of experiments, we induced incidental emotions and measured performance on perceptual (Experiments 1 and 2) and conceptual (Experiment 3) perspective-taking tasks. We predicted that people experiencing anxiety would display greater egocentrism than would those experiencing other negative, high-arousal emotions (i.e., anger or disgust) or neutral feelings. In a second set of experiments, we examined feelings of uncertainty as a potential mechanism underlying the effect of state anxiety on perspective taking. In Experiments 4A and 4B, we used an experimental-causal-chain design (Spencer, Zanna, & Fong, 2005) to test (a) whether anxiety increases uncertainty relative to anger, disgust, and neutral feelings; and (b) whether experiencing uncertainty (vs. certainty) increases egocentrism. Following the logic of uncertainty as a mechanism, in Experiment 5, we explored whether positive emotions associated with uncertainty might produce increases in egocentrism that are comparable with anxiety. We focused on surprise as a positive, uncertainty-associated emotion. Although Smith and Ellsworth (1985) identified surprise as a positive emotion (it was second only to happiness in terms of pleasantness in their analysis; see also Tiedens & Linton, 2001; Whitson, Galinsky, & Kay, 2015), other work has found that surprise is not unequivocally positive (e.g., Noordewier & Breugelmans, 2013). For our purposes, the key point is that surprise is less negative than anxiety. In Experiment 5, we also used a measurement-of-mediation design (Baron & Kenny, 1986) to test whether feelings of uncertainty stemming from anxiety and surprise predict egocentrism.

Across our experiments, we excluded data from non-native speakers, inattentive participants, and suspicious participants (i.e., those who articulated a causal relationship between the emotion induction and the primary dependent measure). These exclusions, which are discussed in greater detail in Appendix A, resulted in a reduction in sample size of no more than 12% in any experiment. Although including these participants' data reduced statistical significance in Experiment 3, in no experiment did these exclusions meaningfully alter the pattern of results (see the Table in Appendix A for complete analyses). We also report how we determined our sample sizes (see Appendix B), all manipulations, and all measures relevant for our hypotheses (Simmons, Nelson, & Simonsohn, 2012).

Experiment 1: Spontaneous Spatial Perspective Taking

In Experiment 1, we examined the effects of incidental anxiety on the spontaneous tendency to adopt another person's spatial perspective. Participants underwent an incidental anxiety, anger, or neutral emotion induction, after which they identified the spatial location of an object that could be described from their own or from another person's perspective. We predicted that, relative to participants in the anger and neutral conditions, anxious participants would be more likely to describe the object from their own egocentric perspective. We also tested whether differences in generalized arousal could explain our results.

Method

Participants and design. Native English-speaking American undergraduates ($N = 139$) participated for course credit. We excluded data from four participants with unscorable location descriptions on the spatial perspective-taking task, leaving a final sample of 135 (89 women;[1] $M_{age} = 18.51$, $SD = 0.71$). Participants were randomly assigned to an incidental emotion condition: anxiety, anger, or neutral.

Procedure and materials. On arrival at the lab, participants were greeted by an experimenter and led to an individual cubicle where they learned that they would be completing tasks for several unrelated experiments that had been combined into a single session for efficiency purposes. All experimental tasks were administered via computer.

Incidental emotion manipulation. As part an "autobiographical memory" task, participants wrote about an emotionally evocative experience from their own lives (Strack, Schwarz, & Gschneidinger, 1985); participants in the two emotion conditions received the following instructions (adapted from Gino, Brooks, & Schweitzer, 2012):

> Please describe, as best you can, a time in the past in which you felt very anxious [angry]. You might begin by describing the general feelings of anxiety [anger] you experienced in this situation. Then write about the details of the situation in which you felt very anxious [angry]. Please write in complete sentences and in as much detail as possible.

Participants in the neutral condition wrote about how they typically spend their evenings (Gino et al., 2012). Prior research has shown that this type of autobiographical recall task is a valid

[1] Across experiments, preliminary analyses revealed no moderation by participant gender.

means of inducing specific incidental emotions (e.g., Bodenhausen et al., 1994; Dunn & Schweitzer, 2005; Tiedens & Linton, 2001), including anxiety-related states (e.g., Gino et al., 2012; Kuhbandner & Zehetleitner, 2011; Lerner & Keltner, 2001; Marzillier & Davey, 2005; Whitson et al., 2015; see Lench, Flores, & Bench, 2011, for a meta-analysis), that have carry-over effects on subsequent judgments and behaviors.

Spatial perspective-taking task. Next, as part of a "pilot test for future studies," participants saw a photograph of a person sitting at a table, facing them, and looking at a book on the table (Tversky & Hard, 2009). Embedded among six filler questions about the photo (see Appendix C) was the critical question that served as our dependent measure: "On which side of the table is the book?" The book sat on the right side of the table from participants' own viewpoint; thus, we coded location descriptions mentioning "the right side" as egocentric and descriptions mentioning "the left side" as other-oriented. For descriptions mentioning both viewpoints, the first one mentioned determined the coding (see Tversky & Hard, 2009).

Manipulation check. Finally, as a manipulation check, participants indicated the extent to which the experience they described during the writing task made them feel each of a series of specific emotions (1 = *not at all*, 7 = *very much so*). We averaged items assessing anxiety (*anxious*, *nervous*, *tense*, *worried*; $\alpha = .92$), anger (*angry*, *furious*, *irate*, *mad*; $\alpha = .93$), and neutral feelings (*calm*, *indifferent*, *neutral*, *unemotional*; $\alpha = .85$). Participants also reported how much generalized arousal (*alert*, *aroused*, *energetic*, *excited*; $\alpha = .63$) they experienced as they were writing.

Results and Discussion

Manipulation check. In this and all subsequent experiments, we examined the effectiveness of our emotion induction by conducting planned contrasts using two-group comparisons (e.g., anxiety vs. anger). These contrast analyses revealed that anxious, angry, and neutral feelings were higher in the anxiety, anger, and neutral conditions, respectively, than in the other conditions ($ts > 6.93$, $ps < .001$, $ds > 1.38$). Generalized arousal was higher in the two emotion conditions than in the neutral condition ($ts > 2.38$, $ps < .019$, $ds > 0.58$). Unexpectedly, generalized arousal was also higher in the anxiety condition than in the anger condition, $t(132) = 1.99$, $p = .049$, $d = 0.38$ (see Table 1 for all *M*s and *SD*s).

Spatial perspective taking. To test our central prediction that incidental anxiety increases egocentrism, we conducted two planned contrasts (Rosenthal, Rosnow, & Rubin, 2000) using logistic regression analyses: One contrast compared the proportion of egocentric location descriptions in the anxiety condition versus the anger condition; the other compared the anxiety condition versus the neutral condition. As predicted, egocentrism was greater in the anxiety condition (34/47, 72.3%) than in both the anger condition (22/44, 50.0%; Contrast 1: $b = .961$, $SE = .444$, Wald = 4.69, $p = .030$) and the neutral condition (20/44, 45.5%; Contrast 2: $b = 1.144$, $SE = .445$, Wald = 6.61, $p = .010$). An additional comparison revealed that the anger and neutral conditions did not differ from each other ($b = .182$, $SE = .427$, Wald < 1, $p = .67$). Importantly, both the anxiety versus anger contrast ($b = .916$, $SE = .450$, Wald = 4.15, $p = .042$) and the anxiety versus neutral contrast ($b = 1.037$, $SE = .472$, Wald = 4.82, $p = .028$) remained significant when controlling for differences in generalized arousal.

Emotion intensity and egocentrism. As an additional examination of the proposed relationship between anxiety and egocentrism, we regressed the proportion of egocentric location descriptions on anxiety intensity (from the manipulation check) across all participants (see DeSteno et al., 2014, for a similar approach). As expected, reported feelings of anxiety positively predicted egocentrism ($b = .205$, $SE = .088$, Wald = 5.47, $p = .019$). When regressing egocentrism on feelings of anxiety, anger, and generalized arousal simultaneously, only anxiety emerged as a marginally significant predictor ($b = .194$, $SE = .104$, Wald = 3.51, $p =$

Table 1
Experienced Emotions by Incidental Emotion Condition (Experiments 1, 2, 3, and 5)

	Incidental emotion condition					
Experienced emotion	Anxiety	Anger	Neutral	Disgust	Surprise	Pride
Experiment 1						
Anxiety	5.21_a (1.89)	3.69_b (1.84)	2.24_c (1.22)			
Anger	1.88_a (0.86)	4.74_b (1.96)	1.66_a (0.93)			
Neutral feelings	2.24_a (1.17)	2.47_a (1.45)	4.52_b (1.53)			
Arousal	3.70_a (1.40)	3.20_b (1.22)	2.58_c (0.94)			
Experiment 2						
Anxiety	5.35_a (1.62)	3.84_b (1.33)	2.03_c (1.05)	3.52_b (1.70)		
Anger	3.31_a (1.73)	5.98_b (1.15)	1.42_c (0.80)	3.22_a (1.71)		
Neutral feelings	1.90_a (1.20)	1.84_a (1.03)	4.04_b (1.04)	2.08_a (1.05)		
Disgust	2.55_a (1.51)	3.11_b (1.65)	1.22_c (0.39)	5.52_d (1.28)		
Experiment 3						
Anxiety	4.39_a (1.78)	3.50_b (1.57)				
Anger	2.38_a (1.62)	5.39_b (1.80)				
Experiment 5						
Anxiety	5.79_a (1.66)	4.74_b (1.82)			2.85_c (2.03)	2.28_d (1.31)
Anger	2.86_a (1.98)	6.43_b (0.99)			1.88_c (1.72)	1.33_d (0.75)
Surprise	3.04_a (1.72)	4.40_b (2.01)			5.93_c (1.41)	3.21_a (1.96)
Pride	3.09_a (2.02)	1.65_b (1.46)			4.59_c (2.14)	6.46_d (0.88)

Note. Standard deviations are in parentheses; within each row, means with different subscripts (e.g., a vs. b) significantly differ ($p < .05$).

.061). Neither anger intensity ($b = -.029$, $SE = .096$, Wald < 1, $p = .76$) nor generalized arousal ($b = .061$, $SE = .162$, Wald < 1, $p = .71$) were reliable predictors.

These results provide initial support for the hypothesis that incidental experiences of anxiety increase egocentrism during perspective taking. Compared with angry and neutral participants, anxious participants were more likely to spontaneously describe an object using their own rather than another person's spatial perspective. Although anxious participants reported higher levels of generalized arousal than did angry participants, the egocentrism-enhancing effect of anxiety was not explained by differences in generalized arousal.

Experiment 2: Speeded Spatial Perspective Taking

In Experiment 2, we aimed to extend these findings in several ways. First, we included another negative, high-arousal emotion (i.e., disgust) for comparison against anxiety. Second, we used a different neutral condition. Third, we used a novel, speeded spatial perspective-taking task inspired by the classic 'three mountains task' (Piaget & Inhelder, 1956) as our focal dependent measure. Across multiple trials, participants had to quickly and accurately identify the spatial location of an object, either from their own perspective ("self" trials) or from other individuals' perspectives ("other" trials). Because responding from others' perspectives requires resisting egocentric interference from one's own spatial perspective, we anticipated that participants would experience greater difficulty on "other" trials than on "self" trials and that anxiety would increase this egocentric bias. Moreover, because this task includes a mental-rotation component, we also tested whether differences in mental-rotation ability could explain our results.

Method

Participants and design. Native German-speaking university students ($N = 246$) participated for a chocolate bar or coffee voucher. We excluded data from one participant because of a computer malfunction, eight participants who had a high number of invalid responses on the spatial perspective-taking task ($> 30\%$ of trials), and eight participants for suspicion, leaving a final sample of 229 (175 women; $M_{age} = 22.33$, $SD = 3.52$). Participants were randomly assigned to an incidental emotion condition: anxiety, anger, disgust, or neutral.

Procedure and materials. On arrival at the lab, participants were greeted by an experimenter and led to an individual cubicle where they learned that they would be completing tasks for several unrelated experiments that had been combined into a single session for efficiency purposes. All experimental tasks were administered via computer.

Incidental emotion manipulation. As in Experiment 1, under the guise of an "autobiographical memory" task, participants in the emotion conditions wrote about an emotionally evocative experience—specifically, a time when they felt very anxious, very angry, or very disgusted. Participants in the neutral condition did not complete the writing task.

Spatial perspective-taking task. Next, as part of a "perceptual judgment" task, participants completed a series of trials in which they identified the spatial location of a green light, either from their own perspective or from the perspective of one of two agents who appeared on the screen. Participants pressed one of three response keys to indicate the green light's location: left (W key), right (P key), or middle (spacebar). A blue bar signaled whose perspective should be taken. On "self" trials, the blue bar appeared at the bottom of the screen, indicating that participants should use their own perspective; on "other" trials, the blue bar appeared under one of the two other agents (see Figure 1 for stimulus examples). There were 30 "self" trials and 30 "other" trials (15 for each agent), for a total of 60 trials that appeared in randomized order. Ten practice trials preceded the experimental trials. We asked participants to respond as quickly and accurately as possible. Incorrect responses were followed by a red X, which remained on screen for 1,500 ms.

Mental-rotation task. Participants also completed three mental-rotation items. They indicated which of three rotated geometric shapes matched a target shape.

Manipulation check. As before, participants reported the emotions they experienced during the writing task. We averaged the anxiety ($\alpha = .89$), anger ($\alpha = .94$), disgust (*disgusted*, *nauseated*, *repulsed*, *sick*; $\alpha = .91$), and neutral ($\alpha = .78$) items.

Results and Discussion

Manipulation check. Planned contrasts revealed that anxious, angry, disgusted, and neutral feelings were higher in the anxiety, anger, disgust, and neutral conditions, respectively, than in the other conditions (ts > 5.38, ps $< .001$, ds > 1.01; see Table 1 for Ms and SDs).

Spatial perspective taking.

Analytic strategy. Our central hypothesis concerned the effect of anxiety on overall *difficulty* when responding from others' spatial perspectives, relative to one's own, rather than on speed or accuracy per se. Thus, following prior perspective-taking research (Apperly, Back, Samson, & France, 2008; Qureshi, Apperly, & Samson, 2010), we integrated speed and accuracy into a single metric of processing cost, or inverse efficiency score, that appropriately weighs the impact of each (Townsend & Ashby, 1983). This entails dividing the mean correct response time (RT) by the proportion of correct responses. It should be noted that interpretation of this processing cost metric can be problematic when error rates are high ($> 15\%$) or when error rates and RTs are not in unison; consequently, its use is recommended only when error rates are low and when error rates and RTs are positively correlated (Bruyer & Brysbaert, 2011; Townsend & Ashby, 1983). Because both of these prerequisites were met in our data—the

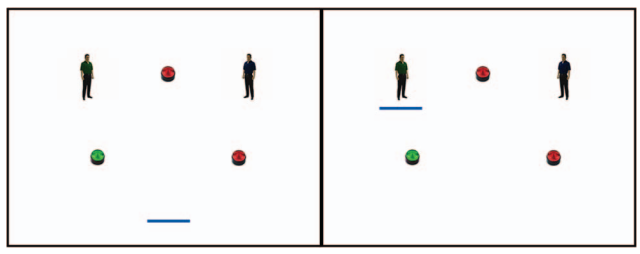

Figure 1. Examples of stimuli used on the "self" trials (left panel) and "other" trials (right panel) in the speeded spatial perspective-taking task (Experiment 2). See the online article for the color version of this figure.

overall error rate was under 10% and error rates and RTs were significantly positively correlated, $r = .31$, $p < .001$—we used processing cost as our unit of analysis.

Prior to analyses, we discarded RTs > 2,000 ms[2] (Samson, Apperly, Braithwaite, Andrews, & Bodley Scott, 2010) as outliers (4.8% of responses) and log-transformed[3] the remaining RTs to reduce positive skew (Fazio, 1990). We then calculated processing cost by dividing the mean correct log-transformed RTs by the proportion of correct responses (Townsend & Ashby, 1983). We also report separate error and RT analyses in the Supplemental Materials. These analyses indicate that our results appear to be driven more by error rates than by RTs, though, importantly, the pattern of results is consistent across metrics.

Egocentric processing cost. To allow for direct comparison with Experiment 1, we computed *egocentric processing cost* as our main dependent measure by subtracting processing cost on the "self" trials from processing cost on the "other" trials; higher scores reflect greater difficulty identifying others' perspectives relative to one's own. We also report processing cost separately for the "other" trials and the "self" trials.

We tested our central prediction that anxiety increases egocentrism by conducting three planned contrasts on the egocentric processing cost index: anxiety versus anger, anxiety versus disgust, and anxiety versus neutral. As predicted, egocentric processing cost was greater in the anxiety condition ($M = 255$ ms, $SD = 210$) than in the anger ($M = 167$ ms, $SD = 171$; Contrast 1: $t(225) = 2.51$, $p = .013$, $d = 0.39$), disgust ($M = 171$ ms, $SD = 146$; Contrast 2: $t(225) = 2.53$, $p = .012$, $d = 0.40$), and neutral conditions ($M = 191$ ms, $SD = 152$; Contrast 3: $t(225) = 2.14$, $p = .033$, $d = 0.34$). Additional comparisons revealed that the latter three conditions did not differ from one another ($|t|$s < 1, ps > .67, $|d|$s < 0.10).

Processing cost on the "other" trials. Using these same three contrasts, we examined processing cost on the "other" trials. As predicted and displayed in Figure 2, anxious participants displayed greater processing cost than did angry (Contrast 1: $t(225) = 2.63$, $p = .009$, $d = 0.38$), disgusted (Contrast 2: $t(225) = 3.29$, $p = .001$, $d = 0.47$), and neutral participants (Contrast 3: $t(225) = 2.74$, $p = .007$, $d = 0.39$). Additional comparisons revealed that the latter three conditions did not differ from one another ($|t|$s < 1, ps > .57, $|d|$s < 0.20; see Table 2 for *M*s and *SD*s).

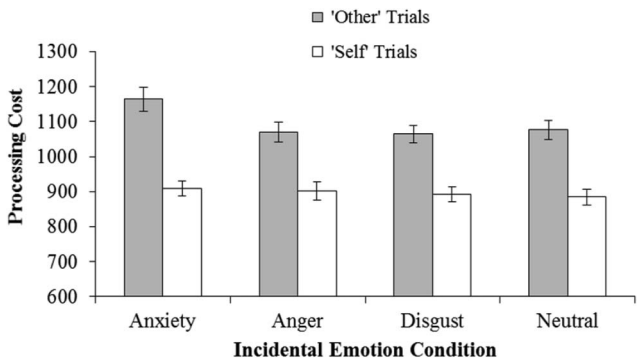

Figure 2. Mean processing cost on the "other" trials and the "self" trials by incidental emotion condition; error bars depict standard errors (Experiment 2).

Processing cost on the "self" trials. None of the three anxiety-related contrasts on processing cost on the "self" trials was significant ($|t|$s < 1, ps > .63, $|d|$s < 0.07). Additional comparisons revealed no significant differences among the anger, disgust, and neutral conditions ($|t|$s < 1, ps > .38, $|d|$s < 0.12; see Table 2 for *M*s and *SD*s).

Mental rotation. Mental-rotation performance ($M_{correct} = 2.37$, $SD = 0.75$) did not differ by emotion condition ($F < 1$, $p > .80$). Additionally, when controlling for mental-rotation performance, each of the previously reported contrasts involving anxiety on egocentric processing cost (ps < .045) and on processing cost on the "other" trials (ps < .009) remained significant.

Emotion intensity and egocentrism. To further examine the proposed relationship between anxiety and egocentrism, we regressed egocentric processing cost on reported feelings of anxiety across all participants. As expected, anxiety intensity positively predicted egocentrism ($b = .057$, $SE = .026$, $\beta = .15$, $t = 2.24$, $p = .026$). When regressing egocentrism on feelings of anxiety, anger, and disgust simultaneously, anxiety marginally positively predicted egocentric processing cost ($b = .054$, $SE = .029$, $\beta = .14$, $t = 1.88$, $p = .062$), whereas anger did not ($b = .038$, $SE = .026$, $\beta = .11$, $t = 1.46$, $p = .15$). Feelings of disgust negatively predicted egocentrism ($b = -.050$, $SE = .025$, $\beta = -.14$, $t = 2.00$, $p = .047$).

We also examined the relationship between emotion intensity and processing cost separately for the "other" trials and the "self" trials. In a first simultaneous regression analysis, anxiety intensity predicted greater processing cost on the "other" trials ($b = .072$, $SE = .025$, $\beta = .21$, $t = 2.93$, $p = .004$), whereas anger intensity did not ($b = .023$, $SE = .022$, $\beta = .08$, $t = 1.02$, $p = .31$). Disgust intensity predicted lower processing cost on the "other" trials ($b = -.045$, $SE = .022$, $\beta = -.15$, $t = 2.07$, $p = .040$). A second simultaneous regression analysis revealed that neither anxiety intensity ($b = .019$, $SE = .019$, $\beta = .08$, $t < 1$, $p = .32$), anger intensity ($b = -.015$, $SE = .017$, $\beta = -.07$, $t<1$, $p = .37$), nor disgust intensity ($b = .005$, $SE = .016$, $\beta = .02$, $t < 1$, $p = .75$) significantly predicted processing cost on the "self" trials.

These results replicate those from Experiment 1 with a different spatial perspective-taking task. Anxious participants had greater difficulty looking beyond their own perceptual vantage points than did angry, disgusted, and neutral participants. These findings were not explained by differences in mental-rotation performance.

Experiment 3: Conceptual Perspective Taking

Our first two experiments found that anxiety increased egocentrism in perceptual forms of perspective taking. In Experiment 3, we examined a different type of perspective taking. After undergoing an anxiety or anger induction, participants predicted how a naïve recipient would interpret a set of ambiguous e-mail messages. Prior research has demonstrated that people are often "cursed" by their own knowledge of the message sender's true

[2] Other trimming procedures (e.g., discarding RTs > 2.5 or 3 *SD*s from the grand mean) produced nearly identical results. All contrasts involving anxiety on processing cost on the "other" trials remained significant (ps < .015).

[3] Although we conducted analyses using log-transformed data, we report untransformed means for ease of interpretation; analyses on untransformed data produced nearly identical results.

Table 2
Processing Cost on "Other" Trials and "Self" Trials by Incidental Emotion Condition (Experiment 2)

Trial type	Incidental emotion condition			
	Anxiety	Anger	Disgust	Neutral
"Other" trials	1164_a (256)	1070_b (204)	1064_b (197)	1076_b (202)
"Self" trials	909_a (166)	902_a (190)	892_a (176)	884_a (178)

Note. Standard deviations are in parentheses; within each row, means with different subscripts significantly differ ($p < .01$).

intentions when predicting the recipient's likely reaction (Epley et al., 2004; Keysar, 1994). We anticipated that anxiety would increase this egocentric tendency.

Method

Participants and design. Native English-speaking American users of Amazon's Mechanical Turk (MTurk; $N = 164$) participated for modest monetary compensation ($0.40). We excluded data from 11 participants for suspicion and six participants for inattention, leaving a final sample of 147 (84 women; $M_{age} = 37.80$, $SD = 12.87$). Participants were randomly assigned to an incidental emotion condition: anxiety or anger.

Procedure and materials. Participants learned that they would be completing tasks for several unrelated experiments that had been combined into a single session for efficiency purposes. All experimental tasks were administered online.

Incidental emotion manipulation. As in Experiments 1 and 2, under the guise of an "autobiographical memory" task, participants wrote about an emotionally evocative experience—specifically, a time when they felt very anxious or very angry.

Conceptual perspective-taking task. Next, as part of a "text comprehension" task, participants read two different scenarios (order counterbalanced) involving ambiguous e-mail messages (Keysar, 1994; see Appendix D). In the *privileged-knowledge* scenario, participants had privileged information about the sender's intentions (i.e., the sender intended the message to be sarcastic) that was unavailable to the recipient. In the *shared-knowledge* scenario, participants and the recipient had identical information (i.e., the sender intended it to be sincere). Participants predicted how the recipient would interpret the message (1 = *very sarcastic*, 7 = *very sincere*).

Manipulation check. Finally, participants reported the emotions they experienced during the writing task. We averaged the anxiety ($\alpha = .88$) and anger ($\alpha = .97$) items.

Results and Discussion

Manipulation check. Feelings of anxiety were higher in the anxiety condition than in the anger condition, $t(145) = 3.20$, $p = .002$, $d = 0.53$. Angry feelings were higher in the anger condition than in the anxiety condition, $t(145) = 10.65$, $p < .001$, $d = 1.76$ (see Table 1 for *M*s and *SD*s).

Conceptual perspective taking. A 2 (Emotion) × 2 (Scenario) mixed ANOVA on the sincerity ratings revealed a main effect of Scenario, $F(1, 145) = 57.07$, $p < .001$, $\eta_p^2 = .282$. Overall, participants displayed a robust "curse of knowledge" bias. More importantly, the two-way interaction was significant, $F(1, 145) = 4.48$, $p = .036$, $\eta_p^2 = .030$. As anticipated and displayed in Figure 3, when the message implied sarcasm (privileged-knowledge scenario), anxious participants ($M = 4.44$, $SD = 1.78$) predicted that the recipient would infer less sincerity than did angry participants ($M = 5.11$, $SD = 1.76$), $t(145) = 2.30$, $p = .023$, $d = 0.39$. When the message implied sincerity (shared-knowledge scenario), however, sincerity ratings in the anxiety ($M = 6.00$, $SD = 1.13$) and anger conditions ($M = 5.98$, $SD = 1.20$) did not differ ($|t| < 1$, $p > .94$, $|d| < .05$).

Emotion intensity and egocentrism. To further examine the proposed relationship between anxiety and egocentrism, we created an egocentrism index by subtracting sincerity ratings on the privileged-knowledge scenario from those on the shared-knowledge scenario and regressed this index on anxiety intensity across all participants. Note that this index parallels the two-way interaction reported above. As expected, feelings of anxiety positively predicted egocentrism ($b = .208$, $SE = .093$, $\beta = .18$, $t = 2.23$, $p = .027$). When regressing egocentrism on feelings of anxiety and anger simultaneously, only anxiety emerged as a significant predictor ($b = .228$, $SE = .094$, $\beta = .20$, $t = 2.43$, $p = .016$); anger was a nonsignificant negative predictor ($b = -.116$, $SE = .071$, $\beta = -.13$, $t = 1.63$, $p = .105$).

We also examined the relationship between emotion intensity and sincerity ratings separately for the privileged-knowledge and shared-knowledge scenarios. In a first simultaneous regression analysis, anxiety intensity predicted marginally lower sincerity (higher sarcasm) ratings on the privileged-knowledge scenarios ($b = -.164$, $SE = .085$, $\beta = -.16$, $t = 1.93$, $p = .055$), whereas anger intensity predicted higher sincerity (lower sarcasm) ratings ($b = .127$, $SE = .065$, $\beta = .16$, $t = 1.97$, $p = .050$). A second simultaneous regression analysis revealed that neither anxiety ($b = .064$, $SE = .056$, $\beta = .10$, $t = 1.13$, $p = .26$) nor anger intensity ($b = .012$, $SE = .043$, $\beta = .02$, $t < 1$, $p = .79$) significantly predicted sincerity ratings on the shared-knowledge scenarios. Note that these analyses parallel the simple effects reported above.

These results indicate that incidental anxiety can magnify the "curse of knowledge" when reasoning about others' beliefs, thereby extending findings from the first two experiments to conceptual forms of perspective taking. Feeling anxious impaired people's ability to set aside their own privileged knowledge when

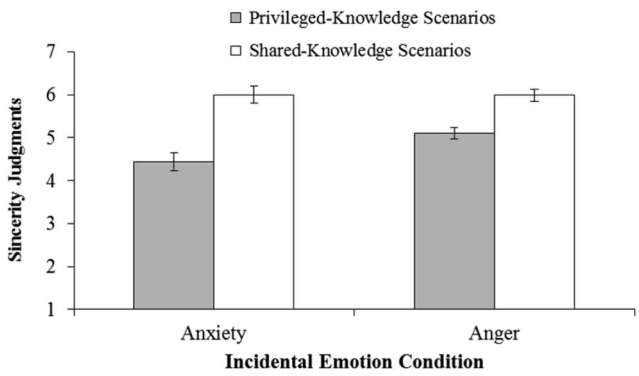

Figure 3. Mean sincerity judgments on the privileged-knowledge and shared-knowledge scenarios by incidental emotion condition; error bars depict standard errors (Experiment 3).

predicting a naïve message recipient's interpretation of an ambiguous message. Taken together, the results of Experiments 1–3 suggest that incidental anxiety can increase egocentrism in both perceptual and conceptual forms of perspective taking. In our final three experiments, we explore a mechanism that may underlie these findings.

Experiments 4A and 4B: The Role of Uncertainty

Anxiety differs from anger and disgust along several appraisal dimensions, including the degree of uncertainty that accompanies each emotion (Lerner & Keltner, 2000, 2001; Smith & Ellsworth, 1985). Whereas anger and disgust are associated with appraisals of high certainty, anxiety is associated with low certainty (i.e., uncertainty). In Experiments 4A and 4B, we used an experimental-causal-chain approach (Spencer et al., 2005) to examine the activation of uncertainty appraisal tendencies (Lerner & Keltner, 2000) as a potential mechanism underlying the egocentrism-enhancing effects of anxiety. In Experiment 4A, we test whether anxiety increases uncertainty. In Experiment 4B, we test whether feelings of uncertainty increase egocentrism when reasoning about another person's differing conceptual perspective.

Experiment 4A: Anxiety → Uncertainty

Method. Native English-speaking American MTurk users (N = 284) participated for modest monetary compensation ($0.40). We excluded data from four participants for inattention, leaving a final sample of 280 (175 women; M_{age} = 31.05, SD = 10.40). Participants learned that they would be completing several unrelated experimental tasks that had been combined into a single online session for efficiency purposes. As in Experiments 1–3, participants were randomly assigned to write about an emotionally evocative experience—specifically, a time when they felt very anxious, angry, or disgusted. In the neutral condition, participants wrote about how they typically spend their evenings. Next, participants indicated how uncertain they were about what was happening around them in the situation they described (1 = *not at all*, 7 = *very much so*; Lerner & Keltner, 2001; Smith & Ellsworth, 1985).

Results. To test our central prediction that anxiety increases uncertainty appraisal tendencies, we conducted three planned contrasts: anxiety versus anger, anxiety versus disgust, and anxiety versus neutral. As predicted, anxious participants (M = 4.79, SD = 1.92) reported greater uncertainty than did angry (M = 3.94, SD = 2.05; Contrast 1: $t(275)$ = 2.45, p = .015, d = 0.30), disgusted (M = 3.29, SD = 2.10; Contrast 2: $t(275)$ = 4.36, p < .001, d = 0.53), and neutral participants (M = 2.75, SD = 2.05; Contrast 3: $t(275)$ = 6.10, p < .001, d = 0.74). Unexpectedly, angry participants reported more uncertainty than did neutral participants, $t(275)$ = 3.44, p = .001, d = 0.41 and marginally more than did disgusted participants, $t(275)$ = 1.82, p = .070, d = 0.22.

Experiment 4B: Uncertainty → Egocentrism

Method. Native English-speaking American MTurk users (N = 178) participated for modest monetary compensation ($0.40). We excluded data from eight participants for suspicion and 12 participants for inattention, leaving a final sample of 158 (89 women; M_{age} = 37.23, SD = 13.97). Participants learned that they would be completing several unrelated experimental tasks that had been combined into a single online session for efficiency purposes. Under the guise of an "autobiographical memory" task, participants were randomly assigned to describe three experiences that made them feel either very certain or very uncertain. They received these instructions (adapted from Clarkson, Tormala, & Rucker, 2008):

> We'd like you to list three experiences you've had in which you felt a great deal of [un]certainty. We're specifically interested in times in your life in which you felt [un]certain about what was happening around you and/or [un]certain about what would happen next. In each of the three boxes that appear on the next several screens, please describe a different experience in which you felt highly [un]certain.

Next, as part of a "text comprehension" task, participants completed the same conceptual perspective-taking task involving ambiguous e-mail messages that we used in Experiment 3 (Keysar, 1994).

Results. A 2 (Certainty) × 2 (Scenario) mixed ANOVA on the sincerity ratings revealed a main effect of Scenario, $F(1, 156) = 43.29$, $p < .001$, $\eta_p^2 = .217$. As in Experiment 3, overall, participants displayed a robust "curse of knowledge" bias. There was also a main effect of Certainty, $F(1, 156) = 4.21$, $p = .049$, $\eta_p^2 = .025$. Participants in the uncertainty condition provided lower sincerity ratings than did participants in the certainty condition. More importantly, the two-way interaction was significant, $F(1, 156) = 8.47$, $p = .004$, $\eta_p^2 = .051$. As anticipated and displayed in Figure 4, when the message implied sarcasm (privileged-knowledge scenario), uncertain participants (M = 4.40, SD = 2.02) predicted that the recipient would infer less sincerity than did certain participants (M = 5.29, SD = 1.88), $t(156) = 2.86$, p = .005, d = 0.45. When the message implied sincerity (shared-knowledge scenario), however, sincerity ratings for uncertain (M = 6.07, SD = 1.12) and certain participants (M = 5.94, SD = 1.32) did not differ ($|t| < 1$, $p > .47$, $|d| < .11$).

Discussion

Together, the results from Experiments 4A and 4B suggest that the uncertainty associated with anxiety can help explain the egocentrism-enhancing effects of anxiety. Feelings of anxiety were

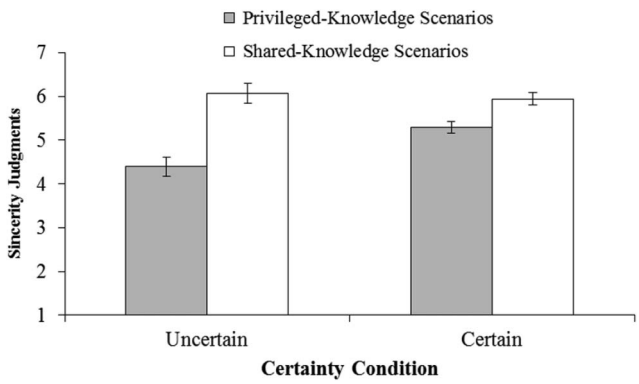

Figure 4. Mean sincerity judgments on the privileged-knowledge and shared-knowledge scenarios by certainty appraisal condition; error bars depict standard errors (Experiment 4B).

accompanied by greater feelings of uncertainty (Experiment 4A), and heightened uncertainty increased reliance on accessible, yet privileged, knowledge when predicting another person's interpretation of an ambiguous message (Experiment 4B).

Experiment 5: Positive and Negative Emotions Differing in Subjective Uncertainty

If subjective feelings of uncertainty increase reliance on self-knowledge during perspective taking, then positive emotions associated with uncertainty should produce comparable effects. To test this hypothesis, in Experiment 5, we independently manipulated emotion certainty and emotion valence, and we assessed conceptual perspective taking with a set of scenarios in which participants must set aside their own privileged knowledge to infer others' beliefs (Saxe & Kanwisher, 2003). We predicted that emotions characterized by uncertainty (anxiety and surprise), independent of emotion valence (negative and positive, respectively; Smith & Ellsworth, 1985; cf. Noordewier & Breugelmans, 2013), would lead to more egocentric errors when inferring others' false beliefs than would emotions associated with certainty (anger and pride). To further explore the role of uncertainty in explaining these effects, we used a measurement-of-mediation design (Baron & Kenny, 1986) to test a model wherein uncertainty underlies the effect on uncertainty-associated emotions on egocentrism (see Lerner & Keltner, 2001).

Method

Participants and design. Native English-speaking American MTurk users ($N = 292$) participated for modest monetary compensation ($0.50). We excluded data from five participants for inattention, leaving a final sample of 287 (184 women; $M_{age} = 35.79$, $SD = 12.32$). Participants were randomly assigned to one of the conditions in a 2 (Emotion Valence: positive, negative) × 2 (Emotion Certainty: certainty-associated, uncertainty-associated) design.

Procedure and materials. Participants learned that they would be completing tasks for several unrelated experiments that had been combined into a single session for efficiency purposes. All experimental tasks were administered online.

Incidental emotion manipulation. As in Experiments 1–3 and 4A, under the guise of an "autobiographical memory" task, participants wrote about an emotionally evocative experience—specifically, a time when they felt very anxious (uncertain, negative), angry (certain, negative), surprised (uncertain, positive), or proud (certain, positive).

Conceptual perspective-taking task. Next, as part of a "text comprehension" task, participants read (in randomized order) a series of 12 scenarios involving one or more characters (Saxe & Kanwisher, 2003; see Appendix E). In the six *false-belief* scenarios, participants read about an exchange between two characters, and they received privileged information that was unavailable to one of the characters. In the *control* scenarios, participants read about a physical characteristic of a single character. Following each scenario, participants completed a forced-choice, fill-in-the-blank item consisting of a single sentence with one word missing. They selected one of two response options to complete the sentence. The key difference between the false-belief and control scenarios was that the former required mental-state reasoning (i.e., participants had to set aside their own privileged knowledge to infer the less-informed character's false belief), whereas the latter did not. To increase the difficulty of the task and thereby increase variability in error rates, we instructed participants to respond as quickly and accurately as possible (see Epley et al., 2004).

Manipulation checks. Finally, participants completed three sets of manipulation checks, all on 7-point scales (1 = *not at all*, 7 = *very much so*). The first set of items assessed the effectiveness of the emotion certainty manipulation. Participants answered the same question from Experiment 4A regarding the degree of uncertainty they experienced when recalling the emotionally evocative event. They also indicated how well they could predict what would happen next in the situation they described (Smith & Ellsworth, 1985). Because these two items were only modestly correlated ($\alpha = .40$), we analyzed them separately. The second set of items assessed the effectiveness of the emotion valence manipulation. Participants indicated the extent to which the event they described was unpleasant and enjoyable (Smith & Ellsworth, 1985). We averaged these items (after reverse-scoring) to form a measure of emotion valence ($\alpha = .88$). The third set of items mirrored those from Experiments 1–3. Participants indicated the extent to which the recalled experience made them feel each of a series of specific emotions. We averaged the anxiety (*anxious*, *worried*; $\alpha = .85$), anger (*angry*, *mad*; $\alpha = .96$), surprise (*surprised*, *shocked*; $\alpha = .81$), and pride (*proud*, *successful*; $\alpha = .94$) items.

Results and Discussion

Manipulation checks. Reported levels of uncertainty experienced during the recalled event was greater in the uncertain emotion conditions (anxiety and surprise combined; $M = 4.28$, $SD = 2.13$) than in the certain emotion conditions (anger and pride combined; $M = 3.34$, $SD = 2.25$), $t(285) = 3.65$, $p < .001$, $d = 0.43$. Conversely, ability to predict what would happen next during the recalled event was lower in the uncertain emotion conditions ($M = 3.40$, $SD = 1.92$) than in the certain emotion conditions ($M = 4.60$, $SD = 2.07$), $t(285) = 5.06$, $p < .001$, $d = 0.60$. Additionally, positivity was greater in the positive emotion conditions (pride and surprise combined; $M = 5.79$, $SD = 1.66$) than in the negative emotion conditions (anger and anxiety combined; $M = 2.09$, $SD = 1.40$), $t(284) = 20.40$, $p < .001$, $d = 2.41$. Finally, planned contrasts revealed that anxious, angry, surprised, and proud feelings were greater in the anxiety, anger, surprise, and pride conditions, respectively, than in the other conditions ($ts > 3.59$, $ps < .001$, $ds > 0.59$; see Table 1 for *M*s and *SD*s).

Conceptual perspective taking. A 2 (Valence) × 2 (Certainty) × 2 (Scenario) mixed ANOVA on error rates revealed a main effect of Scenario, $F(1, 283) = 42.03$, $p < .001$, $\eta_p^2 = .129$. Overall, errors were higher on the false-belief scenarios than on the control scenarios. As predicted and displayed in Figure 5, the only significant two-way interaction was between Certainty and Scenario, $F(1, 283) = 8.50$, $p = .004$, $\eta_p^2 = .029$. Participants induced to experience uncertainty-associated emotions ($M = 13.87\%$, $SD = 20.08$) made more errors on the false-belief scenarios than did those experiencing certainty-associated emotions ($M = 9.42\%$, $SD = 15.59$), $t(285) = 2.33$, $p = .038$, $d = 0.25$, whereas errors on the control scenarios were comparable for those experiencing uncertainty-associated ($M = 4.59\%$, $SD = 11.11$) and certainty-

associated emotions ($M = 6.04\%$, $SD = 14.09$; $|t| < 1$, $p > .33$, $|d| < 0.12$). Importantly, the pattern of findings captured by this two-way interaction was equally strong for positive and negative emotions, as indicated by a nonsignificant Valence × Certainty × Scenario interaction ($F < 1$, $p > .62$).

Emotion intensity, feelings of uncertainty, and egocentrism. To further examine the proposed relationship between uncertainty-associated emotions and egocentrism, we conducted a series of regression analyses using the proportion of errors on the false-belief scenarios as the criterion. We also report the results of these same analyses using the proportion of errors on the control scenarios as the criterion.

In a first set of analyses, we used reported intensity on each of the different emotions across participants as separate predictors. Neither of the uncertainty-associated emotions (anxiety: $\beta = .04$, $p = .53$; surprise: $\beta = -.04$, $p = .54$) nor either of the certainty-associated emotions (anger: $\beta = -.02$, $p = .86$; pride: $\beta = .08$, $p = .93$) significantly predicted the proportion of errors on the false-belief scenarios or the proportion of errors on the control scenarios (anxiety: $\beta = .01$, $p = .94$; surprise: $\beta = -.08$, $p = .21$; anger: $\beta = .14$, $p = .10$; pride: $\beta = .17$, $p = .06$).

In a second set of analyses, we used reported feelings of uncertainty about what was happening in the recalled event across participants as the predictor. Feelings of uncertainty predicted a greater proportion of errors on the false-belief scenarios ($b = .011$, $SE = .005$, $\beta = .14$, $t = 2.39$, $p = .018$), but not on the control scenarios ($b = .004$, $SE = .003$, $\beta = .07$, $t = 1.10$, $p = .27$).[4]

The mediating role of uncertainty. We next conducted a mediation analysis testing a model in which feelings of uncertainty underlie the effects of uncertainty-associated emotions on egocentric false-belief reasoning (see Figure 6). Because our interest was in explaining the link between uncertainty-associated emotions (regardless of valence) and egocentrism, we collapsed across valence in this analysis. A simultaneous regression analysis revealed that controlling for subjective uncertainty reduced the effect of Emotion Certainty condition (0 = *certainty-associated emotions* [anger and pride combined], 1 = *uncertainty-associated emotions* [anxiety and surprise combined]) on the proportion of errors on the false-belief scenarios ($b = .035$, $SE = .022$, $\beta = .097$, $t = 1.63$, $p = .10$). A bias-corrected bootstrapping analysis (Hayes, 2013) revealed that the indirect path through subjective uncertainty was significant ($b = .009$, $SE = .005$; 95% CI [.002, .023]).[5]

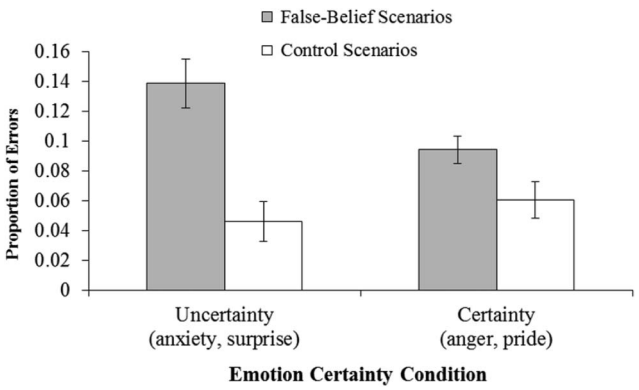

Figure 5. Mean proportion of errors on false-belief and control scenarios by emotion certainty condition; error bars depict standard errors (Experiment 5).

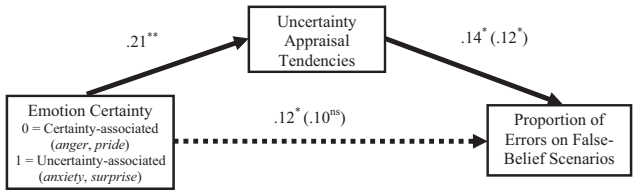

Figure 6. Mediational model wherein uncertainty appraisal tendencies underlie the effect of emotion certainty condition on the proportion of errors on the false-belief scenarios. Numbers represent standardized regression coefficients; numbers in parentheses represent simultaneous regression coefficients (Experiment 5). * $p < .05$. ** $p < .01$.

These results provide additional support for the hypothesis that uncertainty appraisal tendencies underlie egocentrism during mental-state reasoning. Experiencing uncertainty-associated emotions (i.e., anxiety and surprise), regardless of valence, increased reliance on privileged knowledge when inferring others' beliefs. Pride, a self-focused emotion (Tracy & Robins, 2004), did not increase egocentrism, which suggests that differences in self-focused attention are unlikely to explain our findings. We return to the potential mediating role of self-focused attention in the General Discussion.

Meta-Analytic Summary of Emotion Intensity and Egocentrism

In Experiments 1, 2, 3, and 5, we reported the relationship between experienced emotions across participants and our primary outcome variables. Because the magnitude of the relationship between emotion intensity and egocentric mental-state reasoning varied across experiments (e.g., anxiety intensity did not significantly predict egocentrism in Experiment 5), we conducted two sets of meta-analyses to determine the overall reliability and magnitude of this relationship: one using anxiety intensity as the predictor, the other using anger intensity as the predictor. The specific criterion variables for both meta-analyses were as follows: egocentric location descriptions in Experiment 1, processing cost on the "other" trials in Experiment 2, sincerity judgments on the privileged-knowledge scenarios in Experiment 3 (reverse-scored so higher values reflect more egocentrism), and errors on the false-belief scenarios in Experiment 5.

To conduct these analyses, we used the relevant βs and *SE*s from the simultaneous regression analyses in each experiment. We calculated each meta-analytic β by weighing the β for each effect from each experiment by the inverse of its variance, and we calculated each meta-analytic *SE* by taking the square root of the reciprocal of the sum of the weights. We then conducted hypothesis tests on these meta-analytic effects by dividing the meta-

[4] Additional analyses using reported ability to predict what would happen next in the recalled event across participants as the predictor revealed no significant relationship between this variable and errors on either the false-belief or the control scenarios (*p*s > .68).

[5] An additional mediation analysis that isolated anxiety (0 = anger and pride combined, 1 = anxiety) produced nearly identical results; the indirect path through uncertainty was significant ($b = .010$, $SE = .006$; 95% CI [.001, .024]).

analytic β by the meta-analytic *SE*, yielding a *Z* statistic (Lipsey & Wilson, 2001). Consistent with the experimental results reported above, these analyses revealed that anxiety intensity positively predicted egocentrism ($\beta = .14$, $Z = 3.39$, $p < .001$), whereas anger intensity was a nonsignificant negative predictor of egocentrism ($\beta = -.03$, $Z < 1$, $p = .51$).

General Discussion

Across six experiments, we found converging evidence that incidental anxiety can increase egocentrism when intuiting what other people see and know. Compared with people experiencing anger, disgust, and neutral feelings, those experiencing anxiety were more likely to describe an object using their own spatial perspective (Experiment 1), to have difficulty resisting egocentric interference when identifying an object from others' spatial perspectives (Experiment 2), and to mistakenly assume that an uninformed person would interpret an ambiguous message, or otherwise behave, in line with their own privileged knowledge (Experiments 3 and 5). These findings extend earlier correlational and cross-sectional research (Hezel & McNally, 2014; Hünefeldt et al., 2013) by causally linking anxiety to impaired mental-state reasoning.

Our use of multiple comparison emotions across experiments allowed us to isolate the effects of anxiety and provided valuable clues for a potential mechanism underlying our findings. Comparing anxiety with anger (Experiments 1, 2, 3 and 5) and disgust (Experiment 2) suggests that the egocentric effect of anxiety cannot be explained by the combination of negative valence and high arousal alone; rather, it seems that feeling anxious uniquely led to an increased reliance on one's own egocentric perspective, to the detriment of understanding others' viewpoints. Additionally, our inclusion of a neutral condition (Experiments 1 and 2) suggests that anxiety increases egocentrism, rather than other negative, high-arousal emotions decreasing it. This latter finding may shed new light on prior work showing that people experiencing certainty-associated emotions were less susceptible to anchoring effects than were those experiencing uncertainty-associated emotions (Inbar & Gilovich, 2011). Although Inbar and Gilovich interpret their findings as certainty-associated emotions increasing adjustment away from self-generated numeric anchors, our findings suggest that their results might actually reflect decreased adjustment from self-generated knowledge when experiencing uncertainty-associated emotions.

Importantly, our final three experiments provided direct process evidence by showing that the uncertainty appraisal tendencies triggered by anxiety may underlie its egocentrism-enhancing effects. Specifically, we found that anxiety increased feelings of uncertainty (Experiments 4A and 5), and that this heightened sense of uncertainty, in turn, led to greater reliance on privileged knowledge when intuiting others' beliefs (Experiments 4B and 5). Furthermore, showing that surprise increased egocentrism in Experiment 5, but that the self-focused emotion of pride (Tracy & Robins, 2004) did not, suggests that differences in self-focused attention are unlikely to account for our findings.

To further examine the role of self-focused attention in explaining the egocentric effects of anxiety in Experiments 1, 2, 3, and 5, we computed an index of first-person singular pronoun usage (Pennebaker, 2011; Wegner & Giuliano, 1980) in the autobiographical recall essays our participants wrote by counting the number of first-person singular pronouns (e.g., I, me, my) they used and dividing by the total number of words they wrote. We then conducted two sets of meta-analyses using this index of self-focused attention. One examined the effect of anxiety on self-focused attention; the other examined the relationship between self-focus across participants and egocentric mental-state reasoning (for more details, see the Supplemental Materials). These analyses revealed that, across experiments, anxious participants used a greater proportion of first-person singular pronouns than did participants in the other emotion conditions ($d = 0.35$, $Z = 4.04$, $p < .001$); however, first-person singular pronoun usage did not significantly predict egocentric mental-state reasoning ($\beta = .05$, $Z = 1.22$, $p = .22$), suggesting that increases in self-focus are unlikely to explain the egocentric effects of anxiety in the current research. It is worth noting, however, that our experiments were not specifically designed to test a differential self-focus account. Future research will be needed to determine the role (if any) of self-focused attention in accounting for the egocentric effects of anxiety on mental-state reasoning.

Strengths and Limitations

We highlight several strengths of the current research. First, the effects of incidental anxiety were consistent across four different perspective-taking tasks (two perceptual, two conceptual), multiple comparison emotions (anger, disgust, and neutral feelings), and participant samples from two different countries (United States and Germany). Second, recognizing the limitations of any single approach for testing for mediation, we used both experimental-causal-chain (Spencer et al., 2005) and measurement-of-mediation designs (Baron & Kenny, 1986) and found support for a model in which uncertainty appraisal tendencies underlie the egocentric effects of anxiety (and surprise) on mental-state reasoning. Together, this methodological diversity attests to the robustness of our findings. Nevertheless, we concur with others (e.g., Bullock, Green & Ha, 2010) that process evidence is best established through programs of research that systematically test among multiple, theoretically plausible mediators.

We also acknowledge several limitations of the current research, each of which suggests potential directions for future research. First, our experiments relied exclusively on an autobiographical recall task to induce incidental emotions. Although such tasks are among the most frequently used and valid methods for inducing specific emotions, including anxiety-related states (Lench et al., 2011), future research using different emotion inductions, such as watching an anxiety-eliciting video clip (Gino et al., 2012) or anticipating a stressful experience (e.g., an impromptu public performance; Brooks, 2014), will be needed to determine the generalizability of our findings. Second, several of our dependent measures comprised only a few items or even a single item, thus potentially raising concerns about stimulus sampling (see Wells & Windschitl, 1999). Although we used a broad array of perspective-taking tasks in our experiments and the perspective-taking tasks used in Experiments 2 and 5, in particular, included a larger set of trials, future research incorporating a larger variety of specific stimuli would provide additional reassurance for the generalizability of our findings.

Additional Directions for Future Research

The current work sets the stage for a number of additional directions for future research on emotion and mental-state reason-

ing. First, we focused exclusively on the effects of *incidental* emotions triggered by an unrelated prior experience. Future research should investigate whether specific *integral* emotions (i.e., those elicited by the perspective-taking target; Bodenhausen, 1993) lead to comparable increases in egocentrism. One relevant context for exploring this question concerns encounters with social groups that chronically elicit feelings of anxiety (Stephan & Stephan, 1985). Insofar as intergroup anxiety undermines understanding of outgroup members' thoughts, feelings, and intentions, it could be an important constraint on positive intergroup relations (Shelton & Richeson, 2006).

Second, we found that anxiety and surprise—emotions characterized by uncertainty—increased egocentrism. Future research should examine whether other emotions known to trigger uncertainty appraisal tendencies (e.g., hope) produce comparable effects. Future research should also explore whether emotions differing on other appraisal dimensions (e.g., control) differentially affect reliance on self-knowledge during mental-state reasoning.

Third, the perceptual perspective-taking tasks we used in Experiments 1 and 2 measured *spatial* perspective taking, as participants' task was to identify whether an object appeared to a target person's left or right. Future research should examine whether anxiety and other uncertainty-associated emotions also increase egocentric interference on *visual* perspective-taking tasks in which participants must simply identify whether another person can see an object or not (for more on the distinction between spatial and visual perspective taking, see Surtees, Apperly, & Samson, 2013).

Fourth, mental-state reasoning likely recruits both domain-specific and domain-general cognitive processes (Zaki, Hennigan, Weber, & Ochsner, 2010), and there is debate about the unique contributions of these processes on perspective-taking task performance (Apperly, Samson, & Humphreys, 2005; Heyes, 2014; Leslie, Friedman, & German, 2004). Although the results of Experiment 2 were not explained by differences in mental-rotation ability, given the established link between anxiety and diminished executive functioning (Eysenck et al., 2007), future research should test whether anxiety and other uncertainty-associated emotions impede performance on a nonsocial, albeit similarly cognitively demanding, version of our perceptual perspective-taking task (e.g., Santiesteban, Catmur, Hopkins, Bird, & Heyes, 2014).

Finally, on each of our perspective-taking tasks, participants' own mental states directly conflicted with those of the target person(s); thus, "optimal" performance entailed resisting interference from one's own perspective when inferring the targets' differing mental states. Future research should examine whether anxiety and other uncertainty-associated emotions also hinder performance on perspective-taking tasks in which a target's mental states are not in direct conflict with participants' own (e.g., Happé, 1994) or tasks in which egocentric interference is minimal (e.g., reality-unknown false-belief tasks; Apperly, Samson, Chiavarino, & Humphreys, 2004). Relatedly, according to anchoring-and-adjustment accounts of mental-state inference (Epley et al., 2004; Tamir & Mitchell, 2013), perspective taking entails a process of anchoring on one's own perspective followed by an adjustment for potential differences between the target and oneself (see also Todd et al., 2011). Because it is unclear from our experiments at which stage incidental emotions are operating and because appraisal tendencies can influence both the content of judgment and the process by which accessible content is transformed into judgment (Han et al., 2007), future research should explore whether anxiety and other uncertainty-associated emotions alter the extent of "anchoring" on accessible self-knowledge, the extent of "adjustment" away from accessible self-knowledge, or both.

Conclusion

Although much is known about the influence of incidental emotions on judgment and behavior, relatively little is known about whether and how they shape processes involved in mental-state reasoning. Our findings provide the first causal evidence that the uncertainty appraisal tendencies accompanying anxiety can increase reliance on egocentric self-knowledge when trying to understand others' differing perceptual and conceptual perspectives.

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Appendix A

Rationale for Exclusion Criteria

p-Values of Key Experimental Effects Involving Anxiety Before and After Applying Exclusion Criteria (Experiments 2, 3, 4A, 4B, and 5)

Because of the language demands of several of the perspective-taking tasks used in this research, we decided a priori not to analyze data for non-native speakers. Although we did not preclude non-native speakers from participating, we only analyzed data for native English speakers in Experiments 1, 3, 4A, 4B, and 5, and native German speakers in Experiment 2.

We also decided a priori to exclude data from participants whose responses suggested inattention and participants who expressed suspicion regarding the experimental hypotheses. We classified participants as inattentive if they spent $<$ 30 s on the autobiographical recall emotion inductions used across experiments or $<$ 5 s on the conceptual perspective-taking task used in Experiments 3 and 4B. We classified participants as suspicious if they articulated a causal relationship between the emotion induction and the focal dependent measure. Although we were primarily concerned about suspicion in experiments in which the purpose of the perspective-taking task was relatively transparent and performance was easily alterable, we decided to impose a similar suspicion exclusion rule across experiments. Suspicion was generally low across experiments; we suspect that it was higher among MTurk users because of their greater experience with experiments (particularly autobiographical recall emotion inductions), relative to college students (Chandler, Mueller, & Paolacci, 2014). Analyses including these participants' data are reported in Table Appendix A.

Additionally, in Experiment 1, we excluded data from participants who provided unscorable location descriptions on the spatial perspective-taking task (e.g., "at the top"). Finally, in Experiment 3, we excluded data from participants who had invalid responses on $>$ 30% of the trials on the speeded spatial perspective-taking task. Invalid responses consisted of errors and RTs greater than 2,000 ms. We selected the 30% threshold somewhat arbitrarily, using prior research as a guide (e.g., Greenwald, Nosek, & Banaji, 2003); analyses using a more lenient criterion (40%) yielded nearly identical results.

(*Appendices continue*)

Outcome variables/Hypothesis tests	p_{after}	Exclusion criterion: Suspicion $n_{excluded}$	Suspicion p_{before}	Inattention $n_{excluded}$	Inattention p_{before}
Egocentric processing cost (Experiment 2)		8		0	
Anxiety vs. anger contrast	.013		.015		
Anxiety vs. disgust contrast	.012		.011		
Anxiety vs. neutral contrast	.033		.029		
Processing cost on "other" trials (Experiment 2)		8		0	
Anxiety vs. anger contrast	.009		.008		
Anxiety vs. disgust contrast	.001		.001		
Anxiety vs. neutral contrast	.007		.004		
Sincerity ratings (Experiment 3)		11		6	
Emotion × scenario interaction	.023		.083		.143
Simple effect of anxiety on privileged-knowledge scenarios	.036		.059		.049
Uncertainty ratings (Experiment 4A)		0		4	
Anxiety vs. anger contrast	.015				.013
Anxiety vs. disgust contrast	.001				.001
Anxiety vs. neutral contrast	.001				.001
Sincerity ratings (Experiment 4B)		8		12	
Certainty × scenario interaction	.004		.014		.009
Simple effect of uncertainty on privileged-knowledge scenarios	.005		.017		.021
Errors (Experiment 5)		0		5	
Certainty × scenario interaction	.004				.005
Simple effect of uncertainty-associated emotions on errors on false-belief scenarios	.038				.029

Note. p_{after} = p-value after applying both exclusion criteria (these values are identical to what appears in main text); $n_{excluded}$ = number of participants excluded based on each exclusion criterion; p_{before} = p-value before applying each exclusion criterion individually.

Appendix B

Sample Size Determination

We determined our sample size in Experiment 1 based on our own prior work (Todd & Galinsky, 2012; Todd et al., 2011) using Tversky and Hard's (2009) spatial perspective-taking task and an a priori heuristic of at least 40 participants per cell. Post hoc power for the critical contrasts in Experiment 1 fell short of 80% (Faul, Erdfelder, Lang, & Buchner, 2007); thus, to increase a priori power in our subsequent experiments, we increased our target sample sizes to at least 50 participants per cell in Experiment 2 and at least 60 participants per cell in Experiments 3–5. In all experiments, data were collected until this target number was reached or surpassed.

Appendix C

Spatial Perspective-Taking Task Filler Questions (Experiment 1)

The filler questions used in the spatial perspective-taking task (Tversky & Hard, 2009) from Experiment 1 appear below. We presented all questions in an open-ended format. The critical question that served as our dependent measure appeared after the fourth question.

1. How would you judge the brightness of this photo?
2. How would you judge the clarity of this photo?
3. How would you judge the overall quality of this photo?
4. How old do you think the person is?
5. How many picture frames are in the room?
6. How many chairs are in the room?

(*Appendices continue*)

Appendix D

Message Interpretation Task (Experiments 3 and 4B)

The scenarios used in the message interpretation task (Keysar, 1994) from Experiments 3 and 4B appear below. Wording for the privileged information in the privileged-knowledge versions appears in bold; wording for the shared-knowledge versions appears in brackets. For both scenarios, participants answered the following question (1 = *very sarcastic*, 7 = *very sincere*): "How do you think Nick interprets David's e-mail?"

Scenario 1

David needs some cash for a high school dance. He decides to look after the dog of his best friend and neighbor, Nick, for a long weekend. As Nick gives David instructions, he adds, "Damian is a wonderful dog. He'll be great company for you." **David loves animals and all weekend long he exhausts himself trying every trick he knows to play with Damian, but Damian is unresponsive, preferring to play with his chew toys alone.** [David has a lot of work to do this weekend and is glad that Damian is happy sleeping or playing with his chew toys alone.] Since he has to leave for an appointment an hour before Nick is due back, David sends him an e-mail to which he adds, "Wonderful dog. And he's such great company."

Scenario 2

Before David knew it, his first college summer had passed, and the day to choose his sophomore classes had come. Nick, now a freshman at the same college, is curious about one of the professors. He decides to write David an e-mail which asks, "How is Jones as a professor? Is he a nice guy?" **As it turns out, David knows the professor because he had taken his class. However, he hadn't gotten along with the professor because the professor had been rude to him.** [As it turns out, David had taken the professor's class the previous year and had gotten along with him very well.] With that in mind, he immediately responds by writing back, "Oh yeah, Professor Jones is a real nice guy."

Appendix E

False-Belief Task (Experiment 5)

The scenarios for the false-belief task (Saxe & Kanwisher, 2003) used in Experiment 5 appear below. Participants selected one of the two response options (in parentheses) to complete the sentence following each scenario.

False-Belief Scenarios

1. Jenny put her chocolate away in the cupboard. Then she went outside. Alan moved the chocolate from the cupboard into the fridge. Half an hour later, Jenny came back inside.

Jenny expects to find her chocolate in the _____. **(*cupboard*, *fridge*)**

2. Anne made lasagna in the blue dish. After Anne left, Ian came home and ate the lasagna. Then he filled the blue dish with spaghetti and replaced it in the fridge.

Anne thinks the blue dish contains _____. **(*lasagna*, *spaghetti*)**

3. When Lisa left Jacob he was deep asleep on the beach. A few minutes later a huge wave woke him. Seeing Lisa was gone Jacob decided to go swimming.

Lisa now believes that Jacob is _____. **(*swimming*, *sleeping*)**

4. The girls left ice cream in the freezer before they went to sleep. Overnight the power to the kitchen was cut and the ice cream melted.

When they get up the girls believe the ice cream is _____. **(*melted*, *frozen*)**

5. Toby has always liked the snack food called "goldfish." He asked his mother to buy some goldfish when she went to the supermarket. Toby's mother came home with real pet fish.

Toby's mom thought that Toby wanted _____. **(*real fish*, *snack food*)**

6. David knows that Ethan is very scared of spiders. Ethan, alone in the attic, sees a shadow move and thinks it is a burglar. David hears Ethan cry for help.

David assumes that Ethan thinks he has seen a _____. **(*burglar*, *spider*)**

Control Scenarios

1. Jason is wearing blue jeans, white running shoes, a gray scarf, and matching sweater. He has thick glasses on his long hooked nose and a long blond beard on his chin.

The scarf Jason is wearing is _____. (***blue***, ***gray*)**

2. Emily was always the tallest kid in her class. In kindergarten she was already over 4 feet tall. Now that she is in college she is 6′4". She is a head taller than the others.

In kindergarten Emily was over _____ Tall. **(*4 ft.*, *6 ft.*)**

(*Appendices continue*)

3. Harry looks just like a math professor. He wears dark old cardigans with holes in the elbows, corduroy trousers, and brown loafers over green argyle socks.

The shoes Harry wears are _____. (***brown***, ***green***)

4. Dina's hair is long and wild. It runs in black curls all the way down her back and gets caught in her belt and her brown back pack, and in other people's buckles.

The color of Dina's hair is _____. (***black***, ***brown***)

5. Christine is much too thin. Her knee bones stand out from her legs and her knuckles are swollen like an old woman's. Only her smooth cheeks show that Christine is still a teenager.

Because she is thin, Christine's _____ are swollen. (***knees***, ***knuckles***)

6. Each girl wears her uniform slightly differently. Blair wears her shirt untucked. Annette leaves one button undone, and refuses to pull up her knee socks to regulation height.

Annette wears her uniform shirt _____. (***unbuttoned***, ***untucked***)

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