The Journal of Social Psychology

ISSN: (Print) (Online) Journal homepage: https://www.tandfonline.com/loi/vsoc20

The influence of emotional salience on gaze behavior in low and high trait empathy: an exploratory eye-tracking study

Emine Nebi, Tobias Altmann & Marcus Roth

To cite this article: Emine Nebi, Tobias Altmann & Marcus Roth (2022) The influence of emotional salience on gaze behavior in low and high trait empathy: an exploratory eye-tracking study, The Journal of Social Psychology, 162:1, 109-127, DOI: 10.1080/00224545.2021.2001410

To link to this article: https://doi.org/10.1080/00224545.2021.2001410

Published online: 22 Dec 2021.

THE JOURNAL OF SOCIAL PSYCHOLOGY
2022, VOL. 162, NO. 1, 109–127
https://doi.org/10.1080/00224545.2021.2001410

The influence of emotional salience on gaze behavior in low and high trait empathy: an exploratory eye-tracking study

Emine Nebi, Tobias Altmann, and Marcus Roth

University of Duisburg-Essen

ABSTRACT

Previous studies have shown that situational factors like emotional salience are associated with higher subjective levels of state empathy. The present eye-tracking study explored whether gaze behavior varies as a function of emotional salience between individuals with low and high self-reported trait empathy. In a between-subjects design, we presented three social scene images in the context of different emotion conditions (Scene 1: neutral versus positive; Scene 2: neutral versus negative; Scene 3: positive versus negative) and assessed the dwell times of individuals with low versus high self-reported empathy (measured with the Toronto Empathy Questionnaire; TEQ). Analyses revealed that whereas low- and high-TEQ participants differed in their gaze behavior after receiving neutral information, they did not differ after receiving positive or negative information. Our preliminary results suggest that gaze behavior may be more indicative of self-reported trait empathy in situations with low emotional salience than in situations with high emotional salience.

ARTICLE HISTORY
Received 1 April 2021
Accepted 8 October 2021

KEYWORDS
Empathy; eye-tracking; emotional salience; attention; motivation

Introduction

Empathy is an interpersonal, multicomponent phenomenon that enables an individual to experientially understand and align with (i.e., not only cognitively understand, but also share and feel what another feels) the emotional experience of another individual in a vast multitude of contexts (Eisenberg & Miller, 1987; De Vignemont & Singer, 2006; Weisz & Cikara, 2021; Zaki, 2014). Different factors determine whether a specific individual will experience empathy in a specific situation.

The experience of empathy – also situative or state empathy – describes this state of experiental understanding and emerges from the dynamic *interaction* of two components: an affective and a cognitive one. The affective component corresponds with the physiological, emotional reaction of an observer to (emotionally salient) information about another (human) being's well-being (Decety & Hodges, 2006; Decety & Jackson, 2004). Furthermore, the affective component implies that the emotional experience of the empathizer (i.e., the person experiencing empathy) is qualitatively similar to the (assumed) emotional experience of the empathy target (i.e., the person with whom the empathizer has empathy; De Vignemont & Singer, 2006). The cognitive component corresponds with an observer's recognition of the emotions of the other, an understanding of the situational factors that were causally related to these emotions as well as an understanding of the future consequences of the situation of the other (Singer, 2006; Zaki & Ochsner, 2012). The cognitive component is thus related to a grasp of the impact (i.e., the relevance) of the emotional event for the well-being of the other. A further important hallmark of the empathic experience is that the empathizer remains aware of the fact that their affective reaction is prompted by witnessing an emotional event in another (human) being's (i.e., the empathy target's) life (Decety & Hodges, 2006; Decety & Jackson, 2004). The

CONTACT Emine Nebi emine.nebi@uni-due.de Psychology, University of Duisburg-Essen, Essen, Germany
This article has been republished with minor changes. These changes do not impact the academic content of the article.

experience of empathy results from the process of empathizing, in which the affective and cognitive components interact with each other to produce the state of experiental understanding after the (potential) empathizer has witnessed an emotional event in the life of the (potential) empathy target.

The perception and representation of another (human) being's emotional experience thus functions as a *potential* entry point into the process of empathizing. Indeed, observers perceive interpersonal situations as more empathically significant and display a stronger affective reaction to the situation of another if they perceive the situation as being more emotionally arousing and salient (Balconi & Bortolotti, 2014). Emotional salience (i.e., the interaction between the valence and arousal) of a stimulus or situation seems to be a crucial situational factor in prompting the process of empathizing. Moreover, exposure to the emotional experience of another individual prompts cognitive processes that are aimed at understanding the other person's experience and thoughts (Israelashvili & Karniol, 2018; Israelashvili et al., 2020).

However, the mere presence and even the perception of emotional information does not necessarily imply that empathizing will take place (Hofelich & Preston, 2012; Morelli & Lieberman, 2013; Rameson & Lieberman, 2012; Zaki, 2014). Observers' subjective experience of empathy is reduced when they perceive emotional information while simultaneously performing a cognitive load task, and this effect is associated with diminished activity in empathy and social-cognition-related brain regions (Morelli & Lieberman, 2013; Rameson & Lieberman, 2012). The display of mimicry – a supposedly automatic behavioral reaction associated with the self-reported affective component of empathy (Holland et al., 2021) – also seems to depend at least in part on the allocation of attention to an emotional stimulus (Hofelich & Preston, 2012). Intriguingly, Fan and Han (2008) reported a temporal gradient to the effect of cognitive load on empathic neural responses such that the early neural response to an emotional image was unaffected by cognitive load. The task-dependent downregulation of the initial empathy-related neural responses suggests that observers use available information to engage in a decision-making process regarding the allocation of their cognitive resources. In sum, these data suggest that the process of empathizing may rely on the temporally dynamic, moment-to-moment integration of information gathered through sustained, top-down-regulated attention to an emotional stimulus (Hedger et al., 2018).

This concept is in line with evidence that individual factors, such as a person's general motivation to share and participate in others' experiences and a situation-specific motivation to engage in the process of empathizing, play key roles in determining whether individuals experience empathy (Cameron et al., 2019; Weisz & Cikara, 2021; Zaki, 2014). In a series of studies, Cameron et al. (2019) delivered compelling evidence that individuals' choice to empathize is motivated by their currently active individual goals. An analysis of data from 1,204 participants revealed that when given the choice to select between a cognitive task (e.g., describing the age, gender, or emotions of a depicted person) or an empathy task (requiring the participants to share the depicted person's emotional experience), participants robustly avoided the empathy task. This tendency was associated with the perception of the act of empathizing as effortful, aversive, and cognitively taxing, *regardless* of whether the task involved empathizing with a person experiencing a positive or a negative emotional state. Moreover, the increase in the cognitive demand associated with empathizing (e.g., by prolonging the duration of the empathy task) was associated with greater avoidance of the empathy task. Cognitive effort is perceived as being highly aversive (Kurzban, 2016), and when given the choice, individuals even choose to experience pain rather than to engage in cognitively effortful tasks (Vogel et al., 2020).

Intriguingly, however, participants in Cameron et al.'s study were *more likely* to select the empathy task if they were led to believe (through a manipulation of their response accuracy feedback) that prior empathizing enabled superior performance on a subsequent emotion recognition task (Cameron et al., 2019). Hence, although empathizing seems to be perceived as effortful, individuals choose to engage in the process when it is conducive (i.e., relevant to the achievement of) to their presently active goals (Zaki, 2014). What does this tell us about individuals who report that they habitually experience empathy? The fact that individuals avoid empathizing when they can but engage in it when it is aligned with their goals raises the question of whether the act of empathizing has greater relevance to the intrinsic goals of individuals with high trait empathy (usually assessed via self-report questionnaires and considered to capture trait empathy; Holland et al., 2021).

Much of the literature on empathy has focused on the ability and automaticity aspect (for a comprehensive review, see Zaki, 2014). Indeed, it is sensible to assume that an individual's *ability* to react affectively and physiologically to and align with (affective component) and recognize and understand (cognitive component) the emotional situation of another person places a bottleneck on the *maximum potential capacity* of that individual to experience empathy in any given situation. However, in the absence of an intrinsic motivation to empathize, the value of the act of empathizing will be strongly determined by immediate situational factors, such as emotional salience (Balconi & Bortolotti, 2014), effort, and potential rewards (Cameron et al., 2019). In a study by Rameson and Lieberman (2012), high and low trait individuals did not differ in their neural responses when they were told to passively view or when they were instructed to empathize with a depicted person after they had received emotional information about them. However, when participants had to memorize an 8-digit number while viewing images in a cognitive load condition, individuals with high trait empathy displayed stronger neural responses in empathy-related circuits than low trait empathy individuals. Thus, whereas the capacity to empathize did not differ between groups, the tendency to empathize independently of the situational demands did. Intriguingly, the difference in neural responses between the groups was also associated with a superior memory performance of the high trait empathy group. As emotional arousal specifically enhances memory for goal-relevant information (Cahill & McGaugh, 1998; T. H. Lee et al., 2015; Levine & Edelstein, 2009), the superior memory performance of high trait empathy participants in the context of social emotional information strongly speaks to the motivational and relevance-associated aspect of trait empathy

Research has suggested that high trait empathy individuals allocate attentional resources to information that potentially carries emotional information. When viewing dynamic facial stimuli (with an actor narrating emotional or neutral personal experiences), participants with high self-reported trait empathy fixated on the eye region for longer durations than participants with low self-reported trait empathy scores *regardless of* whether the actor's narrative had high or low emotional salience (Cowan et al., 2014; Martinez-Velazquez et al., 2020). The eye region is considered the facial feature with the richest informational value about an individual's inner state (Vaidya et al., 2014). In line with this finding, when comparing low and high trait empathy individuals' gaze behavior while viewing static facial expressions and words, Liu et al. (2020) observed longer fixation durations for emotional material in high than in low trait empathy individuals, whereby this effect was more pronounced for faces. Similarly, when social and nonsocial static images of stimuli compete for attentional resources, individuals with high self-reported trait empathy allocate more visual attention to social information than low trait empathy individuals do (Hedger et al., 2018). Moreover, this effect is *more pronounced for prolonged viewing durations* possibly indicating a process of goal-congruent information gathering. The research reviewed above raises the question of whether the process of empathizing relies, to a different extent, on situational cues in individuals with high self-reported trait empathy in comparison with individuals with low self-reported trait empathy.

The present study

In this pilot study, we investigated a new line of thinking in empathy research. We explored the idea that self-reported trait empathy may reflect a general relevance of the act of empathizing in social situations and that individuals with high self-reported trait empathy may *actively regulate their behavior to maximize their probability of experiencing empathy regardless of the emotional salience of a situatio*n. To address this question, we presented scene images in the context of information with different emotional salience and used eye-tracking to record participants' visual attention. We contrasted three emotional salience conditions: neutral versus positive, neutral versus negative, and positive versus negative. We then analyzed whether the duration and allocation of visual attention to scene elements in the different emotional salience conditions varied to a different extent between the self-reported trait empathy groups.

Method

Participants and excluded data

A total of 50 psychology undergraduate students (38 women) at the University of Duisburg-Essen took part in the study in exchange for partial course credit. Four participants were excluded from the study due to technical failure during recording. Further trial-wise (i.e., scene-wise; see the details in the *Eye-Tracking Experiment* section) exclusions were made when the eye-tracking data were missing or of low quality (defined as a drift offset of more than 2 degrees from the validation values recorded at the beginning of the trial). Thus, the final samples included 32 participants for Scene 1, 37 participants for Scene 2, and 37 participants for Scene 3 (see the details about the scenes and conditions below).

Apparatus

Participants were seated approximately 80 cm from a computer screen (Samsung SyncMaster 2233RZ; 22 Inch). Gaze data were collected with monocular gaze recording using an infrared video-based eye tracker (Eyelink 1000 Desktop System; SR Research, Ontario, Canada) in remote mode (head-free-to-move; sampling rate of 500 Hz). The illuminator and the camera were placed approximately 60 cm from a participant's dominant eye.

Procedure

The experiment took place on 2 days. On the first day, participants completed a battery of tests and questionnaires in a group setting (including the Toronto Empathy Questionnaire, see Measures). On the second day, individual eye-tracking recording was conducted. Prior to the eye-tracking experiment, participants provided informed consent and were prepared for physiological measurement (electrocardiogram and electrodermal activity, not part of the present study). Following a 9-point calibration and the conducting of another study, the eye-tracking experiment took place. After the eye-tracking recording was completed, participants were shown each scene image and verbal stimulus again and rated their subjective experience with respect to the stimulus they had just seen (see the *Subjective Ratings* section in Measures).

Eye-tracking experiment

Design

Figure 1 presents the design of the eye-tracking experiment. The experiment contained a total of three trials. Each trial contained only one image depicting only one of three possible natural scene images (Scene 1, Scene 2, or Scene 3; see Figure 3 for scene images, see also the *Trial Structure* section). Each scene (i.e., trial) was presented in the context of one of two possible emotion conditions (Scene 1: neutral or positive; Scene 2: neutral or negative; Scene 3: positive or negative). Upon arrival, each participant was randomly assigned to one of two pseudo-randomization groups (A or B). The pseudo-randomization group determined the specific emotion condition in which each scene was shown (see the *Experimental Conditions* section) and ensured that each participant always passed through one neutral, one positive and one negative emotion condition over the course of the experiment. The concern behind this precautionary design decision was that seeing two of the scenes (67%) in the context of an emotion condition with similar valence, be it neutral, negative, or positive, could result in an evaluative priming and influence the interpretation of as well as the gaze behavior toward the

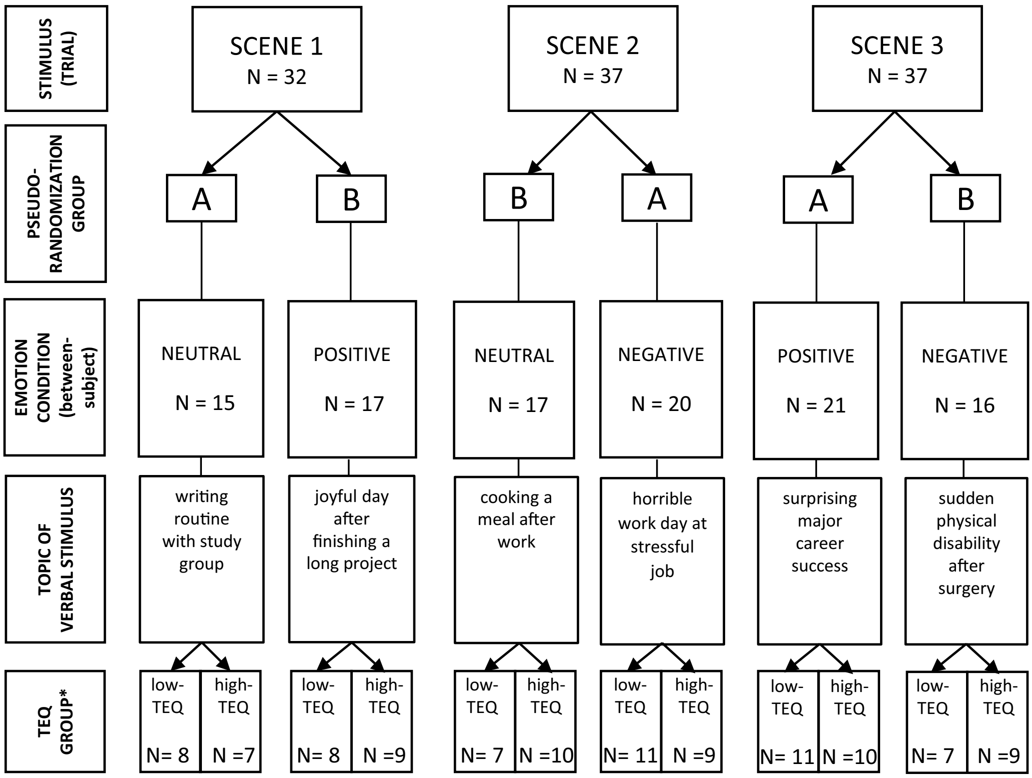

Figure 1. Design of the eye-tracking experiment with sample sizes. *TEQ groups based on a median split of TEQ scores per scene image sample.

remaining scene (Barrett, 2006). Pseudo-Randomization groups were determined such that participants in Pseudo-Randomization Group A saw Scene 1 in the neutral emotion condition, Scene 2 in the negative emotion condition, and Scene 3 in the positive emotion condition, whereas participants in Pseudo-Randomization Group B were presented Scene 1 in the positive emotion condition, Scene 2 in the neutral emotion condition, and Scene 3 in the negative emotion condition (see Figure 1). Thus, a participant in Pseudo-Randomization Group A saw Scene 1 only in the neutral emotion condition, whereas a participant in Pseudo-Randomization Group B saw Scene 1 only in the positive emotion condition. Consequently, each participant was in *either* Pseudo-Randomization Group A or B and passed through one neutral, one positive and one negative emotion condition but saw each individual scene in *only one of two* possible emotion conditions. The order in which participants saw a specific scene was randomized within each pseudo-randomization group.

Experimental conditions

There were three emotion conditions over the course of the experiment: neutral, positive, and negative. Each scene (i.e., trial) was presented in the context of *one of two possible emotion conditions* (Scene 1: neutral or positive; Scene 2: neutral or negative; Scene 3: positive or negative). The emotion conditions were induced by presenting verbal stimuli to the participants (see Figure 1 and the *Design* section). Each condition of each scene was induced by a verbal stimulus specifically constructed to induce that specific emotion condition with a specific scene. Hence, the content of the verbal stimuli and the corresponding emotional salience were chosen in reference to each other (see the *Verbal Stimuli* section) and with the aim of creating a contrast between the different degrees of emotional

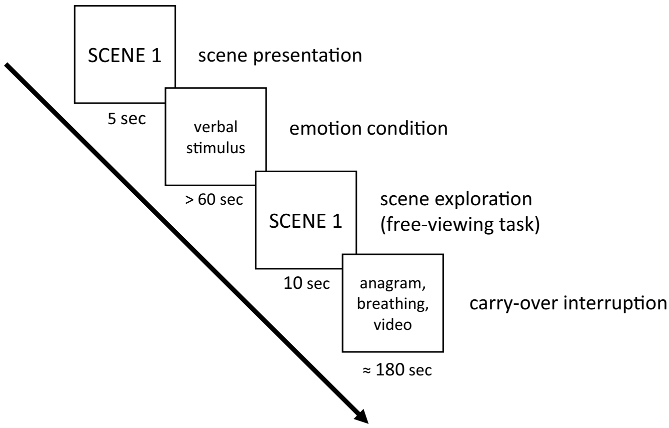

Figure 2. Trial structure of the eye-tracking experiment.

salience in the emotion conditions. Please note that there were only *two possible emotion conditions per scene* and that *none* of the scenes was shown in all three emotion conditions that were presented during the experiment (neutral, positive, and negative).

Trial structure

Figure 2 presents the trial structure. Each trial contained only one scene and only one verbal stimulus. In the *scene presentation* phase, participants were shown a scene image for 5 s. Immediately afterward, a verbal stimulus (see the *Verbal Stimuli* section) was presented. Reading duration was self-paced but was set to last for at least 60 s. Participants pressed a button on a button box placed in front of them to continue the trial and indicate that they had finished reading. This prompted the *scene exploration* phase in which the scene image shown in the scene presentation phase was presented again for 10 s. The trial ended with a *carryover interruption* phase (anagram task, deep breathing, relaxing video) designed to prevent cognitive occupation with the content of the verbal stimulus and to avoid a carryover effect of the physiological arousal between trials.

Stimulus material

Verbal stimuli

The verbal stimuli were specifically developed to be used with a particular, previously determined scene. They consisted of first-person narratives and differed in their emotional salience. The name and age of the narrator were referred to at the beginning of the text so that participants were aware of the narrator's demographics. Semantic overlap between each two scene-matched verbal stimuli was maximized whenever it was possible and whenever it did not compromise the operationalization of the emotional salience condition. For example, the verbal stimuli used to induce the neutral and positive emotion conditions with Scene 1 both referred to a female student and her writing assignment. The verbal stimuli also roughly matched the gist of the visual information of the scene they were presented with. For example, the verbal stimuli presented in Scene 1 both contained references to a botanical garden.

For a summary of the content of the verbal stimuli see Figure 1.

Scene images

The scene images used for the eye-tracking task were specifically developed for the present study (see Figure 3). To assess attention to the empathy target, we used natural, emotionally ambiguous static scene images depicting a dyadic interaction between a man and a woman with ambiguous to neutral

Figure 3. Scene images with corresponding ROIs. a) Scene 1, b) Scene 2 and c) Scene 3. yellow = NARRATOR ROI, blue = NON – NARRATOR ROI, not marked = BACKGROUND ROI. Colors indicate the location, size, and shape of the ROIs.

facial expressions in front of a natural background. Participants could direct their visual attention to one of three scene elements (man, woman, background), thereby displaying their visual attention preference. The size of Scene 1 was 1600 × 899 pixels, the size of Scene 2 was 1600 × 1060 pixels, and the size of Scene 3 was 1600 × 930 pixels. Subjective ratings in a pre-study (N = 114) confirmed the ambiguous emotionality of the images (1 = *very negative* to 7 = *very positive*; Scene 1, M = 3.75, SD = 4.72; Scene 2, M = 2.97, SD = 4.02; Scene 3, M = 3.21, SD = 1.30).

Measures

Toronto empathy questionnaire and trait empathy groups

Trait empathy was assessed with the German Version of the Toronto Empathy Questionnaire (TEQ; Spreng et al., 2009), a 16-item, unidimensional self-report questionnaire for the assessment of global empathy known to measure empathy as an emotional process (Roth & Altmann, 2021). Using a 5-point rating scale, participants responded to statements of which eight are scored positively (e.g., “I can tell when others are sad even when they do not say anything”), and eight are scored negatively (e.g., “I am not really interested in how other people feel”). On the basis of their TEQ scores, participants were assigned to either a low trait empathy (low-TEQ) or a high trait empathy (high-TEQ) group. The TEQ groups were based on a median split. Median splits were performed separately for each scene because each scene had a different sample size. Hence, the grouping of participants into the low-TEQ and high-TEQ groups was specific to each scene and was based on the TEQ scores of only the participants who had valid gaze data for that specific scene (see the *Participants and Excluded Data* section).

Internal consistencies were also calculated separately for the sample associated with each scene and ranged from α = .77 to α = .80.

Subjective ratings

To assess how the emotionality of the verbal stimuli was perceived, we asked participants to rate the emotionality of the narrator of the verbal stimulus (“How does the narrator feel?”) on a 7-point rating scale (1 = *does not apply at all* to 7 = *applies completely*). The questionnaire contained 16 items. Twelve of the items were taken from the Positive and Negative Affect Schedule (PANAS; Watson et al., 1988), two were slightly modified from the PANAS (e.g., “worried” instead of “distressed”), and two were self-constructed (“happy” and “desperate”). The maximal possible score for positive affect (PA) was 42, and the maximal possible score for negative affect (NA) was 63. The internal consistencies ranged from α = .86 to α = .95 for PA and from α = .86 to α = .97 for NA.

Analysis

Eye-tracking

Eye-tracking data were preprocessed in Data Viewer Version 3.2.48 (SR Research, Ontario, Canada). After checking each trial for a successful recording, the first fixation was deleted for each trial (Holmqvist et al., 2011). Three regions of interest (ROIs) were hand-drawn for each scene: 1) NARRATOR, 2) NON-NARRATOR, and 3) BACKGROUND (see Figure 2). Dwell time data were exported for each ROI for the first 2,000 ms of the presentation of the scene and the scene exploration phases (see Figure 1). For each scene, the NARRATOR ROI refers to the person with the same gender as the narrator of the verbal stimulus, whereas the NON-NARRATOR ROI refers to the other person in the dyadic interaction. The BACKGROUND ROI refers to the image surface that is not included in the NARRATOR and the NON-NARRATOR ROIs.

Statistical analysis

All statistical analyses were performed separately for each scene image and the respectively matched emotion conditions. To check for whether our experimental manipulation was successful and the emotion conditions were perceived as differing in emotional salience, we performed *independent t tests* to compare the PA and NA scores between emotion conditions.

To analyze whether the trait empathy groups differed in the amount of time (i.e., dwell time) they spent exploring the specific ROIs, we performed separate *independent t tests* for each emotion condition in each scene. When Levene’s test was significant, corrected values were reported. To assess whether the difference in dwell time between empathy groups varied as a function of emotional salience, we performed a 2 × 2 x 3 *multivariate ANOVA* with the between-subjects factors TEQ group (low-TEQ vs. high-TEQ) and emotion (Emotion Condition 1 vs. Emotion Condition 2) and the within-subject factor ROI (NARRATOR, NON-NARRATOR, BACKGROUND). To analyze whether spatial attention allocation varied between the empathy groups as a function of emotional salience, we performed a *repeated-measures ANOVA* with the between-subjects factors TEQ group (low-TEQ vs. high-TEQ) and emotion (Emotion Condition 1 vs. Emotion Condition 2) and the within-subject factor ROI (NARRATOR, NON-NARRATOR, BACKGROUND).

The present study is exploratory and does not pretend to be confirmatory. It is more about learning and generating hypotheses than about confirming them (E. C. Lee et al., 2014). In such a case, the consequences of Type I and Type II errors are considered to be comparably disadvantageous in an exploratory study. Therefore, in order to avoid premature acceptance of the null hypothesis, we decided to equalize alpha and beta by slightly adjusting alpha in our analyses of the gaze data. The effects are reported as statistically significant at alpha > .1. Effect sizes for the present research question could not be estimated from previous studies because the study question is novel. We assumed that a medium effect size ($d \geq .5$, $\eta^2 \geq .06$) would be empirically relevant for encouraging further studies. On the basis of this assumption, we performed separate post hoc sensitivity power analyses for each scene, assuming a medium effect size ($\eta_p^2 = .06$) and alpha = .10. Based on this assumption, we performed separate post-hoc sensitivity power analyses (using G*POWER 3.1 by Faul et al., 2009) for each scene to estimate minimal detectable effect size (assuming alpha = .10 and 1-beta = .80). For the t-tests, the minimally required effect size *d* ranged between 1.27 and 1.36 for the three scenes. For the MANOVA with 2 × 2 between factors and three dependent variables, the minimally required effect size η_p^2 ranged between 0.14 and 0.16 for the three scenes. For the repeated measures ANOVA with 2 × 2 between factors and one within factor with three measurements, the minimally required effect size η_p^2 ranged between 0.05 and 0.06. Two-tailed *p*-values are the reported.

Results

Manipulation check

To check for whether our manipulation of emotional salience between conditions was successful, we compared the mean positive affect (PA) and mean negative affect (NA) scores for the two emotion conditions for each scene. The results of the independent t test confirmed that both the PA and NA scores differed significantly between emotion conditions for Scenes 2 and 3 (see Table 2). For Scene 1, the PA scores differed significantly between conditions, whereas the difference between NA scores yielded a trend toward statistical significance (p = .056) and a medium effect size (d = 0.37).

Effect of emotion condition on gaze duration

Comparison of mean dwell times between TEQ groups per emotion condition

Descriptive statistics on dwell time data are summarized in Table 1. The results of the independent t tests are summarized in Table 1, Table 3 and Figure 4. TEQ groups did not differ in emotion conditions with positive or negative valence. For both Scenes 1 and 2, after receiving neutral emotional information, high-TEQ participants explored the BACKGROUND ROI for a significantly shorter duration than the low-TEQ participants did. Additionally, in the neutral emotion condition for Scene 2, the high-TEQ participants spent significantly more time exploring the NON-NARRATOR ROI. The TEQ groups did not differ significantly in their dwell times for the NARRATOR ROI.

In sum, t tests indicated significant differences between TEQ groups only in the neutral conditions (Scene 1 and 2) but not in the emotional conditions with positive or negative valence.

Main effects and interactions

The results for the multivariate and repeated-measures ANOVAs are summarized in Table 4 (see also Figure 5).

Scene 1

For Scene 1, the analysis of dwell times for the NARRATOR ROI and the NON-NARRATOR ROI yielded nonsignificant main effects and a nonsignificant *TEQ group x emotion* interaction. This suggests that participants' gaze behavior for these two ROIs was not significantly influenced by their self-reported empathy or by the emotion condition in which they viewed the scene. By contrast, there was a main effect of both TEQ group and emotion for the BACKGROUND ROI. However, despite a medium effect size, we did not observe a statistically significant result for the *TEQ group x emotion* interaction.

Scene 2

The analysis of Scene 2 yielded no main effect of TEQ group for the NARRATOR ROI. By contrast, there was a significant main effect of emotion for the NARRATOR ROI, indicating that participants spent more time looking at the NARRATOR ROI in the negative (M = 854, SD = 97) than in the neutral (M = 372, SD = 107) condition. The *TEQ group x emotion* interaction was nonsignificant for the NARRATOR ROI, implying a similar effect of emotion condition on the TEQ groups. For the

Table 1. Means, standard deviations and 90% CIs per scene image and emotion condition with the criterion dwell time in milliseconds.

	SCENE 1								SCENE 2								SCENE 3							
	neutral				positive				neutral				negative				positive				negative			
	M	*SD*	90% CIs		*M*	*SD*	90% CIs		*M*	*SD*	90% CIs		*M*	*SD*	90% CIs		*M*	*SD*	90% CIs		*M*	*SD*	90% CIs	
			LL	UL			LL	UL			LL	UL			LL	UL			UL	LL			LL	UL
NARRATOR																								
low-TEQ	735	507	395	1074	956	478	634	1275	272	262	79	464	841	628	498	1184	999	559	695	1305	1112	790	532	1691
high-TEQ	951	463	611	1291	964	597	594	1334	473	319	288	658	867	337	659	1076	1005	407	769	1240	1422	483	1123	1722
NON-NARRATOR																								
low-TEQ	448	450	147	750	585	363	342	829	152	262	-39	345	483	519	199	766	442	485	176	707	244	527	-143	630
high-TEQ	562	429	248	877	684	576	326	1041	461	389	235	687	394	255	236	552	417	375	199	634	127	213	-5	259
BACKGROUND																								
low-TEQ	643	542	280	1006	240	158	134	345	1302	507	929	1674	487	376	282	692	344	372	141	547	479	615	27	931
high-TEQ	270	139	168	372	151	69	108	194	823	530	516	1130	493	298	309	678	371	380	150	590	255	246	103	408

Table 2. Results of independent t tests per scene image and emotion condition with the criterion PA and NA scores.

SCENE		N	M	SD	t	df	p	d	95% CIs LL	95% CIs UL
SCENE 1										
	PA score				-5.82	30	< .000	-2.06	-14.12	-6.56
	neutral	15	24.60	6.15						
	positive	17	34.94	4.26						
	NA score				2.00	24.21	.056	0.71	-0.08	5.49
	neutral	15	13.00	4.41						
	positive	17	10.29	3.00						
SCENE 2										
	PA score				11.95	35	< .000	3.94	12.67	17.85
	neutral	17	26.41	4.56						
	negative	20	11.15	3.18						
	NA score				-9.85	35	< .000	-3.25	-28.91	-19.03
	neutral	17	12.53	6.37						
	negative	20	36.50	8.13						
SCENE 3					12.04	35	< .000	4.00	21.56	30.01
	PA score									
	positive	21	37.29	3.35						
	negative	16	11.50	8.75						
	NA score				-14.45	15.46	< .000	-4.80	-44.56	-33.13
	positive	21	10.10	1.51						
	negative	16	48.94	10.67						

Table 3. Results of the independent t tests per scene image and per emotion condition with the criterion dwell time in milliseconds.

SCENE	t	df	p[a]	d	90% CIs LL	90% CIs UL	t	df	p[a]	d	90% CIs LL	90% CIs UL
SCENE 1	neutral condition						positive condition					
NARRATOR	-0.86	13	.406	0.45	-663.53	230.25	-0.04	15	.971	0.02	-473.83	454.41
NON-NARRATOR	-0.50	13	.625	0.26	-517.47	289.36	-0.41	15	.685	0.20	-514.28	317.70
BACKGROUND	`1.88	8.04	.097	0.97	3.73	741.73	1.46	9.37	.175	0.71	-21.60	199.05
SCENE 2	neutral condition						negative condition					
NARRATOR	-1.37	15	.190	0.68	-458.22	55.65	-0.12	15.82	.907	0.05	-410.84	358.54
NON-NARRATOR	-1.82	15	.089	0.90	-605.77	-11.37	0.50	15.13	.625	0.23	-223.06	400.52
BACKGROUND	1.86	15	.082	0.92	28.27	928.48	-0.04	18	.968	0.02	-273.80	261.28
SCENE 3	positive condition						negative condition					
NARRATOR	-0.03	19	.979	0.01	-377.71	366.44	-0.97	14	.347	0.49	-872.26	251.09
NON-NARRATOR	0.13	19	.898	0.06	-305.05	354.74	0.61	14	.554	0.31	-221.47	453.95
BACKGROUND	-0.16	18.71	.872	0.07	-310.67	256.95	1.00	14.00	.333	0.50	-169.85	617.91

[a]*p*-value statistically significant at $p < .10$

NON-NARRATOR ROI, there was not a main effect of emotion or of TEQ group. However, the *TEQ group x emotion* interaction yielded a trend toward statistical significance and a medium effect size. The interaction figures suggested a cross-over interaction.

Analyses also revealed a trend toward statistical significance and a medium effect size for the main effect of TEQ group on dwell times for the BACKGROUND ROI. This indicated that the low-TEQ group (M = 894, SD = 105) spent on average more time exploring the BACKGROUND ROI than the high-TEQ group did (M = 658, SD = 100). Similarly, a significant main effect of emotion for the BACKGROUND ROI suggested longer dwell times in the neutral condition (M = 1062, SD = 107) than in the negative emotion condition (M = 490, SD = 97)

Table 4. Results of the ANOVA analysis per scene image with the criterion dwell time in milliseconds. a) multivariate ANOVA, b) repeated-measures ANOVA.

a) 2 (low-TEQ vs. high-TEQ) x 2 (Emotion Condition 1 vs. Emotion Condition 2) ANOVA

	SCENE 1			SCENE 2			SCENE 3		
	F (1, 28)	p^a	η_p^2	*F* (1. 33)	p^a	η_p^2	*F* (1. 33)	p^a	η_p^2
TEQ group									
NARRATOR	0.38	.544	.01	0.62	.436	.02	0.73	.400	.02
NON-NARRATOR	0.41	.527	.01	0.72	.402	.02	0.26	.613	.01
BACKGROUND	4.97	.034	.15	2.67	.112	.08	0.53	.472	.02
emotion									
NARRATOR	0.40	.532	.01	11.15	.002	.25	2.04	.163	.06
NON-NARRATOR	0.61	.442	.02	1.03	.317	.03	3.12	.087	.09
BACKGROUND	6.37	.018	.19	15.68	.000	.32	0.01	.941	.00
TEQ group x emotion									
NARRATOR	0.32	.579	.01	0.37	.548	.01	0.68	.417	.02
NON-NARRATOR	0.00	.962	.00	2.35	.135	.07	0.11	.743	.00
BACKGROUND	1.88	.181	.06	2.81	.103	.08	0.86	.361	.03

b) 2 (low-TEQ vs. high-TEQ) x 2 (Emotion Condition 1 vs. Emotion Condition 2) x 3 (NARRATOR vs. NON-NARRATOR vs. BACKGROUND) repeated-measures ANOVA

	SCENE 1			SCENE 2			SCENE 3		
	F (1.53, 42.95)	p^a	η_p^2	*F* (1.95, 64.50)	p^a	η_p^2	*F* (1.70, 56.01)	p^a	η_p^2
ROI	9.32	.001	.25	5.72	.006	.15	23.92	.000	.42
ROI * TEQ group	1.08	.333	.04	1.40	.254	.04	0.55	.550	.02
ROI * emotion	1.38	.260	.05	9.98	.000	.23	1.81	.178	.05
ROI * TEQ group * emotion	0.43	.602	.02	1.82	.170	.05	0.57	.540	.02

[a]*p*-value statistically significant at $p < .10$

However, an analysis of the interaction revealed a trend toward statistical significance as well as a medium effect size for the *TEQ group x emotion* interaction for the BACKGROUND ROI, suggesting that the effect of emotion differed between the TEQ groups for these two ROIs.

Scene 3

For Scene 3, a significant main effect of emotion condition indicated that participants spent less time exploring the NON-NARRATOR ROI in the negative (M = 185, SD = 104) than in the positive condition (M = 429, SD = 90).

There were no more significant main effects or interactions.

In sum, there was a non-significant result and a medium effect size for the *TEQ group x emotion* interaction when a scene image was shown in the context of a neutral and of an emotional condition (Scene 1 and 2) whereas there was no evidence for a *TEQ group x emotion* interaction when a scene image was shown in the context of two emotional conditions (Scene 3).

Spatial attention allocation

The repeated-measures ROI yielded a main effect of ROI for all three scenes.

Post hoc comparisons revealed that participants looked at the NARRATOR ROI for longer durations than at the NON-NARRATOR ROI for all three scenes. However, effect sizes differed between the scenes, with Scenes 1 ($\eta_p^2 = .13$) and 2 (ηp2 = .11) yielding smaller effect sizes than Scene 3 ($\eta_p^2 = .49$). Regarding the comparison between NARRATOR and BACKGROUND ROI, we found significant differences and large effect sizes for Scene 1 (F (1,28) = 21.29, $p < .000$, $\eta_p^2 = .43$) and Scene 3 (F(1,33) = 27.88, $p < .000$, $\eta_p^2 = .46$) but not for Scene 2 (F(1,33) = 1.60, $p = .215$, $\eta_p^2 = .05$).

The main effect of ROI in Scene 2 was qualified by a significant *ROI x emotion* interaction. Post hoc comparisons for Scene 2 yielded a significant trend and a medium effect size for the comparison between NARRATOR and NON-NARRATOR ROI (F (1,33) = 2.25, $p = .143$, $\eta_p^2 = .06$) and a significant effect and a large effect size for the comparison between NARRATOR and BACKGROUND ROI (F (1,33) = 16.73, p < .000, η_p^2 = .34). Figures of the interactions suggested that for the NARRATOR ROI, the dwell times were significantly longer in the negative than in the neutral emotion condition, whereas for the BACKGROUND ROI, the dwell times were significantly longer in the neutral condition than in the negative condition.

The *ROI x TEQ group* and *ROI x TEQ group x emotion* interactions did not yield significant results or medium effect sizes for any scene.

In sum, participants tended to view the NARRATOR ROI for longer durations than the NON-NARRATOR or the BACKGROUND ROI. However, this effect was less pronounced in neutral emotion condition of Scene 2, where the participants tended to explore the NON-NARRATOR and BACKGROUND ROIs for longer durations than they did in the positive and negative emotion conditions. There was no effect of TEQ group on the spatial distribution of visual attention.

Discussion

The aim of this exploratory study was to address the previously untested idea that gaze behavior varies to a different extent as a function of emotional salience in individuals with low and high self-reported empathy. We tackled this question by presenting the same scene images in the contexts of verbal, written first-person narratives with varying emotional salience and assessed the gaze behavior of participants with low and high TEQ scores. The empathy groups differed in their dwell times only when they viewed a scene image in the context of neutral information. By contrast, the dwell times were similar between empathy groups after they were given information with higher emotional salience. Thus, our analysis delivered encouraging preliminary results that suggested that when emotional salience is low, participants' gaze behavior is more indicative of their self-reported trait empathy than when emotional salience is high.

We observed differences between empathy groups only when emotional salience was low but not when emotional salience was high. This finding contradicts previous eye-tracking studies that reported longer dwell times in the emotion conditions with higher emotional salience (Balconi & Bortolotti, 2014; Cowan et al., 2014; Martinez-Velazquez et al., 2020). However, these studies used facial stimuli in their eye-tracking paradigm, whereby two of the studies used dynamic video stimuli with an actor narrating a personal experience (Cowan et al., 2014; Martinez-Velazquez et al., 2020). By contrast, our study design delivered semantic information about the inner state of the narrator prior to delivering visual information about him/her, thus provoking a temporal disentanglement of the process of integrating verbal and visual information into a coherent semantic whole (Loftus et al., 1978). It can be speculated that the participants in our experiment received visual information in a different stage of their information gathering and decision-making process than the participants of previous studies who had received visual and verbal information simultaneously. The design of our study may have increased the influence of top-down, motivational factors (e.g., individual social goals) on visual attention. A priori information directs visual attention toward information that is relevant for the task at hand in both initial and prolonged observation phases (Kim & Rehder, 2011). Hereby, attention is selectively directed toward meaningfully category-related visual features that aid categorization decision making. In line with these findings, observers preferentially explore areas of the face that are more diagnostic of the categorization of an emotion when given the task of categorizing an emotion (Vaidya et al., 2014). Furthermore, when considered over the course of visual exploration, observers tend to shift their attention toward (i.e., spend more time attending to) the visual object that is most relevant for the current decision-making goal, an effect known as the gaze cascade effect (Shimojo et al., 2003). In the context of the research reviewed above, our findings raise the question of how situational aspects (e.g., emotional salience) may interact with individual factors (e.g., motivation and ability) in different stages of the process of empathizing.

The lack of a difference between empathy groups when emotional salience was high is in line with a general automatic processing of and orienting toward emotional information in the human observer (Adams et al., 2011; Sakaki et al., 2012). Moreover, it suggests that when a situation conveys emotional

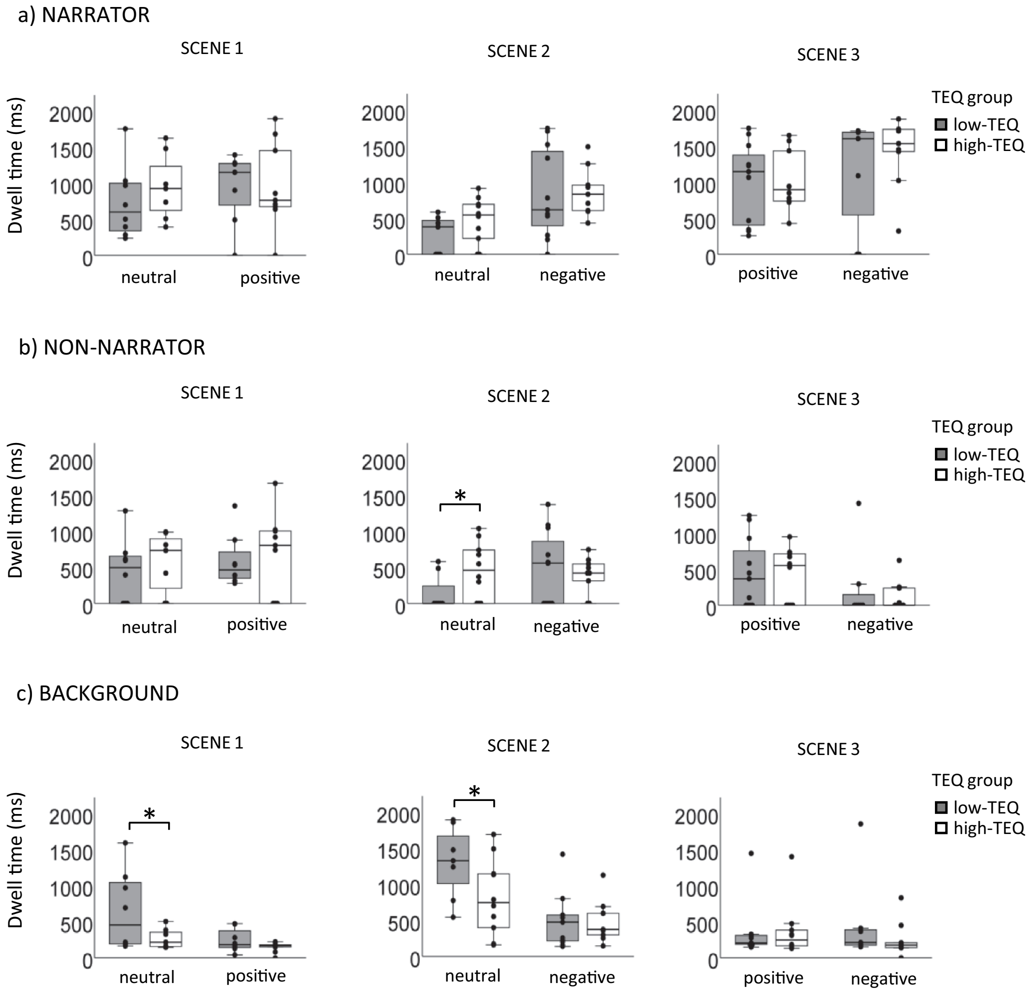

Figure 4. Boxplots with individual datapoints for gaze behavior. a) NARRATOR ROI, b) NON-NARRATOR ROI, and c) BACKGROUND ROI. gray = low-TEQ, white = high-TEQ. *p*-values indicate the results of the t test analysis. * $p < .1$, ** $p < .05$.

information that clearly denotes the relevance of an event for the inner state of the other (i.e., through the high level of emotional salience of the information) and demands on the cognitive effort of deducing another's inner state are low, attention is primarily modulated through bottom-up factors (Cameron et al., 2019; Chambers & Davis, 2012).

In contrast to high trait empathy participants, low trait empathy participants spent less time exploring the social elements of the scene when they viewed the scene in a neutral, low emotional salience condition. Indeed, high trait empathy has previously been associated with a bias toward social information (Hedger et al., 2018). Intriguingly, in the neutral but not in the negative emotion condition for Scene 2, high-TEQ participants tended to allocate more attention to the non-narrator than low-trait participants did. This behavior may indicate that high-TEQ individuals selectively attended to the information that was currently most valuable for the goal of understanding the context of the empathy target's inner experience rather than automatically focusing on and continuing to pay attention to the social and emotional information contained in the narrator's facial or bodily expression (i.e., the visible product of the empathy target's inner experience). Such behavioral regulation would imply that high trait empathy individuals have a superior understanding of or ascribe higher value to the context-dependency of experienced and displayed emotions (Barrett et al., 2019, 2011). In sum, our results can be interpreted as in favor of motivated, goal-directed, and context-sensitive information-gathering in high trait empathy individuals that goes beyond their automatic reactivity to social cues, emotional salience, or a simple approach or avoidance of the empathy target's emotions (Zaki, 2014).

Our study suggests that emotional salience may be an overlooked, essential factor for shaping and explaining individual variation in empathic behavior. Perceiving the emotions of another individual has traditionally been regarded as a gateway into the process of empathizing (e.g., (Besel & Yuille, 2010; Decety & Hodges, 2006; Preston & de Waal, 2002; Zaki, 2014). Not surprisingly, differences in perceiving (Adams et al., 2011), attending to (Van Zonneveld et al., 2017), and understanding (Decety & Hodges, 2006) others' emotions have been assumed to lie at the root of individual differences in empathy. However, there is strong individual variation in the relationship between valence and arousal in subjective experience (Kuppens et al., 2013). Moreover, the physiological and behavioral effects of an emotional stimulus are modulated by individuals' appraisals of the relevance of that stimulus rather than by its bottom-up properties (Cummings et al., 2019; Moors et al., 2013; Olteanu et al., 2019; Scherer, 2013), and this is especially true of social emotional stimuli (Barrett et al., 2011; Sakaki et al., 2012). Our study suggests that differences in the behavior of participants with low versus high self-reported empathy may reflect their appraisal of the relevance of perceived emotional salience rather than differences in their ability to perceive, attend to, and understand emotions per se.

Limitations and implications for future studies

The present preliminary, exploratory study was carried out to generate hypotheses and inform further confirmatory studies. Thus, we caution the reader to remain aware of the typical constraints placed on pilot studies such as the present one (Lee et al., 2014).

The present study was carried out with a relatively small sample. Although small sample sizes are not unusual when testing the waters of a new approach or treatment (Hackshaw, 2008), they confine the interpretations of observed effects to speculations with questionable validity. However, whereas the results of our study in no way allow firm conclusions, they do serve their purpose of allowing us to generate further research ideas. Also, the present study was carried out on a sample of young psychology undergraduates. Future studies should recruit participants with more diverse demographic backgrounds.

Our design included a very small number of trials. We tested gaze behavior for each emotion condition with only one scene image and with one set of verbal stimuli, thus rendering statements about the consistency of the observed effects difficult to make. Moreover, individuals differ in scene perception, visual attention modulation (Adams et al., 2011), and the association between arousal and valence (Kuppens et al., 2013). In the present study, we cannot exclude the possibility that our results reflect an interaction between the emotion conditions and the scene image stimuli rather than an interaction between emotional salience and trait empathy. Future studies should include more trials with varying images per emotion condition in their designs. Also, the emotion conditions presented with each scene should be extended to include all emotion conditions (neutral, positive, and negative).

To validate our verbal stimuli, we used the PANAS and computed PA and NA scores. However, PA and NA scores assess a mixture of valence and arousal and do not allow these factors to be disentangled. Thus, it is not possible to determine the unique contributions of valence and arousal to the process of empathizing. Future studies are strongly advised to validate the valence and arousal of the stimuli used to generate emotion conditions separately, preferably in a different sample than the study sample. This would also allow researchers to include emotion conditions with the same valence and different arousal, thus enabling insights into how interactions with these two factors shape the empathic response in low and high trait empathy.

Finally, we assessed trait empathy with the TEQ, a self-report questionnaire known to measure empathy as an emotional process (Roth & Altmann, 2021). However, empathy is a multicomponent phenomenon comprising at least two components (Decety & Hodges, 2006; Weisz & Cikara, 2021; Zaki, 2014). Thus, differences observed between the TEQ groups in our study should be generalized to

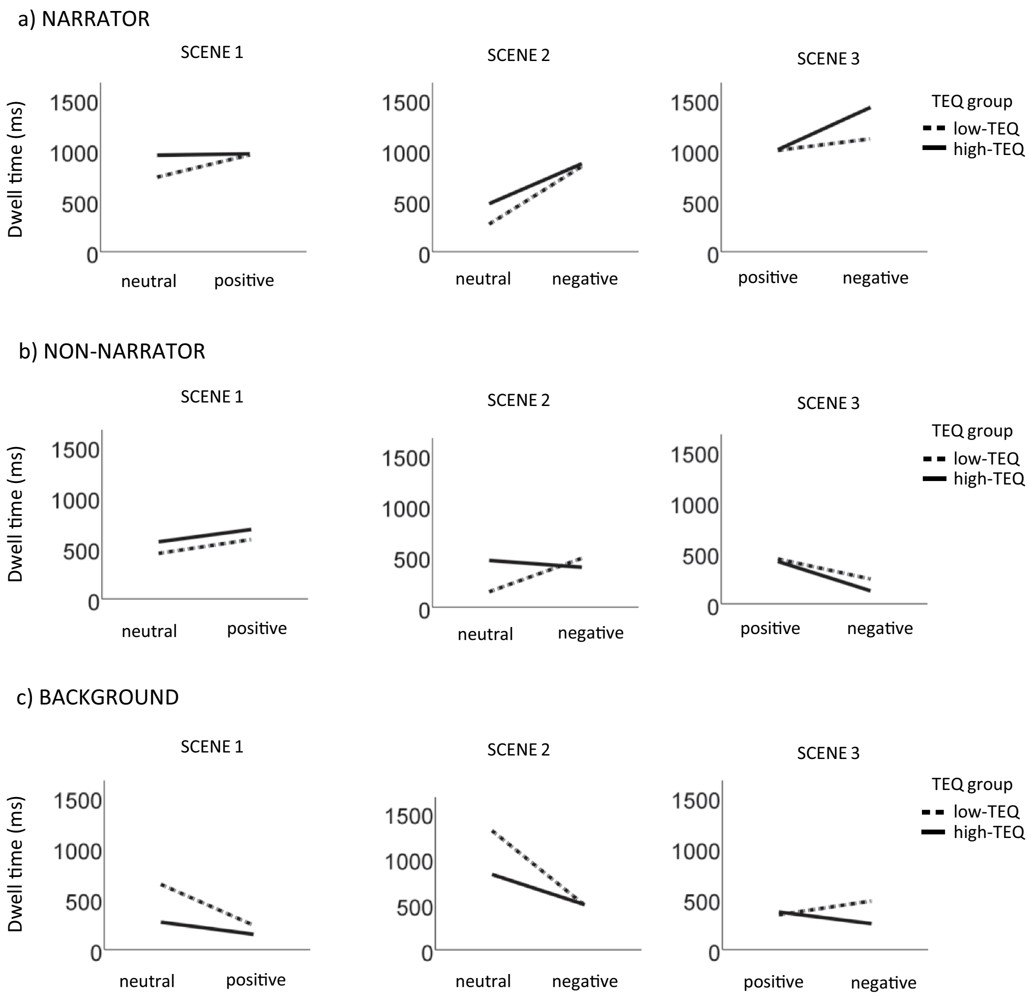

Figure 5. Interaction graphs for gaze behavior. a) NARRATOR ROI, b) NON-NARRATOR ROI, and c) BACKGROUND ROI. Intermitted line = low-TEQ, continuous line = high-TEQ.

trait empathy with caution as the content of the items may more strongly reflect the influence of the affective aspect of trait empathy. Future studies would be well-advised to use multiple questionnaires and methods to assess empathy to increase the validity of their results.

Conclusions

Previous research on gaze behavior in empathy has focused on differences in the recognition of and visual attention to facial areas associated with *emotional expressions* as an explanatory model for differences in trait empathy (Balconi & Canavesio, 2016; Cowan et al., 2014; Liu et al., 2020; Martinez-Velazquez et al., 2020; Moutinho et al., 2021; Yan et al., 2017). This approach was motivated by theoretical models emphasizing emotion perception as a necessary and sufficient component for experiencing empathy (Decety & Hodges, 2006; Preston & de Waal, 2002). However, evidence from the present study adds to the body of research that suggests that individuals may differ in their motivation to experience empathy in social situations, and individual motivation may interact with situational factors like the appraisal of the relevance of the act of empathizing as beneficial to the achievement of active individual goals (Cameron et al., 2019; Hedger et al., 2018; Morelli & Lieberman, 2013; Zaki, 2014). Despite its limitations, our exploratory study indicated that emotional salience (with its components valence and arousal) may be an important situational factor with potentially high explanatory power regarding the individual differences between individuals with low and high self-reported empathy. Our results encourage research into the effects of emotional contexts with varying salience on empathy-related behavior and subjective experience in low- and high self-reported trait empathy and imply that such research could promote a better understanding of the contributions of individual motivation and ability in self-reported trait empathy.

Data availability statement

The data described in this article are openly available in the Open Science Framework at https://doi.org/10.17605/OSF.IO/VMCTE.

Open scholarship

This article has earned the Center for Open Science badges for Open Data and Open Materials through Open Practices Disclosure. The data and materials are openly accessible at https://doi.org/10.17605/OSF.IO/VMCTE.

Disclosure statement

No potential conflict of interest was reported by the author(s).

Funding

The author(s) reported there is no funding associated with the work featured in this article.

Notes on contributors

Emine Nebi is a PhD researcher at the University of Duisburg-Essen. Her research interests include social cognition, empathy, and empathic processing, and visual information processing.

Tobias Altmann is a postdoctoral fellow at the University of Duisburg-Essen. His research interests include psychological assessment, empathy and empathic communication, and self-esteem and self-esteem measurement.

Marcus Roth is a professor at the University of Duisburg-Essen. His research interests include empathy and empathic communication, typological approaches to personality psychology, and psychometric personality assessment.

ORCID

Emine Nebi http://orcid.org/0000-0001-8952-9303
Tobias Altmann http://orcid.org/0000-0001-7294-7808

References

Adams, J. R. B., Ambady, N., Nakayama, K., & Shimojo, S. (2011). *The Science of Social Vision* .New York: Oxford University Press. . https://doi.org/10.1093/acprof:oso/9780195333176.001.0001

Balconi, M., & Bortolotti, A. (2014). Self-report, personality and autonomic system modulation in response to empathic conflictual versus non conflictual situation. *Cogn Emot*, *28*(1), 153–162. https://doi.org/10.1080/02699931.2013.805685

Balconi, M., & Canavesio, Y. (2016). Is empathy necessary to comprehend the emotional faces? The empathic effect on attentional mechanisms (eye movements), cortical correlates (N200 event-related potentials) and facial behaviour (electromyography) in face processing. *Cogn Emot*, *30*(2), 210–224. https://doi.org/10.1080/02699931.2014.993306

Barrett, L. F., Adolphs, R., Marsella, S., Martinez, A. M., & Pollak, S. D. (2019). *Emotional expressions reconsidered: Challenges to inferring emotion from human facial movements*. (2160–0031 (Electronic)).

Barrett, L. F., Mesquita, B., & Gendron, M. (2011). Context in emotion perception. *Current Directions in Psychological Science*, *20*(5), 286–290. https://doi.org/10.1177/0963721411422522

Barrett, L. F. (2006). Valence is a basic building block of emotional life. *Journal of Research in Personality*, *40*(1), 35–55. https://doi.org/10.1016/j.jrp.2005.08.006

Besel, L. D. S., & Yuille, J. C. (2010). Individual differences in empathy: The role of facial expression recognition. *Personality and Individual Differences*, *49*(2), 107–112. https://doi.org/10.1016/j.paid.2010.03.013

Cahill, L., & McGaugh, J. L. (1998). Mechanisms of emotional arousal and lasting declarative memory. *Trends in Neurosciences*, *21*(7), 294–299. https://doi.org/10.1016/S0166-2236(97)01214-9

Cameron, C. D., Hutcherson, C. A., Ferguson, A. M., Scheffer, J. A., Hadjiandreou, E., & Inzlicht, M. (2019). Empathy is hard work: People choose to avoid empathy because of its cognitive costs. *Journal of Experimental Psychology: General*, *148*(6), 962–976. https://doi.org/10.1037/xge0000595

Chambers, J. R., & Davis, M. H. (2012). The role of the self in perspective-taking and empathy: Ease of self-simulation as a heuristic for inferring empathic feelings. *Social Cognition*, *30*(2), 153–180. https://doi.org/10.1521/soco.2012.30.2.153

Cowan, D. G., Vanman, E. J., & Nielsen, M. (2014). Motivated empathy: The mechanics of the empathic gaze. *Cogn Emot*, *28*(8), 1522–1530. https://doi.org/10.1080/02699931.2014.890563

Cummings, D. J., Loxton, N. J., & Poropat, A. E. (2019). The relevance/significance of stimuli appraisals for personality traits in an academic context. *Learning and Individual Differences*, *69*, 225–231. https://doi.org/10.1016/j.lindif.2018.04.008

de Vignemont, F., & Singer, T. (2006). The empathic brain: How, when and why? *Trends Cogn Sci*, *10*(10), 435–441. https://doi.org/10.1016/j.tics.2006.08.008

Decety, J., & Hodges, S. D. (2006). The social neuroscience of empathy.van Lange, P.A.M. In *Bridging social psychology: Benefits of transdisciplinary approaches* (pp. 103–109). Lawrence Erlbaum Associates Publishers.

Decety, J., & Jackson, P. L. (2004). The functional architecture of human empathy. *Behav Cogn Neurosci Rev*, *3*(2), 71–100. https://doi.org/10.1177/1534582304267187

Eisenberg, N., & Miller, P. A. (1987). The relation of empathy to prosocial and related behaviors. *Psychological Bulletin*, *101*(1), 91–119. https://doi.org/10.1037/0033-2909.101.1.91

Fan, Y., & Han, S. (2008). Temporal dynamic of neural mechanisms involved in empathy for pain: An event-related brain potential study. *Neuropsychologia*, *46*(1), 160–173. https://doi.org/10.1016/j.neuropsychologia.2007.07.023

Faul, F., Erdfelder, E., Buchner, A., & Lang, A. G. (2009). Statistical power analyses using G*Power 3.1: Tests for correlation and regression analyses. *Behav Res Methods*, *41*(4), 1149–1160. https://doi.org/10.3758/BRM.41.4.1149

Hackshaw, A. (2008). Small studies: Strengths and limitations. *Eur Respir J*, *32*(5), 1141–1143. https://doi.org/10.1183/09031936.00136408

Hedger, N., Haffey, A., McSorley, E., & Chakrabarti, B. (2018). Empathy modulates the temporal structure of social attention. *Proc Biol Sci*, *285*(1893), 20181716. https://doi.org/10.1098/rspb.2018.1716

Hofelich, C., & Preston, S. D. (2012). The meaning in empathy: Distinguishing conceptual encoding from facial mimicry, trait empathy, and attention to emotion. *Cognition & Emotion*, *26*(1), 119–128. https://doi.org/10.1080/02699931.2011.559192

Holland, A. C., O'Connell, G., & Dziobek, I. (2021). Facial mimicry, empathy, and emotion recognition: A meta-analysis of correlations. *Cogn Emot*, *35*(1), 150–168. https://doi.org/10.1080/02699931.2020.1815655

Holmqvist, K., Nyström, M., Andersson, R., Dewhurst, R., Jarodzka, H., & Van de Weijer, J. (2011). *Eye tracking: A comprehensive guide to methods and measures*. Oxford University Press.

Israelashvili, J., & Karniol, R. (2018). Testing alternative models of dispositional empathy: The affect-to-Cognition (ACM) versus the cognition-to-Affect (CAM) model. *Personality and Individual Differences*, *121*, 161–169. https://doi.org/10.1016/j.paid.2017.09.036

Israelashvili, J., Sauter, D. A., & Fischer, A. H. (2020). Different faces of empathy: Feelings of similarity disrupt recognition of negative emotions. *J Exp Soc Psychol*, *87* ,103912. https://doi.org/10.1016/j.jesp.2019.103912

Kim, S., & Rehder, B. (2011). How prior knowledge affects selective attention during category learning: An eyetracking study. *Mem Cognit*, *39*(4), 649–665. https://doi.org/10.3758/s13421-010-0050-3

Kuppens, P., Tuerlinckx, F., Russell, J. A., & Barrett, L. F. (2013). The relation between valence and arousal in subjective experience. *Psychol Bull*, *139*(4), 917–940. https://doi.org/10.1037/a0030811

Kurzban, R. (2016). The sense of effort. *Current Opinion in Psychology*, *7* , 67–70. https://doi.org/10.1016/j.copsyc.2015.08.003

Lee, E. C., L., W. A., M., J. R., & Julious, S. A. (2014). The statistical interpretation of pilot trials: Should significance thresholds be reconsidered? *BMC Medical Research Methodology*, *14*(41). https://doi.org/10.1186/1471-2288-14-41

Lee, T. H., Greening, S. G., & Mather, M. (2015). Encoding of goal-relevant stimuli is strengthened by emotional arousal in memory. *Front Psychol*, *6*, 1173. https://doi.org/10.3389/fpsyg.2015.01173

Levine, L. J., & Edelstein, R. S. (2009). Emotion and memory narrowing: A review and goal-relevance approach. *Cognition and Emotion*, *23*(5), 833–875. https://doi.org/10.1080/02699930902738863

Liu, P., Sun, J., Zhang, W., & Li, D. (2020). Effect of empathy trait on attention to positive emotional stimuli: Evidence from eye movements. *Current Psychology*. https://doi.org/10.1007/s12144-020-00723-2

Loftus, E. F., Miller, D. G., & Burns, H. J. (1978). Semantic integration of verbal information into a visual memory. *Journal of Experimental Psychology: Human Learning and Memory*, *4*(1), 19–31. https://doi.org/10.1037/0278-7393.4.1.19

Martinez-Velazquez, E. S., Ahuatzin Gonzalez, A. L., Chamorro, Y., & Sequeira, H. (2020). The influence of empathy trait and gender on empathic responses. A study with dynamic emotional stimulus and eye movement recordings. *Front Psychol*, *11*, 23. https://doi.org/10.3389/fpsyg.2020.00023

Moors, A., Ellsworth, P. C., Scherer, K. R., & Frijda, N. H. (2013). Appraisal theories of emotion: State of the art and future development. *Emotion Review*, *5*(2), 119–124. https://doi.org/10.1177/1754073912468165

Morelli, S. A., & Lieberman, M. D. (2013). The role of automaticity and attention in neural processes underlying empathy for happiness, sadness, and anxiety. *Front Hum Neurosci*, *7*, 160. https://doi.org/10.3389/fnhum.2013.00160

Moutinho, R., Castro, S. L., & Silva, S. (2021). Look at me: The relation between empathy and fixation on the emotional eye-region in low vs. high social anxiety. *J Behav Ther Exp Psychiatry*, *70*, 101610. https://doi.org/10.1016/j.jbtep.2020.101610

Olteanu, L., Golani, S., Eitam, B., & Kron, A. (2019). The effect of relevance appraisal on the emotional response. *Emotion*, *19*(4), 715–725. https://doi.org/10.1037/emo0000473

Preston, S. D., & de Waal, F. B. M. (2002). Empathy: Its ultimate and proximate bases. *Behavioral and Brain Sciences*, *25* (1), 1–20. https://doi.org/10.1017/S0140525X02000018

Rameson, L. T. A. M. S., & Lieberman, M. D. (2012). *The neural correlates of empathy: Experience, automaticity, and prosocial behavior*. (1530–8898 (Electronic)).

Roth, M., & Altmann, T. (2021). Personality and individual differences. *The Self-other Agreement of Multiple Informants on Empathy Measures and Its Relation to Empathic Accuracy*, *171*, 110499 . https://doi.org/10.1016/j.paid.2020.110499

Sakaki, M., Niki, K., & Mather, M. (2012). Beyond arousal and valence: The importance of the biological versus social relevance of emotional stimuli. *Cogn Affect Behav Neurosci*, *12*(1), 115–139. https://doi.org/10.3758/s13415-011-0062-x

Scherer, K. R. (2013). The nature and dynamics of relevance and valence appraisals: Theoretical advances and recent evidence. *Emotion Review*, *5*(2), 150–162. https://doi.org/10.1177/1754073912468166

Shimojo, S., Simion, C., Shimojo, E., & Scheier, C. (2003). Gaze bias both reflects and influences preference. *Nat Neurosci*, *6*(12), 1317–1322. https://doi.org/10.1038/nn1150

Singer, T. (2006). The neuronal basis and ontogeny of empathy and mind reading: Review of literature and implications for future research. *Neurosci Biobehav Rev*, *30*(6), 855–863. https://doi.org/10.1016/j.neubiorev.2006.06.011

Spreng, R. N., McKinnon, M. C., Mar, R. A., & Levine, B. (2009). The toronto empathy questionnaire: Scale development and initial validation of a factor-analytic solution to multiple empathy measures. *J Pers Assess*, *91*(1), 62–71. https://doi.org/10.1080/00223890802484381

Vaidya, A. R., Jin, C., & Fellows, L. K. (2014). Eye spy: The predictive value of fixation patterns in detecting subtle and extreme emotions from faces. *Cognition*, *133*(2), 443–456. https://doi.org/10.1016/j.cognition.2014.07.004

van Zonneveld, L., Platje, E., de Sonneville, L., Goozen, S., & Swaab, H. (2017). Affective empathy, cognitive empathy and social attention in children at high risk of criminal behaviour. *Journal of Child Psychology and Psychiatry, and Allied Disciplines*, *58*(8), 913–921 . https://doi.org/10.1111/jcpp.12724

Vogel, T. A., Savelson, Z. M., Otto, A. R., & Roy, M. (2020). Forced choices reveal a trade-off between cognitive effort and physical pain. *eLife*, *9*, e59410. https://doi.org/10.7554/eLife.59410

Watson D, Clark L A and Tellegen A. (1988). Development and validation of brief measures of positive and negative affect: The PANAS scales. Journal of Personality and Social Psychology, *54*(6), 1063–1070. 10.1037//0022-3514.54.6.1063

Weisz, E., & Cikara, M. (2021). Strategic regulation of empathy. *Trends in Cognitive Sciences*, *25*(3), 213–227. https://doi.org/10.1016/j.tics.2020.12.002

Yan, Z., Pei, M., & Su, Y. (2017). Children's empathy and their perception and evaluation of facial pain expression: An eye tracking study. *Front Psychol*, *8*, 2284. https://doi.org/10.3389/fpsyg.2017.02284

Zaki, J., & Ochsner, K. N. (2012). The neuroscience of empathy: Progress, pitfalls and promise. *Nat Neurosci*, *15*(5), 675–680. https://doi.org/10.1038/nn.3085

Zaki, J. (2014). Empathy: A motivated account. *Psychol Bull*, *140*(6), 1608–1647. https://doi.org/10.1037/a0037679