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Feeling Watched: What Determines Perceived Observation?

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The feeling of being watched has several well-documented consequences, from social facilitation to the induction of pro-social behavior. Even though the effects of being watched have long been in the focus of scientific interest, it remains unclear which features determine the actual subjective feeling of being watched. We report 2 experiments to approach this question. Participants were confronted with pictures showing the faces of different creatures while imagining being in an embarrassing situation. Participants rated for each creature in each situation how strongly they felt watched and how much ability they ascribed to the creature to reflect on the situation. A between-experiment manipulation of how much ability was ascribed to a particular creature further probed for a causal relation between the 2 variables. Results confirmed that the creature's ascribed ability to reflect on the situation is a key component that determines the feeling of being watched in humans.

Keywords: observation, feeling watched, social interaction

"I always feel like somebody's watching me!" Just as the American musician Rockwell sang in his debut song in the 1980s, each of us has experienced the awkward feeling of being watched. Once roused, this feeling has a strong impact on our thoughts and actions, and this impact has been scrutinized in numerous studies from diverse backgrounds (e.g., Bateson, Nettle, & Roberts, 2006; Riether, Hegel, Wrede, & Horstmann, 2012). Surprisingly, in contrast to the effects of being watched, hardly any research exists on the subjective phenomenon of *feeling watched* for healthy individuals. We will therefore sketch different lines of research on the consequences of being watched in humans and nonhumans, and describe their implications for the question of "What does it mean to be watched?" Subsequently, we present an experimental approach to study the phenomenon of feeling watched.

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Consequences of Being Watched

The feeling of being watched can have many faces. It ranges from a vague notion without any discernible cause to overt observation by a pair of eyes following one's movements. Not surprisingly, these different faces lead to different consequences for the person who is watched—and researchers have examined these consequences in different studies and experimental settings.

A prominent consequence of being watched is *social facilitation* (Zajonc, 1965; for reviews, see Bond & Titus, 1983; Riether et al., 2012). Social facilitation refers to improved performance when an individual acts in front of an audience, and this effect occurs not only in humans, but it also occurs across diverse species such as cockroaches (Gates & Allee, 1933) and greenfinches (Klopfer, 1958). Performance boosts due to the presence of observers have mainly been reported for well-learned behaviors, whereas the performance of more demanding behaviors suffers, which suggests that dominant response tendencies are facilitated while subordinate response tendencies are suppressed as a consequence of observation (Zajonc & Sales, 1966).

Observation can also influence behavior by cues that are subtler than a live audience. For instance, researchers have discovered that confronting human participants with a picture of a pair of eyes staring in their direction fosters prosocial behavior in both anonymous economic games (Haley & Fessler, 2005) as well as in real-world settings (Bateson et al., 2006).

The mentioned studies deliberately created conditions in which observation was either clearly present—because there was a salient audience or observation-related stimulus nearby—or clearly absent—because there was no such audience or stimulus. Matters get more complex, however, if others are present who may or may not watch one's own behavior. In these situations, humans readily detect gazes that are directed straight at them, and they detect these gazes faster than averted gazes—the *stare-in-the-crowd effect* (von Grünau & Anston, 1995; see also Doi & Ueda, 2007). This asymmetry was taken to indicate that looks oriented toward oneself capture attention automatically (Farroni, Csibra, Simion, & Johnson, 2002; Sheldrake, 2005). From an evolutionary perspective, this preferential processing would be advantageous, as being gazed at might signal upcoming interactions of potential significance. In line with this assumption, studies have shown that being stared at increases physiological arousal (McBride, King, & James, 1965; Snyder, Grather, & Keller, 1974), which is even greater when being observed by a member of the opposite sex (Strom & Buck, 1979).

Feeling watched thus can exert a profound impact on various aspects of cognition and behavior: It captures attention, engenders physiological arousal, and primes dominant response tendencies. These findings also yield first indications regarding determinants of the subjective feeling of being watched, which we will outline in the following section.

Feeling Watched

Studies on the stare-in-the-crowd effect confirm the rather intuitive assumption that feelings of being watched arise primarily when noticing a straight gaze directed at oneself. Interestingly, it seems as if stimuli that consistently orient toward one's own position generate a feeling of animacy and intentionality regarding the stimuli (Gao, McCarthy, & Scholl, 2010) that may likely foster feelings of being watched. Direct gaze or similar, gaze-like stimuli in the environment thus seem to constitute the minimal necessary and sufficient condition for a feeling of being watched to arise.

To our knowledge, additional determinants for how strongly an agent feels watched have not yet been targeted by empirical research. In the following study, we therefore test whether the observer's ascribed ability to reflect on what he or she sees influences the feeling of being watched. Such an influence not only seems intuitively plausible but is also suggested by studies on the effects of being watched that refer to processes such as evaluation apprehension (Henchy & Glass, 1968; Cottrell, Wack, Sekerak, & Rittle, 1968) and reputational concerns (Bateson et al., 2006). In the following, we present two experiments to test this hypothesis.

Experiment 1

In Experiment 1, we confronted participants with pictures of different creatures observing them from a screen while the participants were instructed to imagine being in an embarrassing situation. We opted for embarrassing situations because such situations likely instigate self-conscious processing and therefore provide a strong trigger for feelings of being watched (Tracy & Robins, 2004). The watching creatures were selected on the basis of different levels of perceived intelligence and different similarity to humans (see the methods for details). Participants indicated how strongly they felt watched in each situation and how much ability to reflect on the situation they ascribed to each creature. We hypothesized that (a) feeling watched ratings will vary among different observing creatures and that (b) the creatures' ascribed ability to reflect on the situation will predict the strength of the participants' feeling of being watched.

Method

Participants. Thirty-six participants ranging from 18 to 32 years of age (M_{age} = 21.3 years, SD = 3.1; five males) were tested with the majority being psychology students. Participants were recruited online through an online study management portal, and they received course credit for their participation. The study was conducted according to the Declaration of Helsinki, and all procedures were implemented in accordance with the guidelines of the local ethics committee.

Apparatus and stimuli. The experiment was conducted at a standard PC with 17-in. monitors, and participants used the computer keyboard for their responses (numbers 1–7 for ratings on the 7-point scale; see below for details). The stimulus set contained 10 grayscale pictures of the faces of different living creatures (fish, insect, pigeon, crow, cow, cat, dog, chimpanzee, human infant, human adult; with one picture per category). To create a feeling of being watched, pictures were selected to ensure that each creature was oriented directly toward the participant and looked straight at the participant.

Procedure. The study was conducted in individual sessions and data collection was performed by the first author who at that time worked as a research assistant in the department. Instructions were provided on screen to allow for a standardized procedure. At the beginning of the session the experimenter left the room and the participant completed the task alone to avoid demand characteristics influencing responses to the experimental protocol.

The session was structured in three phases: a familiarization phase, the main experiment, and a debriefing phase. In the *familiarization phase*, participants were introduced to the stimulus set. This phase aimed at minimizing potential order effects of the randomized stimulus presentation in the main experiment (see below), and it further aimed at preparing the imagery task by fostering participant reflection on the different creatures. To this end, each face was presented centrally on the screen, and participants were asked to provide a set of three initial ratings for each creature. Each question was displayed below the picture, accompanied by a 7-point rating scale with labels at the poles. The three questions were: "How intelligent is the creature in comparison to a human?" (*human* = 7, without label at the lower pole), "How much is the creature reflecting on you?" (1 = *it does not reflect at all*, 7 = *it has very concise ideas*), and "How often do you encounter this creature in your everyday life?" (1 = *never*, 7 = *almost every day*; translated from the German originals). Participants answered all three questions before proceeding to the next creature, and the sequence of creatures was randomized across participants.

In the following *main experiment*, participants were instructed to imagine themselves being in embarrassing situations. The three situations were "bending down to tie one's shoes when the trousers split open," "throwing garbage onto the street," and "picking one's nose." One situation at a time was presented in written descriptions, and for each situation participants were instructed to imagine being watched by the particular creature that was presented on screen to set the individual pictures in context (Schwarz, Pfister, & Büchel, 2016; Schwarz, Wieser, Gerdes, Mühlberger, & Pauli, 2013; Wieser et al., 2014). The situations were presented in random order, and within each situation, all 10 pictures followed in randomized sequence. For every creature in each situation, participants provided the two main ratings of interest: A rating of how much they felt watched in the situation (1 = *not at all*, 7 = *strongly*) and a rating of how much the displayed creature was able to reflect on the situation (1 = *not at all*, 7 = *very well*). For both ratings, we also collected the corresponding response times of the participants. Response times are particularly informative because they capture the time the participant had spent looking at the creature, reading the question, imagining the described scenario, and selecting their response. That is, for the feeling watched rating, these times measure how long the participant had in fact been exposed to the displayed creature because this question was always presented before the question regarding the creature's ability to reflect on the situation. Marked differences in response times between different creatures are informative for two reasons. For one, response times likely capture how fluently participants were able to form their judgment (among other processes), with fast responses indicating effortless, straightforward responses. For another, however, they also allow us to address a potential confound: Differences in response times equate to different durations that the participants were actually "watched" by the creature on the screen. Unambiguous conclusions regarding the impact of other factors are thus only possible for conditions that do not differ in response time.

In the final *debriefing*, participants were instructed to judge the similarity between the creature and a human, and they were also asked to rate how uncomfortable each situation had been for them (this judgment was only recorded from the seventh participant onward). The lowest boundary of the 95% confidence intervals (CIs) for these ratings was 4.88 for the individual stories, suggesting that the situations were indeed perceived as intended).

Results

As a first analysis, we computed a repeated-measures analysis of variance (ANOVA) with the mean feeling watched ratings as dependent variable, and watching creature as well as situation as within-subject factors. Figure 1a shows the corresponding mean ratings that were significantly affected by the watching creature, $F(9, 315) = 150.91$, $p < .001$, $\eta_p^2 = .81$ (Greenhouse–Geisser $\varepsilon = .49$ due to violations of sphericity). Error bars in Figure 1a show scaled within-subjects standard errors that were computed based on the mean squares of the interaction of subject and condition MS_W (cf. Loftus & Masson, 1994, for this notation) and the sample size n according to the following formula:

$$SE_{within} = \sqrt{\frac{MS_w}{n}} * \sqrt{2}.$$

Additionally, a significant main effect of situation, $F(2, 70) = 14.27$, $p < .001$, $\eta_p^2 = .29$, and a significant interaction term, $F(18, 630) = 5.75$, $p < .001$, $\eta_p^2 = .14$ ($\varepsilon = .48$), were driven by higher feeling watched ratings for one situation ("throwing garbage onto the street") relative to the remaining two situations, and this was especially true for five watching creatures

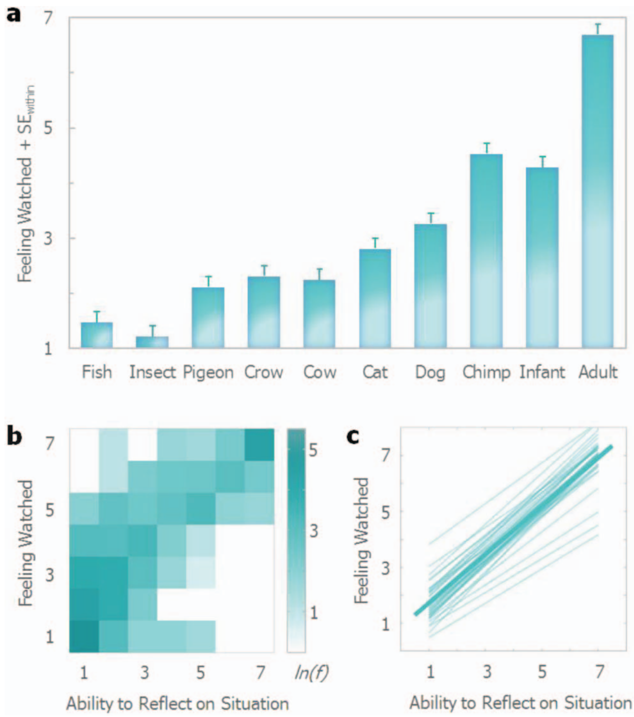

Figure 1. Results of Experiment 1. (a) Ratings for the feeling of being watched based on different species, averaged over participants and situations. Error bars indicate scaled within-subject standard errors (SE_{within}; see the text for details). "Infant" and "adult" both refer to human faces. (b) Frequencies of rating combinations for the creatures' ascribed ability to reflect on the situation and the subjective feeling of being watched for this situation. The color scale is displayed in log-transformed units due to oversaturation of certain pairings (especially [1,1] and [7,7]). (c) Participant-wise regression lines when regressing the feeling of being watched on the watching creatures' ascribed ability to reflect on the situation. The bold line resembles the mean regression line across all participants resulting from a regression coefficient analysis. See the online article for the color version of this figure.

(pigeon, crow, dog, cat, and chimpanzee; see Table 1 for the corresponding ratings).

A similar pattern resulted for the degree to which the observing creature was rated to reflect on the situation (see Table 1). Accordingly, there were main effects of watching creature, $F(9, 315) = 220.17$, $p < .001$, $\eta_p^2 = .86$ ($\varepsilon = .38$), and situation, $F(2, 70) = 15.66$, $p < .001$, $\eta_p^2 = .31$ ($\varepsilon = .85$), as well as an interaction, $F(18, 630) = 7.66$, $p < .001$, $\eta_p^2 = .18$ ($\varepsilon = .44$).

Similar rating patterns on the group level, however, should not be taken as strong evidence for a link between feeling watched and an observer's ascribed ability to reflect on the situation. To assess this hypothesized link descriptively, we plotted the frequency of each combination of both ratings in Figure 1b, indicating a substantial correlation between both measures. We then computed a regression coefficient analysis (RCA) as a second analysis to approach the hypothesized link more formally (Lorch & Myers, 1990; see also Pfister, Schwarz, Carson, & Janczyk, 2013). RCA allows quantifying the relation of two variables across participants while taking the nested structure of the data into account by estimating linear regression models for each participant for further analysis (Figure 1c). We extracted the slope coefficient when regressing the feeling watched rating on the rating of the creature's ability to reflect on the situation. These participant-wise slope coefficients ranged from 0.60 to 1.06, with a mean slope of 0.83 that was clearly different from zero, 95% CI [0.83, 0.90]. Transforming the participant-wise correlations of both ratings to Fisher *Z* scores, averaging these scores and retransforming the result yielded a mean correlation coefficient of $r = .90$ between both ratings.

Finally, the analysis of response time of the feeling watched rating did not show any effect of situation, $F(2, 70) = 0.43$, $p = .610$, $\eta_p^2 = .01$ ($\varepsilon = .78$), nor an interaction, $F(18, 630) = 1.18$, $p = .323$, $\eta_p^2 = .03$ ($\varepsilon = .23$), but there was a significant main effect of creature, $F(9, 315) = 3.13$, $p = .025$, $\eta_p^2 = .08$ ($\varepsilon = .36$). More precisely, participants spent only little time

Table 1
Detailed Results of Experiment 1, With Mean Ratings in the Left Half (on a Scale of 1–7) and Corresponding Exposure Times in the Right Half (in ms)

		Rating situation			Response time situation		
Question	Creature	Trousers	Garbage	Nose	Trousers	Garbage	Nose
Feeling watched	Fish	1.47 (0.97)	1.5 (0.88)	1.47 (0.81)	1,890 (2,223)	2,208 (3,750)	2,119 (2,284)
	Insect	1.19 (0.58)	1.42 (0.73)	1.06 (0.23)	1,856 (1,844)	1,859 (1,323)	1,801 (2,070)
	Pigeon	1.72 (1.09)	2.92 (1.65)	1.72 (1.06)	2,325 (2,463)	2,610 (2,219)	3,209 (3,973)
	Crow	1.83 (1.11)	3.14 (1.85)	1.97 (1.18)	2,816 (5,277)	2,499 (1,962)	2,994 (3,073)
	Cow	2.19 (1.39)	2.5 (1.36)	2.06 (1.15)	2,468 (2,390)	3,270 (3,720)	4,143 (4,595)
	Cat	2.39 (1.29)	3.33 (1.82)	2.72 (1.54)	4,510 (9,710)	2,793 (2,583)	2,510 (2,228)
	Dog	2.89 (1.69)	3.97 (1.72)	2.94 (1.49)	2,320 (1,655)	3,321 (4,449)	3,739 (6,049)
	Chimp	4.08 (2.13)	5.03 (1.65)	4.5 (1.83)	3,369 (3,298)	3,356 (2,779)	3,256 (2,118)
	Infant	3.97 (1.92)	4.47 (1.76)	4.42 (1.92)	2,994 (2,157)	3,144 (2,386)	3,332 (2,703)
	Adult	6.83 (0.45)	6.58 (0.91)	6.67 (0.72)	2,767 (2,714)	2,218 (1,891)	2,856 (3,266)
Creature's ability to reflect on situation	Fish	1.17 (0.70)	1.22 (0.54)	1.22 (0.68)	1,287 (1,261)	1,635 (1,537)	1,791 (1,657)
	Insect	1.14 (0.49)	1.33 (0.86)	1.19 (0.58)	1,252 (1,330)	1,353 (1,204)	1,448 (1,118)
	Pigeon	1.25 (0.50)	2.31 (1.67)	1.25 (0.55)	1,650 (1,627)	1,770 (1,492)	2,463 (3,026)
	Crow	1.47 (0.91)	2.36 (1.69)	1.39 (0.96)	1,789 (2,180)	2,305 (2,630)	1,905 (2,042)
	Cow	1.47 (0.94)	1.89 (1.37)	1.47 (0.84)	1,647 (1,185)	2,740 (4,056)	2,700 (3,951)
	Cat	1.58 (1.02)	2.64 (1.59)	1.89 (1.30)	1,571 (1,371)	2,148 (2,875)	2,560 (3,918)
	Dog	1.86 (1.25)	3.08 (1.66)	2.00 (1.15)	2,470 (2,791)	3,087 (2,388)	2,497 (2,298)
	Chimp	3.33 (1.91)	4.28 (1.83)	4.36 (1.64)	2,794 (2,086)	3,076 (2,529)	2,783 (1,950)
	Infant	2.67 (1.69)	3.42 (1.57)	3.67 (1.97)	2,902 (3,023)	2,777 (1,777)	2,612 (1,501)
	Adult	6.94 (0.23)	6.83 (0.45)	6.92 (0.28)	1,999 (1,506)	1,995 (1,641)	2,691 (2,034)

Note. Numbers in parentheses indicate standard deviations. For all analyses of response times, we focused on the response times for the feeling watched ratings. Ratings regarding the creature's ability to reflect on the situations always followed the feeling watched ratings for which participants already had to imagine the corresponding situations and might even prepare the following response so that the response times to the second question have to be treated with caution.

when confronted with either fish or insect as compared to all remaining stimuli. To substantiate this impression, we performed a contrast analysis and compared two successive levels of the factor, with factor levels ordered as in Table 1. This analysis indeed showed a significant difference between insect and pigeon, $t(35) = 3.09$, $p = .004$, $d_Z = 0.51$, whereas all remaining pairwise comparisons returned nonsignificant results, $ps \geq .100$.

Discussion

The data of Experiment 1 lend first support to the hypothesis that the subjective feeling of being watched is influenced by the observer's ascribed ability to reflect on the situation: Participants reported a stronger feeling of being watched when they also reported the watching creature to have a higher ability to reflect on the situation. These differences were further not confounded by different exposure times for most creatures (with fish and insect being the only exceptions).

It should be noted, however, that the findings relating to the regression coefficient analysis are correlational in nature, and should therefore be interpreted with caution. To investigate whether these findings can indeed be taken as evidence for a causal relationship, Experiment 2 introduced an experimental manipulation of a creature's ascribed cognitive abilities. More precisely, participants learned about the (possibly unexpected) cognitive repertoire of one particular creature, and we investigated whether this manipulation also affected the corresponding feeling watched ratings.

Experiment 2

The results of Experiment 1 suggested that a creature's ascribed ability to reflect on a situation is a strong determinant for the subjective feeling of being watched. In Experiment 2, we aimed at establishing a causal relation between both variables by manipulating the perceived cognitive abilities of one of the creatures and investigating the ensuing changes regarding the feeling of being watched.

To do so, we focused on a particular finding of Experiment 1: Pigeons and crows gave rise to nearly identical feeling watched ratings (cf. Figure 1a), which may come as a surprise given that in the scientific literature corvids are regarded as possessing exceptional cognitive abilities (Emery & Clayton, 2004). For instance, crows remember the face of potentially dangerous people over a period of at least 2.7 years (Marzluff, Walls, Cornell, Withey, & Craig, 2010). After having been trapped by a person wearing a distinct mask, the crows recognized the face even when someone other than the initial offender was wearing it. Crows further show the ability to generalize their acquired knowledge and therefore make use of categorical learning, whereas exemplar learning is dominant in pigeons (Bogale, Aoyama, & Sugita, 2011).

When confronted with these findings, participants should ascribe stronger cognitive abilities to crows than they would do without any information (as in Experiment 1). If the ascribed ability to reflect on the situation plays a causal role as hypothesized, the feeling of being watched should also increase specifically for crows. More precisely, Experiment 2 used the availability bias (Tversky & Kahneman, 1973) to change the participants' view on corvids by showing an excerpt from a documentary on the cleverness of crows. This made information on the cognitive abilities of crows more accessible during the following experimental task. We expected this manipulation to increase the ascribed ability to reflect on the probed situations of crows relative to Experiment 1. Crucially, we also expected this manipulation to increase the feeling watched ratings for crows, whereas the feeling watched ratings of pigeons served as a control condition.

Method

Participants. We recruited a new sample of 36 participants between 18 and 57 years of age ($M_{age} = 26.9$ years, $SD = 10.1$; 10 males). The study was conducted according to the Declaration of Helsinki and all procedures were in accordance with the guidelines of the local ethics committee.

Materials and procedure. Experiment 2 was similar to Experiment 1 with the exception that a short 1-min video clip on the cognitive abilities of crows was shown before the actual computer task. The clip was taken from a documentary on corvids (Fleming, 2009), summarizing recent research on the ability of crows to think about and remember humans (Marzluff et al., 2010). The remaining procedure was as in Experiment 1, and the situations were again rated as embarrassing as expected with the lowest boundary of the individual 95% CIs being 5.19.

Results

Experiment 2 replicated the main results of Experiment 1. That is, feeling watched ratings again varied across different observing creatures (Figure 2a), $F(9, 315) = 81.40$, $p < .001$, $\eta_p^2 = .70$ ($\varepsilon = .50$), and a significant main effect of situation, $F(2, 70) = 14.16$, $p < .001$, $\eta_p^2 = .29$, and a significant interaction term, $F(18, 630) = 4.40$, $p < .001$, $\eta_p^2 = .11$ ($\varepsilon = .43$), were driven by higher feeling watched ratings for one situation ("throwing garbage onto the street") relative to the remaining situations, especially for four watching creatures (pigeon, crow, dog, and cat; see Table 2 for the corresponding ratings). A similar pattern emerged for the ratings regarding the creature's ascribed ability to reflect on the situation with a significant main effect of creature, $F(9, 315) = 128.88$, $p < .001$, $\eta_p^2 = .79$ ($\varepsilon = .55$), a significant main effect of situation, $F(2, 70) = 22.56$, $p < .001$, $\eta_p^2 = .39$ ($\varepsilon = .73$), and a significant interaction term, $F(18, 630) = 5.45$, $p < .001$, $\eta_p^2 = .13$ ($\varepsilon = .43$; with a similar pattern as for the feeling watched ratings, see Table 2).

A strong descriptive relation of both ratings (Figure 2b) was again mirrored by the results of an RCA (Figure 2c). The corresponding partic-

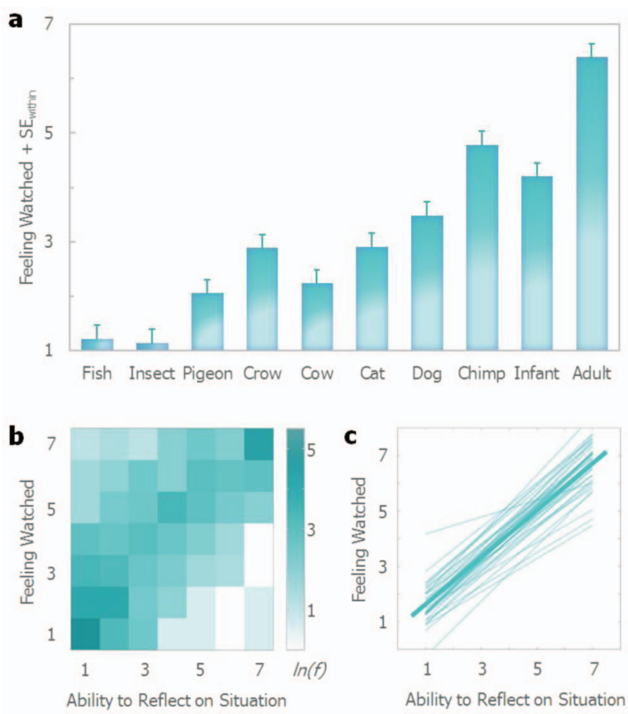

Figure 2. Results of Experiment 2. (a) Ratings for the feeling of being watched based on different species, averaged over subjects and situations. Error bars indicate scaled within-subject standard errors (SE_{within}). "Infant" and "adult" both refer to human faces. (b) Frequencies of rating combinations for ascribed ability to reflect on the situation and the subjective feeling of being watched. The color scale is displayed in log-transformed units due to oversaturation of certain pairings (especially [1,1] and [7,7]). (c) Participant-wise regression lines when regressing the feeling of being watched on the watching creatures' ascribed ability to reflect on the situation. The bold line resembles the mean regression line across all participants resulting from a regression coefficient analysis. See the online article for the color version of this figure.

Table 2
Detailed Results of Experiment 2, With Mean Ratings in the Left Half (on a Scale of 1–7) and Corresponding Response Times in the Right Half (in ms)

		Rating situation			Response time situation		
Question	Creature	Trousers	Garbage	Nose	Trousers	Garbage	Nose
Feeling watched	Fish	1.19 (0.47)	1.28 (0.74)	1.17 (0.45)	1,979 (2,735)	1,676 (1,768)	1,541 (1,432)
	Insect	1.08 (0.28)	1.28 (0.66)	1.03 (0.17)	1,497 (1,060)	1,819 (1,392)	1,510 (1,257)
	Pigeon	1.56 (1.05)	2.83 (1.78)	1.75 (1.25)	2,316 (2,142)	2,136 (1,283)	2,627 (2,769)
	Crow	2.44 (1.5)	3.69 (2.12)	2.50 (1.66)	3,208 (2,307)	3,194 (3,202)	1,815 (1,094)
	Cow	2.25 (1.5)	2.33 (1.64)	2.11 (1.47)	2,034 (1,397)	2,809 (2,280)	2,089 (2,016)
	Cat	2.50 (1.50)	3.33 (2.00)	2.86 (1.82)	2,168 (1,623)	3,409 (3,865)	2,302 (1,441)
	Dog	2.97 (1.81)	4.11 (2.00)	3.36 (2.00)	2,216 (1,245)	4,122 (10,313)	2,378 (1,665)
	Chimp	4.39 (1.93)	5.00 (1.84)	4.94 (1.90)	3,254 (2,639)	2,772 (2,298)	2,429 (1,876)
	Infant	3.69 (2.00)	4.42 (2.17)	4.47 (1.92)	3,415 (2,597)	2,819 (2,699)	2,798 (1,376)
	Adult	6.42 (1.18)	6.33 (1.33)	6.42 (1.32)	2,137 (1,265)	2,447 (2,301)	2,023 (1,209)
Creature's ability to reflect on situation	Fish	1.08 (0.28)	1.11 (0.32)	1.14 (0.35)	1,520 (1,484)	1,150 (1,004)	1,301 (1,672)
	Insect	1.08 (0.37)	1.42 (0.77)	1.14 (0.42)	1,137 (1,100)	1,770 (1,676)	1,185 (1,141)
	Pigeon	1.31 (0.75)	2.28 (1.37)	1.44 (0.84)	1,368 (1,373)	1,991 (1,797)	1,756 (1,768)
	Crow	2.17 (1.59)	3.50 (2.13)	2.14 (1.4)	2,485 (2,460)	2,175 (1,968)	1,777 (1,476)
	Cow	1.56 (1.00)	1.67 (0.93)	1.39 (0.73)	1,653 (1,153)	2,045 (1,865)	1,686 (2,023)
	Cat	1.75 (1.08)	3.11 (1.83)	2.08 (1.56)	2,172 (2,684)	2,145 (1,400)	1,515 (1,298)
	Dog	2.19 (1.39)	3.31 (1.8)	2.33 (1.69)	1,842 (1,572)	2,184 (1,474)	2,064 (1,751)
	Chimp	3.86 (1.84)	4.39 (1.81)	4.53 (1.73)	3,288 (2,548)	2,248 (1,946)	1,767 (1,272)
	Infant	3.06 (1.90)	3.86 (2.03)	3.78 (1.88)	2,808 (2,516)	2,456 (1,802)	3,001 (3,732)
	Adult	6.78 (0.96)	6.78 (1.02)	6.78 (1.05)	2,669 (2,839)	2,149 (1,690)	2,167 (2,941)

Note. Numbers in parentheses indicate standard deviations.

ipant-wise slope coefficients ranged from 0.31 to 1.07, with a mean slope of 0.85 that was clearly different from zero, 95% CI [0.79, 0.90]. Transforming the participant-wise correlations of both ratings to Fisher Z scores, averaging these scores and retransforming the result yielded a mean correlation coefficient of $r = .88$ between both ratings.

The analysis of response time of the feeling watched rating again did not show a significant main effect of situation, $F(2, 70) = 2.73$, $p = .072$, $\eta_p^2 = .07$, nor an interaction, $F(18, 630) = 1.24$, $p = .298$, $\eta_p^2 = .03$ ($\varepsilon = .17$), and there was again a significant main effect of creature, $F(9, 315) = 3.22$, $p = .024$, $\eta_p^2 = .08$ ($\varepsilon = .34$). Participants spent only little time when confronted with either fish or insect as compared to all remaining stimuli (see Table 2). As in Experiment 1, repeated contrasts showed a difference between insect and pigeon, $t(35) = 3.25$, $p = .003$, $d_Z = 0.54$, whereas all but one of the remaining pairwise comparisons returned nonsignificant results, $ps \geq .141$. Human adults also gave rise to relatively fast responses as compared to human infants, $t(35) = 2.65$, $p = .012$, $d_Z = 0.44$ (confirming the descriptive pattern of response times in Experiment 1; cf. Table 1).

To assess the main question of Experiment 2, we computed two planned comparisons between both experiments. First, we compared the mean ratings for the creature's ability to reflect on the situation for pigeons and crows between both experiments by means of a 2 × 2 split-plot ANOVA with creature (pigeon vs. crow) as within-subjects factor and background information regarding crows (not provided vs. provided) as between-subjects factor. This manipulation check revealed the predicted pattern of results (Figure 3a): A robust interaction, $F(1, 70) = 12.75$, $p < .001$, $\eta_p^2 = .15$, confirmed similar ratings for crows and pigeons when no background information was provided (Experiment 1), $t(35) = 1.23$, $p = .227$, $d = 0.20$, but higher ratings for crows than for pigeons when background information was provided to the participants (Experiment 2), $t(35) = 4.89$, $p < .001$, $d = 0.82$.

Based on this manipulation check, we analyzed the feeling watched ratings of pigeons and crows by means of the same split-plot ANOVA (Figure 3b). Crucially, this ANOVA also

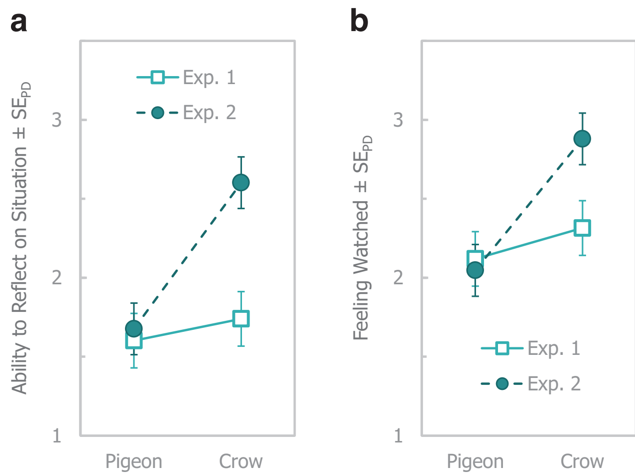

Figure 3. Mean intelligence ratings for pigeons and crows in Experiments 1 and 2. Participants had received background information regarding the cognitive abilities of crows in Experiment 2 whereas the participants of Experiment 1 had not received such information. Error bars show standard errors of paired differences (SE_{PD}; Pfister & Janczyk, 2013), computed separately for each experiment. See the online article for the color version of this figure.

yielded an interaction of creature and background information, $F(1, 70) = 7.21$, $p = .009$, $\eta_p^2 = .09$, with similar ratings for both creatures without background information (Experiment 1), $t(35) = 1.13$, $p = .268$, $d = 0.19$, but higher feeling watched ratings for crows than for pigeons when background information on crows was provided (Experiment 2), $t(35) = 5.10$, $p < .001$, $d = 0.85$.

To further ensure that this comparison was not confounded by other factors, we reran the ANOVA on the feeling watched rating using the participants' age as covariate, which replicated the critical interaction of creature and background information, $F(1, 70) = 4.26$, $p = .043$, $\eta_p^2 = .06$. Also a direct comparison of reading times for crows between Experiment 1 and 2 as tested with a *t* test for independent samples returned a nonsignificant result (2,769 ms vs. 2,739 ms), $t(70) = 0.06$, $p = .950$, $d = 0.01$.

Discussion

The results of Experiment 2 confirmed our main hypothesis: Manipulating the ascribed cognitive abilities of a creature indeed triggered stronger feelings of being watched. As expected, the feeling of being watched increased with higher perceived intelligence of the observer. It should of course be noted that these interpretations rest on a between-experiments comparison, and participants thus were not allocated fully randomly to the conditions but rather Experiment 2 was conducted shortly after Experiment 1. Given that our approach allowed controlling for a range of additional variables such as reading times and stimulus attributes, we remain confident that the present results indeed document a causal link between an observer's ascribed ability to reflect on the witnessed situation and the corresponding subjective feeling of being watched.

General Discussion

This study examined the phenomenon of feeling watched and analyzed features that determine the strength of this feeling in human agents. Our findings clearly showed that the observer's ascribed ability to reflect on the situation is a major determinant for the subjective feeling of being watched. Not only did higher ability ratings predict the corresponding feelings of being watched in each experiment, but a between-experiment manipulation of the cognitive abilities that were ascribed to crows had a strong impact on the resulting feelings of being watched.

Obviously, a creature's ability to reflect on a given situation and, more broadly, its intelligence depend on various factors such as the number of cortical neurons and high-velocity cortical fibers (Roth & Dicke, 2005). These attributes, however, cannot be perceived directly, but have to be estimated based on other information (cf. Waytz, Gray, Epley, & Wegner, 2010). The processes, by which human agents ascribe certain cognitive abilities to other beings, have been of continued interest to research on theory of mind. In general, the theory of mind describes the concepts of attributing mental states to the self and others (Frith & Frith, 2005; Leslie, 1987; Premack & Woodruff, 1978). Viewing the present results against a theory of mind framework might also explain why humans have an equal feeling of being watched when observed by either infants or chimpanzees, because both are easily construed as possessing a similar theory of mind. Such a background also suggests that human agents may feel watched by inanimate observers such as robots, as long as they ascribe a rudimentary theory of mind to these observers (McCarthy, 1979; Waytz et al., 2010).

In addition to features of the observer, feelings of being watched are also likely affected by features of the agent who feels watched. For instance, would feelings of being watched differ as a function of previous experiences? Moreover, would the results of the present experiments differ if they were conducted with a clinical sample rather than a sample of healthy participants?

Regarding the first question, it indeed seems likely that the same person will respond differently depending on his or her previous behavior. For example, the deliberate violation of rules seems to automatically prime authority-related concepts (Wirth, Foerster, Rendel, Kunde, & Pfister, 2017). It seems possible that rule violations as compared to rule compliance would increase the feeling of being watched as well. Regarding the second question, it seems pertinent to consider (sub-)clinical conditions that may be associated with overreactive feelings of being watched, such as social anxiety or social phobia. Individuals suffering from social phobia or pronounced social anxiety exhibit an attentional, negative response bias and threat interpretation biases (i.e., they may tend to interpret ambiguous stimuli as threatening and focus more strongly on potentially threatening stimuli than healthy individuals; Beard & Amir, 2009; Schwarz et al., 2013; Wieser, Pauli, Alpers, & Mühlberger, 2009; Winton, Clark, & Edelmann, 1995). A distinctive trait of socially anxious individuals is a fear of negative evaluation. We hypothesize that socially anxious individuals might thus be especially sensitive to the feeling of being watched in embarrassing situations—but only if they need to fear being judged unfavorably by the observer who understands the implications of the situation.

Limitations and Future Directions

Even though the present study obtained first evidence that feelings of being watched depend on the cognitive abilities that are ascribed to the observer, our experimental approach comes with several limitations. First, we had restricted our stimulus set to a small set of creatures that all looked directly at the participants. This stimulus set was designed to provide optimal conditions for a first demonstration of the hypothesized link, but it obviously does not allow for testing boundary conditions that may exist for more opaque situations with multiple potential observers that look at the participant not directly but from an angle or even change their gaze behavior across time (though human agents seem to readily interpret gazes as being directed toward them; Mareschal, Calder, & Clifford, 2013).

A second limitation concerns our method of asking participants to imagine certain situations. This approach allows for a controlled experimental approach to the question at hand, although real-life feelings and behavior may not always be captured entirely by this method (see, e.g., related methodological discussions regarding studies on third-party punishment; Pedersen, Kurzban, & McCullough, 2013). Future studies should therefore approach the feeling of being watched in a more ecologically valid design, and in a variety of settings that include, but are not limited to situations that foster self-conscious processing such as the present set of embarrassing situations. Extending the analysis to such settings would also allow testing for potential mediating variables such as social relations between observer and participant or different likelihoods of upcoming interactions with the observer.

Summary

The present findings indicate that an observer's ascribed ability to reflect on a given situation determines how strongly human agents feel watched in this situation. Promising avenues for future research include additional characteristics of potential observers, features of the acting agent, and potential contextual information (such as knowledge about the observer, likelihood of future interactions, etc.) that further affect the strength of the subjective feeling of being watched. Finally, studying the feeling of being watched may have implications for understanding clinical and subclinical conditions of social phobia and other populations that may come with an overreactive feeling of being watched. Potential consequences for such individuals are also highlighted in the song mentioned at the beginning of this article, during which Rockwell's feeling of being watched increases throughout the song climaxing in a constant suspicion of being watched by everyone (Rockwell, 1980).

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