The relationship between charitable giving and emotional facial expressions: Results from affective computing

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ARTICLE INFO

ABSTRACT

This study investigated the relationship between emotional states (valence, arousal, and six basic emotions) and donation size in pet charities, and it compared the effectiveness of affective computing and emotion self-report methods in assessing attractiveness. Using FaceReader software and self-report, we measured the emotional states of participants (N = 45) during the donation task. The results showed that sadness, happiness, and anger were significantly related to donation size. Sadness and anger increased donations, whereas happiness decreased them. Arousal was not significantly correlated with the willingness to donate. These results are supported by both methods, whereas the self-reported data regarding the association of surprise, fear, and disgust with donation size are inconclusive. Thus, unpleasant emotions increase donation size, and combining affective computing with self-reported data improves the prediction of the effectiveness of a charity appeal. This study contributes to the understanding of the relationship between emotions and charitable behavior toward pet charities and evaluates the effectiveness of marketing mix elements using affective computing. The limitations include the laboratory setting for this experiment and the lack of measurement of prolonged and repeated exposure to unpleasant charity appeals.

1. Introduction

Charitable organizations significantly impact socioeconomic processes in society by implementing programs aimed at improving various aspects of the population's life or preventing its deterioration [1]. As instruments for promoting community subjective well-being [2], charities are highly dependent on community support. For instance, in the United States, approximately 70 % of all contributions to charitable organizations were made by individuals as opposed to corporate bodies [3].

With economic instability and global challenges faced by people worldwide, the smoothing effect exerted by charities is crucial. However, raising funds to implement mandates is challenging for many charities [4].

Pet charities find themselves in an especially difficult situation because of the ambiguous attitude of society toward their beneficiaries. Stray dogs can be perceived as both victims and enemies [5], which reduces donations to pet charities. This attitude is caused by the fact that, left unattended, stray dogs can become a source of rabies [6] or other diseases [7] and behave aggressively [8]; this

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leads to their cruel treatment [5,9], which makes it vitally important to solve the problem of homeless pets before anything negative happens to either animals or humans. Supporting charitable organizations with individual donations contributes to a humane solution to the problems caused by homeless pets as it allows the use of modern methods such as sterilization, vaccination, and the promotion of responsible ownership [10,11].

Exploring the reasons behind the donation decision-making process can provide additional support to the nonprofit sector in general and pet charities in particular. However, prosocial behavior, that is, the willingness to sacrifice one's resources for the benefit of another [12], is a complex psychological phenomenon [13] that is difficult to study and sometimes leads to contradictory findings.

Emotional state is one of the key factors influencing charitable behavior [14–16]. Among the basic emotions that affect the willingness to donate are sadness, anger, fear, and happiness [16–19]. However, the effectiveness of specific discrete emotions in the context of appeals for charity still remains under debate. Contradictions in the results of research relate not only to the type of emotions but also to their valence. In particular, some studies have shown that negative (unpleasant) emotions are more effective in attracting charity [20,21], whereas others have shown the opposite [22,23]. At the same time, research on the relationship between arousal, caused by a call for charitable giving, and willingness to donate is lacking.

Overall, research on emotions and prosocial behavior has shown a significant bias toward intra-species versus inter-species assistance. In other words, the bulk of published research has examined appeals for charities that support people [16,20–24], while the impact of emotions on prosociality toward animals remains understudied.

Regarding methodological approaches, it should be noted that the bulk of studies of charitable behavior and emotions use declarative methods, which has certain limitations since participants may not always be conscious of their feelings or not be willing to disclose them. This is especially true for controversial and taboo topics, such as sexual orientation and venereal disease, helping socially undesirable or outcast groups [25], and it may also be applicable for stray dogs as the attitude toward them is often ambivalent [5].

A solution to overcome methodological limitations in assessing emotions by declarative methods could be automatic emotion recognition software based on facial expressions, such as FaceReader, iMotions, and others, which is referred to as affective computing [26–29]. It is also possible to comprehensively and discretely assess one's actual emotional state owing to their ability to simultaneously and objectively assess all basic emotions as well as valence and arousal. Thus, it can be assumed that affective computing can be an effective method for researching the relationship between emotions and prosocial behavior.

Affective computing is currently used in several areas, including diagnostics of mental disorders [30], improvement of online learning [31,32], virtual reality [33], client assessment satisfaction [34,35], and the evaluation of the effectiveness of advertising [25, 36]. However, academic research assessing the predictive ability of affective computing methods for evaluating advertising materials compared to traditional methods, such as self-reported emotion, is lacking [37]. Despite the potential benefits that automatic emotion recognition systems can bring to marketing [37,38], an insufficient number of published studies have explored affective computing to investigate which emotions are triggered by a product, advertisement, or another element of the marketing mix. In addition, within the framework of non-commercial advertising, we have found no studies on the relationship between emotions and the effectiveness of appeals for charities using automatic emotion recognition systems.

Therefore, the main aim of this study is to examine the relationship between emotional state and donation size in the context of pet charities. Moreover, it compares the effectiveness of using affective computing and emotional self-reporting to predict donations for stray dogs. To achieve this, we obtained six basic self-reported emotions in addition to valence and arousal, as well as emotional expressions automatically recognized by FaceReader, while participants viewed pictures of dogs' in various conditions and made decisions about donations in response to them. Based on the above, the following research questions were formulated:

Q1: How do valence and arousal relate to donation size in the context of pet charities?

Q2: How do the six basic emotions relate to donation size in the context of pet charities?

Q3: How do the predictive abilities of FaceReader (as one of the affective computing methods) compare with the self-reported emotions method to study the relationship between donations and emotional state?

Thus, this study contributes to the research on how the six basic emotions—along with valence and arousal, which are provoked by charity appeals—are related to willingness to donate. In addition, this study expands the literature on human prosocial behavior to support other biological species. Moreover, it provides insight into the applicability of affective computing in evaluating the effectiveness of marketing communications, which is a gap in this research area, and it describes an experimental paradigm that could be the basis for future investigations. This study is also the first to evaluate advertising materials asking for donations using affective computing, which may help other researchers assess the feasibility of using such technologies to research charity appeals.

Given the vital role of individual donations for charity organizations, this study has practical implications as the results obtained may be useful for evaluating the effectiveness of their appeals before a public release. A substantial contribution for the nonprofit sector as a whole is to test the applicability of affective computing, based on FaceReader software, for assessing the effectiveness of charity appeals. This method uses objective measurements and allows for a complex assessment of the benefactors' emotions, even when they are subconscious or in cases of controversial and taboo topics or when the recipients are not ready to reveal their true emotions—for instance, when under the pressure of some social norms.

The following is an overview of the research examining the relationship between emotions, charitable behavior, and decision-making. The literature on affective computing and its applicability in evaluating the effectiveness of promotional materials is also presented.

2. Literature review

2.1. Emotions and prosocial behavior

Emotions are discrete automatic responses to different types of events, including universally shared, culture-specific, and individual-specific ones [39]. Numerous attempts have been made in the scientific literature to categorize emotions, separating them according to various criteria [40–44], which has created an extensive list of different emotions. In particular, one of the proposed models suggests the presence of 66 different emotions, 10 of which are primary and 56 secondary [31]. However, it is extremely difficult to estimate such a large number of emotions, particularly considering that similar emotional states may have overlapping parameters. To solve this problem, most researchers have used dimensional approaches [45] to assess emotional state, including valence (unpleasant-to-pleasant) and arousal (low-to-high), as well as six basic emotions (happiness, sadness, anger, surprise, fear, and disgust) [41], which are considered universal and have relatively accurate recognizable patterns [31,46].

Emotional state assessment is widely used to study various types of behavior and decision making. In the context of prosocial behavior, the willingness to donate has been associated with emotional state [14–16]. Donations and helping behavior have been found to be associated with emotions, conceptualized in both discrete [47–49] and dimensional approaches [50,51].

In particular, when anger aims to restore equity, it can act as an effective emotional appeal in charitable communications [19]. According to van Doorn et al. [19], people who felt angry after reading information about the needs of a charity were willing to donate significantly more to compensate for victims' suffering than those who did not feel angry.

Fear-raising charity appeals have also been shown to be effective in attracting donations. Comparing the effects of different types of messages, Hine and Gifford [17] found that exposure to a message about environmental pollution that caused fear contributed to financial donations more than exposure to a control, non-affective message [17]. Another study found that perceived fear is an important predictor of donation discrimination in charities [52] and showed that individuals donate money out of a general perceived fear of a condition experienced by a charity's potential beneficiaries. Another motive may be the opportunity to prevent the fear that they themselves will not be helped in such situations in the future.

Sadness is another negative emotion that provokes willingness to help and increases donation size [16]. At the same time, it is especially effective to use a combination of sadness with positive (pleasant) emotions such as strength [15] or hope. Appeals that combine hope and sadness produce enhanced levels of sympathy, inspiration, and donations [14].

Considering the effect of emotions on donation size in the context of dimensional approaches, most studies have demonstrated the effectiveness of negative and positive emotions. For instance, Burt and Strongman [20] found that pictures showing negative emotions seem to increase the quantity of donations, including money, items, and time. It has also been shown that individuals are willing to donate more when they see pictures of sad dogs rather than happy ones [50]. Using different manipulations to induce moods, Sabato and Kogut [21] showed that participants' willingness to donate is stronger in a negative mood than in a positive mood [21]. In addition, an EEG study has shown that negative-valence advertising induces more attention to potentially threatening stimuli, as evidenced by the amplitude of the ERP component P1 [53].

At the same time, the frequent use of negative emotions in appeals for charity has been criticized [54,55] and can lead to resentment toward charities [56]. Against this background, increasing evidence has shown that pleasant emotions can be effective in attracting donations [23,57]. Specifically, functional magnetic resonance imaging (fMRI) data showed that participants were more willing to donate when the presented images increased the activity of the nucleus accumbens, an area of the brain associated with positive arousal [23]. In the context of affective computing, donations have also been shown to be positively correlated with happiness and the valence experienced before making a donation decision [22].

Thus, special attention should be paid to the effect of arousal on donations. Eye-tracking studies have shown that, as arousal increases, interest in viewing charity ads increases, which, in turn, can increase the likelihood of a donation [58]. According to a survey conducted after a major fire in Australia by Amato [59], people who experienced a higher level of emotional arousal, such as terror or shock, donated more often to relief charities and showed a willingness to help victims of the fire [59]. However, to the best of our knowledge, the relationship between the amount of donation and arousal has not been studied sufficiently.

Thus, results regarding the relationship between emotions and giving behavior are conflicting. In particular, some studies have shown the effectiveness of positive emotions in collecting donations, whereas others have shown the opposite. The role of individual discrete emotions as a whole also remains unclear as various studies have shown the effectiveness of a range of emotions; this may be due to differences in research paradigms and the conditions under which donation decisions were made. In addition, research examining the relationship between prosocial behavior and arousal is scarce. Hence, prerequisites allow for further studies on the relationship between emotions and donations.

2.2. Using affective computing to evaluate the effectiveness of promotion materials

The face and facial expressions are the most visible and commonly studied information signals for emotions [41,60]. According to Ekman [41], the six basic emotions (happiness, sadness, anger, surprise, fear, and disgust) can be differentiated based on different facial expressions [41]. Measuring facial muscle movements based on emotional patterning allowed Ekman and Friesen [46] to develop a Facial Action Coding System (FACS) for capturing and categorizing facial expressions [46].

The development of computer technology has allowed to automate the process of coding facial expressions, decomposed into action units, and the FACS has become the basis for such software as FaceReader [28], iMotions [27], and others. Some of these algorithms have undergone validation procedures. In particular, FaceReader recognized 88 % of the target emotional labels in the Warsaw Set of

Emotional Facial Expression Pictures and the Amsterdam Dynamic Facial Expression Set [61]. FaceReader uses a deep neural network-based facial modeling technique [62] that describes the locations of 468 keypoints on the face. Then, it analyzes 20 Action Units, described in the FACS [28], and classifies facial expressions (happiness, sadness, anger, surprise, fear, and disgust) using a deep artificial neural network trained over 20,000 images that have been manually annotated. It also provides data according to a dimensional approach to emotions: valence (unpleasant-to-pleasant) and arousal (low-to-high) [28].

Automatic emotion recognition systems are now used to analyze materials used in marketing campaigns [25,36]. However, the number of published academic studies is small, and some have called for the scientific community to continue research on the predictive abilities of affective computing in the context of the marketing mix [37]. Such systems are relatively inexpensive and quick tools for predicting the effectiveness of an advertisement before its production. Given these properties, automated emotion recognition systems are likely to reduce the cost of marketing communications analysis for various organizations in both the commercial and nonprofit sectors.

Previously published works can serve as confirmation of the suitability of FaceReader for evaluating the effectiveness of promotional materials. In Hadinejad et al. [36], participants expressed low arousal and positive emotions while watching tourism advertisements [36]. Facial expression recognition analysis allowed researchers to conclude that the presented advertisement, except for some particular moments, was not overly exciting. When assessing cross-cultural differences in the perception of product packaging, Ploom et al. [63] showed that the level of positive emotions in Northeast Asians and Northern Europeans differs depending on the packaging color; however, they did not find any significant differences in product selection [63]. At the same time, Pichierri et al. [64] tested olive oil advertisements using FaceReader and discovered that perceived healthiness increased consumers' intentions where health claims elicited greater arousal [64].

In a study of shocking and social advertising, FaceReader, in comparison with declarative methods, captured differences in emotional reactions to advertising messages [25]. This allowed the researchers to conclude that in the context of socially taboo topics, participants are not always ready to declare their emotions openly, while these can be identified with an analysis of facial expressions.

Previously, FaceReader has been used to study the effect of emotions on donation size, where it was shown that valence is positively correlated with donation size [22]. However, these authors did not use any material as stimuli for charity appeals, meaning that no practical applications are possible in the context of analyzing charity advertisements. In addition, Fiala and Noussair [22] indicated that self-reported valence data and the ones measured by FaceReader were not consistent, which also limits the possibilities for further application of the results of this study [22].

However, to our knowledge, automated emotion recognition systems have not yet been applied to charity advertising campaigns associated with donations. Nevertheless, the use of such systems could help nonprofit organizations improve the effectiveness of charitable communication, which is especially important when they are faced with a lack of donations [65,66].

Thus, published research using affective computing covers only a small part of the research questions related to evaluating the effectiveness of certain elements of the marketing mix. In particular, advertising research applicable to the needs of the nonprofit sector is lacking. Consequently, prerequisites allow for further study on the capabilities of automatic emotion recognition systems in the context of evaluating the effectiveness of advertising materials, which served as an additional reason for conducting this study.

3. Methods

3.1. Measurements of emotional states

This study aimed to explore the relationship between emotional state and donation size in the context of stray animals. To obtain data on donations, we presented pictures of dogs and invited the participants to make voluntary donations to support the animals. To change the emotional state of the participants, we showed them dogs in various states (sick/healthy, domestic/homeless, adult/puppy, with human/without human). The participants' emotional states were measured using eight metrics: valence, arousal, and six basic emotions. These metrics were selected because they are universal and have clearly recognizable patterns. Participants' emotional state was recorded using Noldus' FaceReader software and self-reported emotion. The affective computing method was chosen because it allows a real-time, objective recording of the six basic emotions and the valence and arousal of participants based on their facial expressions, which is a unique advantage over other common emotion measurement methods, such as self-report, skin conductance response, or electromyography. FaceReader was used because it has one of the highest recognition accuracy ratings among the eight most common automatic emotion recognition software [26]. As an additional measure, we used the emotional self-report to validate the FaceReader data and assess its predictive ability compared to traditional self-reports. Furthermore, we surveyed the participants' financial well-being to assess the possible impact of this factor on charitable behavior [67].

3.2. Participants

The required sample size ($N = 44$) was determined based on a power analysis with G-power software [68], which was chosen for a medium effect of 0.40 and a power of 80 %. Therefore, 46 participants were recruited to participate in the study owing to possible data loss. Due to the inability to recognize the FaceReader data, one of the participants was excluded. The final sample size was 45 healthy participants (58.8 % women, mean age = 23.9 years, SD = 5.3, range = 19–40). The presence of glasses, a beard, and a mustache were a hindrance for participation as, during our pilot experiment, it transpired that these elements can interfere with FaceReader software; subsequently, all the participants had short to no facial hair and were not wearing glasses. Before participating in the experiment, all recruited participants reported that they had never been injected with botulinum toxin or other drugs that affected facial muscle

activity. Participants were mainly students and people from the general public recruited via online advertisements. All procedures were conducted in accordance with the Declaration of Helsinki and were approved by The HSE Committee on Interuniversity Surveys and Ethical Assessment of Empirical Research. Prior to the experiment, the participants were given 320 monetary units (MU) of local currency—equivalent to 12 USD, with correction for purchasing power parities [69]. They were instructed that they would have the option to donate this money fully or partially throughout the experiment and that they would be able to keep the remaining amount. Participants were instructed that all their donations were real and would be given to a charity whose name they would learn after participating in the experiment.

3.3. Material and design

Thirty-two pictures were selected from the Internet for the experiment, with two photos for each of the 16 categories. These 16 categories were selected by shuffling four binary characteristics of dogs potentially significant for emotional state and donations: health status, presence of a home, age, and the presence of a human nearby.

3.4. Procedure

The experimental procedure comprised two steps. In the first part of the experiment, the participants observed 32 pictures of dogs (for 6 s). The pictures were presented on a 19-inch computer screen. The inter-trial interval was between 12 and 18 s. To reduce the sequential effect of affective valence, we used three different orders of stimulus presentation [70]. To limit the presence of pictures in the same category, they were distributed quasi-randomly; in this way, pictures in the same category were not presented more than twice consecutively. The participants' emotional state was recorded via FaceReader software while they viewed pictures of dogs. After each picture, the participants could make a voluntary donation by choosing one of the scale values from 0 to 10 monetary units. Thus, the participants had 320 monetary units for 32 pictures of dogs on the basis that they could donate no more than 10 monetary units per dog. On the same screen, participants could see the residual amount of money (from the 320 that they received before the experiment) and the counter of pictures (Fig. 1 A).

In the second part of the experiment, participants were again presented with the same pictures (6 s), after which they rated the valence, arousal, and six basic emotions of each picture (from 1 to 9), without video recording, in a free-time setting (Fig. 1B). Three quasi-randomized presentation orders were used for the presentation of pictures in the second part of the experiment, which differed from those used in the first part. A self-reported emotion assessment was performed in the second part of the experiment to separate it from the donation task and to exclude the influence of conscious reflection on the emotions that the pictures evoked when making the decision to donate.

To test for the influence of external factors, such as financial well-being, after the experiment, participants assessed their level of
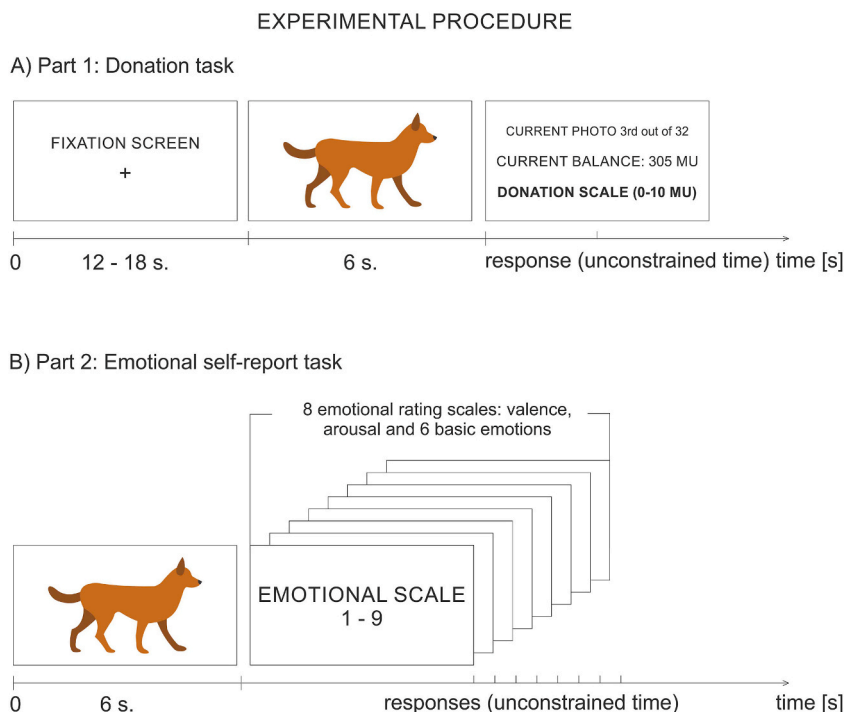
EXPERIMENTAL PROCEDURE

A) Part 1: Donation task

B) Part 2: Emotional self-report task

Fig. 1. Experimental procedure. A) Part 1: Donation task; B) Pars 2: Emotional self-report task.

financial well-being, satisfaction with the current level of financial well-being, and the significance level of the reward for participating in the study (320 MU) on a 7-point scale. In addition, participants reported their current salary in MU and the percentage of income they spent annually on charity.

The donations attracted as part of this study were transferred to a pet charity.

3.5. Data collection and reduction

PsychoPy software [71] was used to perform the experiments. A Logitech Webcam Brio 960–001106 webcam with a resolution of 4096p, mounted on top of a computer monitor, recorded the participants' facial expressions. FaceReader™ (version 8.0, Noldus Information Technology) was used for the automatic classification of facial expressions obtained from the video recordings at the sampling rate of 10 Hz and a resolution 720p (1280 × 720). FaceReader software scored two dimensions of emotions (valence and arousal), six basic emotions (happiness, sadness, anger, surprise, fear, and disgust), and the "neutral" state. The values of valence vary from −1 (extremely negative emotions) to 1 (extremely positive emotions). The values of arousal, as well as the 6 basic emotions, lie between 0 (inactive) and 1 (active). The participant calibration procedure used the image or frame with the lowest model error and expressions other than neutral found in this image for calibration [28]. For each display of a picture, emotions measured by FaceReader were calculated by subtracting emotional state within 1 s before the picture onset from the value of the average emotional state measured during the 6 s of picture display, which neutralized the friction caused by changes in the participants' emotional state before stimuli presentation.

3.6. Data analysis

We used the Shapiro–Wilk test to measure the normality of the distributions for all variables and performed Spearman's correlation analysis to reveal the relationships between all dependent variables (with pictures as cases) that were ordinal or not normally distributed. Then, we conducted Pearson's correlation analysis to study the relationships between normally distributed measurement variables and performed quadratic regression to reveal relationships between valence and arousal, measured by self-report as well as FaceReader (with pictures as cases). We considered p values less than 5 % to indicate significance. The false discovery rate [72] was used to correct multiple correlations. We performed a correlation analysis of the data using JASP version 0.11.1.0 and a regression analysis using IBM SPSS Statistics 26.

4. Results

4.1. Manipulation check

Table 1 presents descriptive statistics of the self-reported (SR) responses to the pictures. The donations' distribution was normal ($W = 0.956$, $p = .21$). The excellent internal consistency (α = 0.99) of the donation task suggests that all items measured the same construct.

Table 2 presents the descriptive statistics of FaceReader (FR) responses to the pictures. The distributions of arousal, sadness, fear, surprise, and anger were normal ($Ws = 0.98, 0.95, 0.99$, and 0.97, respectively; all $ps > .05$), whereas valence, happiness, and disgust were not normally distributed ($Ws = 0.89, 0.85$, and 0.93, respectively; all $ps < .05$).

The relationship between SR valence and SR arousal showed a typical quadratic pattern, $F(2,29) = 91.3$, $p < .001$, $R^2 = 0.86$ (Fig. 2). In other words, the most negative and positive pictures were rated as having the highest arousal. Similarly, neutral pictures (i. e., pictures with a middle valence) were rated as having the lowest arousal. This result is consistent with previous results [73] and confirms that the presented stimuli provoked a variety of emotions, from highly unpleasant arousal to neutral and pleasant arousal. These data show that participants made their donation decisions in various emotional states.

The relationship between FR valence and arousal did not show a typical quadratic pattern, $F(2,29) = 2.47$, $p = .10$, $R^2 = 0.15$ (Fig. 3). Most of the presented stimuli caused unpleasant low arousal, whereas the next main group reflected pleasant medium and high arousal. However, only a few stimuli elicited high unpleasant arousal as measured by FaceReader, which may explain the lack of a typical U-shaped curve describing the relationship between FR valence and FR arousal.

The correlation analysis of SR and FR emotions showed that SR valence and FR valence had a positive correlation, with $\rho(32) = 0.87$, $p < .001$, and so did SR arousal and FR arousal, $\rho(32) = 0.40$, $p = .025$ (marginally significant); SR sadness and FR sadness $\rho(32)$

Table 1
The descriptive statistics of average self-reported responses to pictures.

	Donations	Valence	Arousal	Sadness	Happiness	Fear	Disgust	Surprise	Anger
Mean	5.806	4.471	5.005	4.367	2.908	1.751	1.784	1.872	1.840
Median	5.856	3.978	4.833	5.156	2.122	1.589	1.300	1.644	1.778
Std. Deviation	1.293	1.794	0.698	1.972	1.826	0.668	1.007	0.512	0.723
Shapiro–Wilk	0.956	0.910	0.965	0.846	0.821	0.870	0.755	0.859	0.902
P value	0.212	0.011	0.371	<.001	<.001	0.001	<.001	<.001	0.007
Minimum	3.556	1.844	3.711	1.133	1.067	1.022	1.022	1.311	1.022
Maximum	7.889	7.533	6.267	6.622	6.578	3.578	4.844	3.178	3.222

Table 2
The descriptive statistics of average FaceReader responses to pictures.

|	Valence	Arousal	Sadness	Happiness	Fear	Disgust	Surprise	Anger
Mean	0.005	0.014	0.005	0.015	0.0003	−0.0003	0.0003	0.007
Median	−0.007	0.013	0.003	0.0007	0.0005	0.0002	0.0002	0.007
Std. Deviation	0.037	0.006	0.009	0.026	0.002	0.003	0.001	0.012
Shapiro–Wilk	0.890	0.977	0.950	0.848	0.989	0.929	0.966	0.955
P value	0.004	0.711	0.146	<.001	0.978	0.036	0.404	0.206
Minimum	−0.053	0.0007	−0.010	−0.013	−0.004	−0.011	−0.002	−0.022
Maximum	0.109	0.024	0.026	0.080	0.004	0.004	0.003	0.026
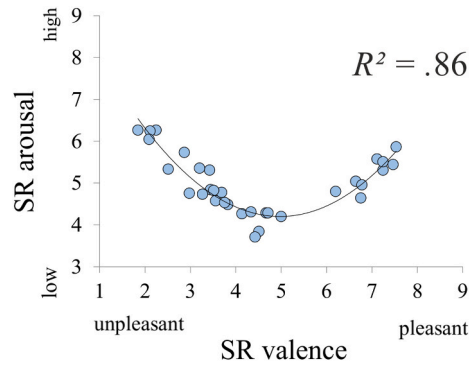
Fig. 2. The relationship between self-reported valence and self-reported arousal of the presented pictures of dogs. Each dot corresponds to a picture.
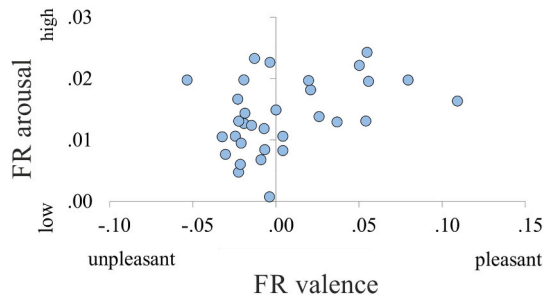

Fig. 3. The relationship between valence and arousal of the presented pictures of dogs measured by FaceReader. Each dot corresponds to a picture.
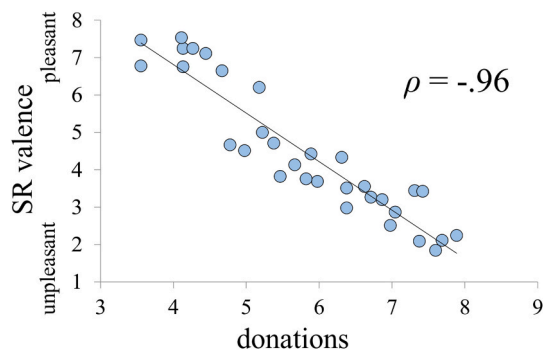

Fig. 4. The relationship between self-reported valence and donations. Each dot corresponds to a picture.

$= 0.55, p = .001$; SR happiness and FR happiness, $\rho(32) = 0.87, p < .001$; and SR anger and FR anger, $\rho(32) = 0.60, p < .001$. However, we did not find a significant correlation between SR fear and FR fear, $\rho(32) = -0.19, p = .30$, nor between SR disgust and FR disgust, $\rho(32) = 0.09, p = .62$, or SR surprise and FR surprise, $\rho(32) = -0.28, p = .12$. The Spearman's correlation matrix related to emotional states can be found in the supplementary material (Supplementary Table S1).

Thus, the FR and self-reported data were consistent for valence, arousal, happiness, sadness, and anger. These results are consistent with previous FaceReader [26] recognition tests but differ from previous findings in the context of a charity study [22], where SR valence and FR valence were not correlated. The consistency of the data provides reason to trust these emotions in assessing their relationship with donations, in contrast to those that did not show consistency, namely disgust, surprise, and fear.

4.2. Relationship between emotions and donations

Donations correlated with SR valence, $\rho(32) = -0.96, p < .001$ (Fig. 4), and FR valence, $\rho(32) = -0.83, p < .001$ (Fig. 5). At the same time, donations did not correlate with SR arousal, $\rho(32) = 0.28, p = .12$, and FR arousal $r(32) = -0.20, p = .28$. That is, the more negative a picture, the larger the donations generated, and arousal had no significant effect.

Thus, the data on valence and excitation obtained using emotional self-report and FaceReader coincided, which gives reason to trust the results obtained. These results are consistent with previous findings [20,21,50] by which negative emotions have also been shown to promote charitable behavior. At the same time, our results contradict those of another study using affective computing, where valence was positively correlated with donation size [22]. We also found no support for the previously described suggestion that charitable behavior is associated with arousal [58,59].

With regard to the six basic emotions, donations were negatively correlated to SR happiness, $\rho(32) = -0.84, p < .001$, and FR happiness, $\rho(32) = -0.79, p < .001$, and they were positively correlated with SR sadness, $\rho(32) = 0.94, p < .001$, and FR sadness $r(32) = 0.51, p = .003$. Moreover, donations were correlated with SR anger, $\rho(32) = 0.87, p < .001$, and FR anger $r(32) = 0.55, p = .001$. In other words, pictures that induced less happiness and more sadness and anger led to larger donations; thus, in relation to happiness, sadness, and anger, the self-report and FaceReader data showed similar relationships with the size of donations. In addition, our results are consistent with those of previous studies, which have already confirmed similar relationships between happiness, sadness, and anger and the willingness to donate one's resources to meet others' needs [16,19].

As for other emotions, the self-report and FaceReader data showed inconsistent trends. In particular, donations correlated with self-reported fear, $\rho(32) = 0.93, p < .001$, disgust, $\rho(32) = 0.87, p < .001$, and surprise, $\rho(32) = 0.81, p < .001$, whereas donations did not correlate with fear, $r(32) = -0.12$, disgust, $\rho(32) = 0.09$, and surprise $r(32) = -0.22$, (all $ps > .23$) as measured by FaceReader. Correlation matrices related to the relationship between emotional states and size of donations can be found in the supplementary material (Supplementary Tables S2–S4).

According to previous data, fear can provoke prosocial behavior in cases where participants seek to avoid a state in which the beneficiaries of their donations find themselves [52]. In our study, participants may have experienced fear while viewing pictures; however, their fear was caused by different reasons, which may explain the differences in the self-report and FaceReader data. In general, the differences in surprise, fear, and disgust data obtained using self-report and FaceReader indicate the need for further study of these contradictions and may be due to the fact that self-reported and FaceReader data were recorded at different points in time. In other words, FaceReader recorded emotions at the time of the first presentation of the stimuli and immediately before the decision to donate, while the self-reporting of emotions took place in the second part of the experiment, when participants were repeatedly presented with stimuli.

4.3. Relationship between additional factors and donations

Table 3 presents descriptive statistics of the participants' personal financial data. None of the variables were normally distributed (all $ps < .05$).

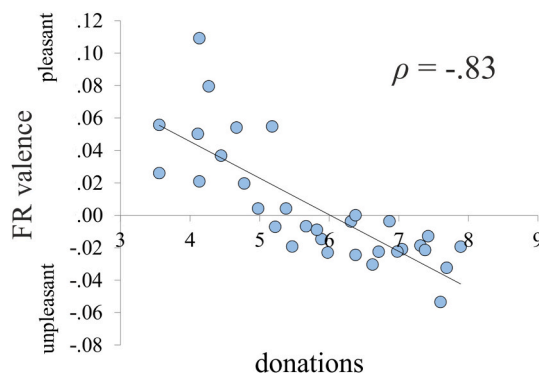**Fig. 5.** The relationship between FaceReader valence and donations. Each dot corresponds to a picture.

Table 3
The descriptive statistics of participants' personal financial data.

|	Total donations (MU)	Financial level (1–7)	Satisfaction of financial level (1–7)	Sensitivity to 320 MU	Personal income, MU	Annual donations (%)
Mean	185.800	3.422	3.467	2.511	37219.867	2.924
Median	176.000	3.000	3.000	2.000	20000.000	1.000
Std. Deviation	96.800	1.118	1.272	1.660	40796.963	3.149
Shapiro–Wilk	0.938	0.928	0.935	0.823	0.814	0.808
P value	0.018	0.008	0.014	<.001	<.001	<.001
Minimum	0.000	1.000	1.000	1.000	0.000	0.000
Maximum	320.000	6.000	6.000	7.000	200000.000	10.000
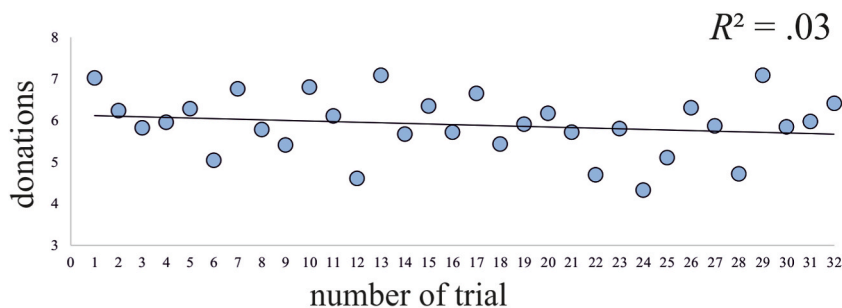
Fig. 6. The relationship between the presentation order and donation was not significant. In other words, the order did not influence donations.

The participants' total donation amount did not correlate with their financial well-being, $\rho(32) = -0.03$, $p = .86$, and their satisfaction of their current financial level, $\rho(32) = -0.08\ p = .60$. At the same time, the sums of their donations negatively correlated with their sensitivity to 320 MU, $\rho(32) = -0.53$, $p < .001$. Moreover, we did not find a significant correlation between the sum of donation and income, $\rho(32) = 0.08\ p = .59$, and annual donations, $\rho(32) = -0.10\ p = .51$.

Thus, the participants' donations were not related to their current income or to a subjective assessment of their current and desired financial well-being, which correlates with the findings of a previously published review [67]. In addition, the donation amount was not related to how much the participants gave to charity annually. At the same time, this was influenced by how significant the 320 monetary units were for the participants; that is, when the participants reported that this money was very significant for them, they donated, on average, less than those for whom this amount was insignificant.

We also tested the impact of time on donation size (Fig. 6). To do this, we calculated the average values of donations for each trial (from the first to the 32nd) and did not reveal a significant correlation between donation size and time ($R^2 = 0.03$). In other words, we did not observe any effect of progression or fading.

5. Discussion

This study aimed to examine the relationship between donation size and emotional state in the context of pet charities. It also sought to compare the predictive ability of affective computing with that of self-reported emotions to evaluate the effectiveness of charity appeals.

Thus, we used FaceReader software and emotional self-report to measure participants' emotional response when viewing pictures of dogs and making donation decisions. The results showed that valence, as measured by emotional self-report and FaceReader, correlated negatively with donation size; this implies that the more unpleasant the feelings experienced by the participants, the more willing they were to donate. These results are consistent with data from previous studies that demonstrated that pictures depicting negative emotions seem to increase the willingness to donate various resources to other people [20] and, potentially, donate more money to meet the needs of homeless dogs [50]. At the same time, the self-reported valence displayed a positive correlation with the FaceReader valence, which confirms the validity of the FaceReader measurements and is consistent with previously obtained data [61].

However, our results do not support previous findings that giving is positively correlated with valence [22] and pleasurable arousal [23]. The difference in the results may be explained by the fact that, in Fiala and Noussair's [22] study, the emotional state measured before the decision to donate was not caused by charity appeals but only reflected the participants' current emotional state. In addition, self-reported valence and FaceRader data measured after the decision to donate did not correlate with each other, which may indicate the methodological limitations of Fiala and Noussair's [22] study. In the context of the fMRI study by Genevsky et al. [23], positive arousal associated with nucleus accumbens activity increased the probability of donation; however, at the same time, it was associated with a fixed donation amount, which differed from trial to trial. In other words, participants experienced positive arousal and willingness to donate when they were asked to donate a small amount compared to a larger one. This means that the positive

arousal felt by the participants may not have been associated with the act of giving but with the fact that the donation requested was small. This may explain the contradiction between our results and those reported by Genevsky et al. [23].

We also showed that self-reported and FaceReader measured arousal were not correlated with donations. The consistency of the self-report and FaceReader data indicates the stability of this trend; however, these results are inconsistent with the work of Amato [59], who showed that a greater arousal of negative emotions could evoke higher intentions toward prosocial behaviors. The reasons for these differences may be related to the fact that, in an earlier published study, the factor of negative emotions experienced by survey participants (horror, shock) had a greater influence on their willingness to help than the level of their arousal. In addition, in Amato's study, participants reported their emotions and intentions to help not immediately but after a long period of time, which could affect the results obtained and is also a significant methodological difference from our research paradigm.

It is also important to note that the relationship between the self-reported valence and arousal had a typical *U*-shape, in contrast with the relationship between FaceReader valence and arousal, which did not. These results may be due to the fact that in our study we used 32 pictures of dogs that, according to FaceReader, elicited mostly unpleasant low arousal as well as pleasant medium and high arousal, while only a few stimuli elicited high unpleasant arousal in the data. The appearance of a *U*-shaped curve describing the valence and arousal recorded by FaceReader may be possible if the set of pictures adds more stimuli that provoke high unpleasant arousal.

In the context of discrete emotions, we found that donation size was positively correlated with self-reported and FaceReader measured anger and sadness, which is consistent with previous research [16,19]. We also showed that donations are negatively correlated with happiness, which is consistent with previously obtained data [16]. Thus, participants donated more when the pictures of dogs made them feel sad and angry, whereas donations decreased when the pictures provoked happiness. In addition, these data are also consistent with our data on valence measured using self-report and FaceReader, which suggests that it is the unpleasant emotions identified by a charity appeal that increase willingness to donate.

The self-reported emotions of surprise, disgust, and fear were also positively correlated with donation size. This means that pictures of dogs, to which the participants donated more money, instilled more surprise, disgust, and fear in them than those to which they donated less. However, these data contradict those recorded by FaceReader, which showed no relationship between surprise, disgust, and fear with donation size. These differences can be explained by the fact that the FaceReader recording with the self-report of emotions was conducted at different times, and FaceReader registered emotions at the moment of the first presentation of the stimulus, taking into account the baseline (1 s before a picture onset). In contrast to facial expressions, the self-reporting of emotions occurred in the second part of the experiment, when the participants were presented with pictures of dogs for the second time, which may have affected their conscious assessment of emotions. In addition, since the emotion self-report included questions about valence, arousal, and the six basic emotions, each time the participants were asked to evaluate each of these emotional metrics, their decisions might have been affected by explicit mention, which is also known as the mere-measurement effect [74]. In other words, the participants were able to accurately reflect the level of valence and arousal as these are general characteristics of emotional state. When assessing discrete emotions, they could declare the presence of an emotion because the question made them think about it, rather than because of its true presence.

Thus, since the FaceReader data are objective (calculated based on facial expression, not subjective assessment) and were recorded immediately prior to the donation decision, they are likely to reflect more reliable information than the self-reported data. In addition, the associations of emotions (valence, sadness, happiness, and anger) with donations that were shown based on the FaceReader data were expected and are consistent with previously obtained results. At the same time, the assessment of facial emotions did not show an association between fear and charitable giving, which differs from the results of previous studies [17,52]. However, the presence of this connection in previous studies is explained by the fact that people experience fear directly related to them—for example, in the case of specific diseases [52] or ecology, which affect the lives of all humans [17]. Simultaneously, we showed images of dogs rather than people, and such pictures did not generate fear, which could affect the willingness to donate. Moreover, inconsistencies in the results may reflect a key difference between intraspecific and interspecific charitable behavior. In other words, when a call is made to help other people, the benefactors may associate themselves with the beneficiaries of donations, and the act of giving may be performed out of fear of being in a similar situation in the future without the help of others. In the context of pet charity, such an association may not form; therefore, the causes of prosocial behavior are not associated with this type of fear.

Taking into account the garnered results, it can be concluded that FaceReader can more accurately predict the effectiveness of charity appeals compared to emotional self-report or at least highlight the most significant associations between discrete emotions and donations. It is also important to note that our results did not reveal any behavior-influencing emotions that the participants did not self-report, as shown in a shock social ad study [25]. Thus, we did not find evidence that the participants tried to hide the true emotions aroused by stray dogs.

Regarding additional factors influencing the participants' charitable behavior, it can be noted that the current level of financial well-being, satisfaction with the current level of financial well-being, and income were not associated with donation size. This means that participants donated regardless of how much they earned, how financially comfortable they felt, or how satisfied they were with their current financial well-being. At the same time, the amount of donation was influenced by how significant the endowment (320 MU, which they could spend on charity or keep for themselves) was for the participants. These results are consistent with the earlier conclusions of Neumayr and Pennerstorfer [67] that the relationship between giving and financial well-being has been insufficiently studied, and the results supporting or refuting it are inconsistent due to differences in experimental design. In addition, the percentage of annual income that participants gave to charity was not related to their donations to stray dogs. This means that personal philanthropy was not significantly associated with the participants' charitable behavior in the experiment.

6. Conclusions

This study posed three research questions from which the following conclusions can be drawn.

1. Valence is related to the amount of donations in support of homeless animals. The more unpleasant the emotions experienced by the participants, the greater their donations. This association is confirmed by the self-report of emotions given by FaceReader. No relationship was observed between arousal and donations.
2. Donation size is associated with sadness, happiness, and anger. The more sad and angry the participants were, the larger their donations; at the same time, happiness reduces the willingness to donate. These findings are derived from both self-report and FaceReader and coincide with previous studies. The positive association of donations with surprise, disgust, and fear was found with self-report but not with FaceReader, which may indicate a need for further study of these relationships.
3. FaceReader and emotion self-report showed similar results for valence, arousal, sadness, happiness, and anger. However, the results for surprise, disgust, and fear differed. We attribute these differences to the fact that the assessment of self-reported emotions and FaceReader was at different times and the questions asked to the participants may have influenced the self-report data. Thus, we believe the FaceReader data complement the emotion self-report and highlight stronger associations between emotion and donation size, making FaceReader an effective method for evaluating charity appeals.

In sum, our results indicate that unpleasant emotions, as opposed to pleasant ones, increase donation size, as indicated by the data, conceptualized in both discrete and multidimensional approaches. In addition, compared with emotion self-report alone, the combined use of affective computation and emotion self-report can improve the prediction of the effectiveness of charitable appeals.

Thus, this study contributes to the literature on the relationship between emotional state and donation size in the context of pet charity. In addition, these findings expand the academic literature on the study of interspecies prosocial human behavior triggered by calls for charity. This study also fills a gap in research evaluating the effectiveness of the elements of the marketing mix using affective technologies, and it proposes a new experimental paradigm that can be used for further research on philanthropic and commercial advertising. Furthermore, this study is the first in the field of evaluating the effectiveness of appeals for charity using FaceReader software, which allows to assess the feasibility of using this method for future studies. The practical significance of this study is that the results obtained and procedures described can help pet charities evaluate the effectiveness of their advertising messages before their public release, which will optimize the cost of attracting donations. In particular, the experimental model we used can be adapted and used to select advertising materials that most successfully achieve the goals of advertising campaigns as well as to contribute to the standardization of approaches for evaluating the effectiveness of advertising materials using an automatic emotion recognition system. Finally, this study draws the attention of the scientific community to the problem of homeless pets, which remains relevant to many countries worldwide.

Limitations and future directions

The main limitation of this study is that it was conducted in a laboratory setting. In everyday life, participants may react differently to the pictures presented. In particular, unpleasant stimuli can trigger an avoidance response; that is, the potential benefactor may go to another site, change the TV channel, or take other actions to interrupt the negative message. Moreover, our study does not cover the effects that may occur with repeated and long-term exposure to negative incentives—for example, when a person is exposed to unpleasant charity appeals for several weeks or months, which, according to some data [54–56], can form an aversion to the charities and organizations that broadcast them. Thus, future research could explore the relationship between emotions and charitable behavior in more environmentally valid settings, such as by using social networks or other online communication channels with potential philanthropists. Additionally, it is important to investigate the relationship between emotions and donations with a long-term impact on the audience; that is, longitudinal studies are needed.

Another limitation of this study may lie in the differences in emotion self-report and FaceReader data. Adjustments to the experimental procedure can help eliminate such differences. Since self-reported results may have been influenced by the mere-measurement effect, an alternative would be to allow participants to choose which emotions they experienced and to what extent.

Data availability statement

Data will be made available on request.

Funding

Ethics approval and consent to participate

The study protocol was approved by the Institutional review board of the National Research University Higher School of Economics (№103, date January 23, 2023). Informed consent was obtained from all individual participants included in the study.

CRediT authorship contribution statement

Anna Shepelenko: Writing – review & editing, Writing – original draft, Visualization, Software, Project administration, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Pavel Shepelenko:** Writing – review & editing, Software, Methodology, Data curation. **Anastasia Obukhova:** Writing – review & editing, Data curation. **Vladimir Kosonogov:** Writing – review & editing, Supervision, Methodology, Formal analysis, Conceptualization. **Anna Shestakova:** Writing – review & editing, Supervision, Funding acquisition, Conceptualization.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.heliyon.2023.e23728.

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