# A Dog Accompanying a Man Makes Social Threatening Contexts Less Aversive and Enhances Perceived Safety Regardless of Societal Safety Levels

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**Abstract**

Literature has shown that the inclusion of a dog in pictures showing a man in threatening scenarios improves women's emotional reactions to such scenes. However, the magnitude of this "dog accompanying effect" (i.e., whether the inclusion of a dog renders social threatening scenes less aversive, neutral, or positive) and its effectiveness in societies differing in terms of safety remain unknown. To address these issues, undergraduate females from societies differing in safety levels (lower [n = 120] and higher [n = 131] safety levels) provided valence, arousal, dominance, and safety ratings to images depicting a man alone or with a dog in threatening scenes, as well as to images of pleasant and neutral social scenes. The same response pattern was found in both societies: when viewing images of a dog accompanying a man, women had lower valence, dominance, safety, and calmness ratings than when viewing images of neutral scenes. Conversely, women had higher valence, dominance, safety, and calmness ratings when observing images of the dog accompanying a man compared with images showing the man alone in threatening scenes. Overall, these data indicate that dog presence–in pictures–buffered negative emotional reactions to photos of threatening social scenes in societal contexts differing in safety levels, but still (slightly) activated the defensive motivational system. The slight activation of the defensive motivational system is interpreted as an adaptative response of the organism to reduce or avoid potential harm (e.g., a hypothetical attack by the man). Our study provides a deeper understanding of the influence of dogs on women's emotional reactions to images of threatening scenes by clarifying the magnitude of the dog effect in societies differing in safety levels.

*Keywords*: Dogs, Emotional reactivity, Threatening social scenes, Sense of safety, Human-animal interaction

## Introduction

Human-animal relations, which are rooted in our shared evolution, have been prevalent over the course of the human history (Amiot et al., 2016). Archaeological evidence suggests that dogs were the first species to be domesticated (Clutton-Brock, 1995) primarily due to their special role as "companion" animals (Beck et al., 2000; Levinson, 1969; Messent & Serpell, 1981; Serpell, 1986). In contemporary society, dogs occupy a special place in human life, as evidenced by their involvement in human activities (e.g., in research/rescue and policing; Wells, 2009), and the increasing rates of dog ownership in the United States and Europe in the last decade (American Veterinary Medical Association, 2018; Statista, 2021). The increasing interest in the multispecies family may be due to the beneficial effects of human-dog relationships: dogs positively impact owners' physical health (e.g., by reducing blood pressure; Friedmann et al., 2013) and psychological well-being (e.g., by reducing loneliness, depression, and stress; Crossman et al., 2020; Le Roux & Kemp, 2009; Powell et al., 2019).

Dogs positively impact on their owner's psychological well-being partly through their ability to act as "social lubricants": i.e., they help to catalyze social relationships between humans (Collis & McNicholas, 1998). For instance, owners sitting at public places or engaging in normal daily activities while accompanied by a dog (vs. alone) tend to receive higher social approachability ratings and experience more social interactions, even when dressed scruffily (Lawson, 2001; McNicholas & Collis, 2000). Handling a dog is also associated with higher rates of solicited (asking for money in the street) and unsolicited (picking up coins that the confederate previously dropped on the ground) helping behaviors (Guéguen & Ciccotti, 2008). People with

disabilities also benefit from these social interaction-catalyzing effects. Indeed, adults with intellectual disabilities have more encounters when out with a handler and a service dog (vs. out only with the handler; Bould et al., 2018) and people in a wheelchair received more smiles and conversations from passers-by when a service dog was present (Eddy et al., 1988). Similarly, the service dog also positively impacts families with autistic children by facilitating the family's external relationships (Burrows et al., 2008).

A process that may be at work when dogs enhance social interaction is that participants may form impressions–or "dispositional attributions"– of others based on their association with animals (Lockwood, 1983). Consequently, viewers make judgments about the person's personality characteristics or disposition based on their behavior/actions (Jones & Davis, 1966), such as owning a dog. In this sense, owning a dog might be seen as a sign of empathic, caretaking and altruistic behaviors, and of the possession of various other emotional resources (Serpell & Paul, 2011; Tifferet et al., 2013). These dispositional attributions are reflected in the improved perceptions of the social attributes of people accompanied by dogs, as shown in many studies using photographs of dogs and people. For instance, previous literature showed that people seem friendlier and less dangerous when they are photographed with a dog or his/her own dog (Lockwood, 1983; Rossbach & Wilson, 1992). This "dog accompanying effect" on the owner's image occurs even in the context of social danger, i.e., when participants perceive that there is a possibility of being attacked by another person. For example, pictures depicting a man walking with his dog (vs. alone) in an unsafe alley at night with no other passers-by is perceived as more friendly and trustworthy, and less threatening and aggressive (Delgado-Rodríguez, Mena Cabrera, et al., 2022).

Attributing positive social characteristics to individuals associated with dogs in social threatening scenes, along with the improvement of their social image (arising from dog ownership), might affect observers' emotional state in such situations. To examine this, Delgado-Rodríguez, Carriquí Madroñal, et al. (2022) exposed undergraduate participants to pictures of a man or a woman (alone or handling a dog) in threatening and safe contexts. The results were especially interesting for threatening contexts; participants had less negative valence, and also felt more in control, calmer, and safer, when the man or woman were handling a dog versus appearing alone. Despite the contributions of the previous study (e.g., refining knowledge of the calming effect of dogs; Pendry & Vandagriff, 2019; Wells & Perrine, 2001b, 2001a), the experimental design did not allow inferences to be drawn regarding the magnitude of the dog effect in aversive contexts; i.e., the lack of other emotional scenes (e.g., pleasant and neutral pictures) prevents authors from concluding if the presence of a dog (or a man/woman walking with his/her dog) made participants react to threatening situations as if they were less aversive (i.e., slightly aversive), neutral, or even pleasant situations (Research Question 1/RQ 1). Further, the previous study was performed in the city of Jaén (Spain, a safe country according to the Global Peace Index/GPI; Institute for Economics & Peace, 2023). Jaén (111,669 inhabitants in 2022; Institute of Statistics and Cartography of Andalusia, 2022) is considered a safety city (Numbeo, 2023a) given its low levels of crime (Spanish Ministry of Interior, 2021), which are below the average Spanish crime rates (which in turn are below average European crime rates; Macrotrends, 2023); for example, according to the Spanish Ministry of Interior, during 2021, there were five reports of sexual assault with penetration, one kidnapping, and no intentional

homicides or murders (EPDATA, 2022). Considering the positive safety-related characteristics of the city in which the previous study was performed, one may wonder if the dog would still be effective in reducing negative emotional reactions to threatening social scenes in a less safe social context. In this sense, previous literature showed that living in cities with higher rates of criminality increases both the probability of being victimized and worry about crime (Brunton-Smith & Jackson, 2012; Chiricos et al., 2000; Eschholz et al., 2003; Ferguson & Mindel, 2007; Katz et al., 2003). In turn, this greater fear of being a victim and the individual-level experience of crime have a negative impact on social relationships (Lee & Cho, 2018; Palmer et al., 2005): they decrease people's participation in social interactions (Lee & Cho, 2018) and the perceived trustworthiness of others (Blanco & Ruiz, 2013), which could in turn hinder the dog effect. An analysis of the dog accompanying effect (buffering negative emotion to threatening social scenes) in less safe cities would reveal whether dogs still serve as a "safety cue" in more extreme social contexts (Research Question 2/RQ 2).

The RQ 1 can be explored using Lang's bioinformational model of emotion (Bradley & Lang, 2007; Lang, 1995). According to Lang, emotion is a predisposing factor for action that is organized around two motivational systems: appetitive and defensive. The model also assumes that emotional stimuli are mainly organized according to two basic parameters of emotion: valence and arousal. Cues differing in valence activate different motivational system; cues with a high valence (i.e., pleasant cues) activate the appetitive system, which involves a basic repertoire of responses such as ingestion, copulation, and caregiving behaviors, whereas cues with low valence (i.e., unpleasant cues) activate the defensive system, which involves responses such as

withdrawal, escape, and attack. However, cues with different arousal ratings differ in the degree of system activation; i.e., cues with higher (vs. smaller) arousal ratings produce greater system activation. When cues (words, pictures, or sounds; Bradley & Lang, 2000; Gantiva et al., 2015) are represented in a bidimensional space defined by valence (vertical axis) and arousal (horizontal axis), they show a global boomerang-shaped distribution that supports the two motivational systems: an arm extending from a neutral space (medium-valence and low arousal; e.g., neutral object pictures) to a high valence-arousal space (the upper arm; appetitive system; e.g., erotic pictures) and an arm extending from a neutral space to a low valence-high arousal space (the lower arm; defensive system; e.g., mutilation pictures) (Bradley et al., 2001; Lang et al., 1997). Examining emotional reactivity to images depicting a man with a dog in threatening contexts, along with pleasant, neutral, and unpleasant pictures, will shed light on the emotional space occupied by dog-related cues and, in turn, show whether inclusion of the dog accompanying the man leads to participants perceiving social threatening scenes as slightly negative, neutral, or even pleasant.

RQ 2 can be addressed by examining the dog accompanying effect in a less safe city, such as Bogotá (Colombia). According to the GPI[1] (Institute for Economics & Peace, 2023), Colombia was (along with Venezuela) the least peaceful Latin American country in 2023; while Colombia occupies the 140$^{th}$ position in the GPI, Spain occupies the 32$^{nd}$ position (among 163 countries). The two countries differ particularly in terms of safety and security (a domain of GPI): Colombia scores 3.6 and Spain 1.88 (in a scale ranging from 1–5; lower scores indicate higher safety and security). In particular, Bogotá, which has nearly 8 million inhabitants (District Planning Secretariat, 2021), had a homicide rate in 2017 seven times higher than in European

cities such as Madrid (Bogotá Chamber of Commerce, 2018), and is one of the least safe cities in Colombia (the second most dangerous among a list of the five most populated cities in Colombia), especially at night (Numbeo, 2023b). Considering differences in safety between Colombia and Spain (Institute for Economics & Peace, 2023), that Bogotá and Jaén are good examples of unsafe and safe cities in the two respective countries (Numbeo, 2023a; Spanish Ministry of Interior, 2021), and that Jaén is rated as almost twice as safe as Bogotá (Numbeo, 2023a, 2023b), we consider that these cities are highly suited to the study of whether the dog accompanying effect differs between societies with differing safety levels.

In the current study, we used Lang's theoretical model to examine the emotional processing of images depicting threatening social scenes (with and without a dog) in participants from social contexts differing in safety. For this, college females from Jaén and Bogotá were exposed to images depicting pleasant (e.g., people at a party) and neutral (e.g., two people having a coffee) social situations, along with images portraying a man in threatening scenes appearing alone (unpleasant social situations) or with a dog ("man with dog" social situations). They were asked to indicate how they felt while viewing each picture by providing ratings for the dimensions of valence, arousal, and dominance. Dominance is a third dimension of emotion proposed by Lang that, along with valence and arousal, organizes the emotional experience; the range of feeling dominated to feeling dominant reflects the experience of control over a given situation or stimulus (Bradley & Lang, 1994). Dominance has been less well-studied using Lang's theoretical model; however, we included this scale because it is affected (i.e., decreased) by socially threatening situations (Delgado-Rodríguez, Carriquí Madroñal, et al., 2022). Moreover, we used the

*threatening/safe scale* (TSS) to assess the sense of safety when viewing pictures.

## Hypothesis

*Hypothesis 1* (RQ 1). We expected to find that images of a man with a dog (in threatening scenes) slightly activate the defensive systems in the sample recruited from the safe context (Jaén). Specifically, we hypothesize that, compared to pictures of the man alone, participants will feel more positive valence, more in control, calmer, and safer when viewing pictures of the man with a dog. At the same time, man with dog pictures will prompt lower valence, dominance, and safety ratings, and higher arousal ratings, than neutral pictures. Man with dog pictures will be placed in the lower arm of the bidimensional space, between the neutral and man alone pictures. We made this prediction because even though the dog is a safety cue that enhances the social characteristics of the person who it is accompanying, it is nonetheless present in threatening contexts (e.g., accompanying a man in an unsafe alley at night with no other passers-by), which have been shown to promote an adaptative state of greater defensive mobilization (Grillon & Charney, 2011). In addition, some authors showed that a threat signal (threatening social scenes in the current study) does not inhibit defensive system activation even when it is associated with a positive cue (the dog in the current study) (Bradley et al., 2005; Bublatzky et al., 2022).

*Hypothesis 2* (RQ 2). Considering that greater fear of being victimized negatively impacts on social relationships (Lee & Cho, 2018; Palmer et al., 2005) and the perceived trustworthiness of others (Blanco & Ruiz, 2013), we do not expect to find a clear dog accompanying effect on emotional reactions to threatening social scenes in participants from less safe contexts (Bogotá): i.e., man with dog and man alone

pictures will prompt similar emotional reactions in all, or the majority, of emotional dimensions.

## Method

### Participants

A total of 251 female undergraduates (131 from Jaén [Spain] and 120 from Bogotá [Colombia]) voluntarily participated in this study. Spanish participants received partial credit towards their courses; however, the Colombian volunteers did not receive anything because this was not permitted by the Ethics Committee of the University of Los Andes. The average age was 19.7 (*SD* = 3.8) and 21.1 (*SD* = 3.4) years for the Spanish and Colombian participants, respectively (Table 1). The average age of the whole sample was 20.4 (*SD* = 3.7). The experiment was conducted at the University of Jaén (Spain) and the University of Los Andes (Colombia). We assessed only women because they consistently report feeling more fear in threatening situations (believing that they may be unable to physically protect themselves if attacked; Gordon & Riger, 1991), feel more unsafe (Blöbaum & Hunecke, 2005; Boomsma & Steg, 2014), and benefit more from dog presence in terms of sense of safety (Christian et al., 2016) than men. This research was conducted according to the Declaration of Helsinki and the Ethics Committees of the University of Jaén (Spain) and the University of Los Andes (Colombia), which reviewed the study justification, procedure, and objective, as well as the viewing task, proposed use of the data, and any potential risks of participating (none in this study).

**Table 1.**

Sociodemographic and dog-related question data.

| Measures | Jaén (n = 131) | Bogotá (n = 120) | *Test results* |
|---|---|---|---|
| Age, years[*] | 19.7 (3.8) | 21. 10 (3.4) | < 0.001 |
| Live with dog(s) currently[a**] | No = 64<br>Yes = 67 | No = 51<br>Yes = 69 | ns |
| Lived with dog(s) in the past[ab**] | No = 32<br>Yes = 32 | No = 25<br>Yes = 26 | ns |
| Importance attributed to dogs (currently or in the past)[c**] | No = 0<br>Yes = 64 | No = 0<br>Yes = 69 | ns |
| Fear of dogs[**] | No = 121<br>Yes= 10 | No = 107<br>Yes= 13 | ns |
| CRAS-S | - | 4.03 (0.42) | – |
| AAS-20 | 77.91 (7.99) | - | – |
| Perceived unsafety[***] | 15.62 (3.51) | 20.16 (4.19) | < 0.001 |

*Note.*

[a] Live with dogs was defined as living with dog(s) in the same home, and sharing bonds of affection. In addition, it implies the presence of special attention, affection, and care that promotes physical, mental, social, and emotional well-being.

[b] Includes those that currently do not own a dog (Spain, n = 64; Colombia, n = 51).

[c] Includes those that currently and/or previously owned a dog (Spain, n = 67; Colombia, n 69).

[*]Values represent means (SD), Kruskal-Wallis test.

[**]Values represent frequencies, chi-squared test.

[***]Values represent means (SD), one-factor ANOVA.

## Materials

### *Stimuli*

Participants were exposed to 12 pictures belonging to four different categories of social situation: pleasant (*n*=3), neutral (*n*=3), men accompanied by a dog in threatening contexts (dog, *n*=3), and men alone in threatening contexts (alone, *n*=3). Pleasant and neutral pictures were selected from the International Affective Picture System/IAPS (Lang et al., 2008). Pleasant images depicted people in a party (IAPS code: 7499), a group of smiling children (IAPS code: 2347), and a couple in a sexual context (IAPS code: 4698), while the neutral cues portrayed a couple in a working environment (IAPS code: 2393), a couple having a coffee (IAPS code: 2390), and a

man in a butcher's shop (IAPS code: 2235). The two categories differ significantly in valence and arousal (pleasant > neutral) according to both Spanish (Moltó et al., 2013; Vila et al., 2001) and Colombian normative ratings (Gantiva et al., 2011, 2019).

Some photographs for the man with a dog (*n*=3) and man alone (*n*=3) categories were selected from a previous study (Delgado-Rodríguez, Carriquí Madroñal, et al., 2022), while others were taken specifically for this study. We ensured that males depicted in the dog condition, when shown without the dog, provoked the same emotional reaction as those depicted in the alone condition. To achieve this, we conducted a pilot study in which 56 female college students (Spain, n=24; Colombia, n=32) rated the six pictures (six men alone in threatening contexts) in terms of valence and arousal, as well as using the TSS. While pictures from the alone category were the same between the pilot and the experimental study, the pictures from the man with a dog category were different. For the latter category, we first photographed the three men without the dog, and then included the dog (some minutes after); the two pictures of the same man (with and without a dog) were exactly the same, i.e., we maintained the perceptual characteristics in both pictures (e.g., same distance from the camera, position of the camera, lighting, etc.). Table 2 shows that, when appearing without a dog in the pilot study, males to be shown with a dog in the experimental study did not have different ratings on any scale from males appearing alone in the pilot and experimental studies (i.e., the three males from the alone condition).

**Table 2.**

Emotional reactivity to men appearing alone in threatening contexts in the pilot study belonging to the alone or dog condition in the experimental study.

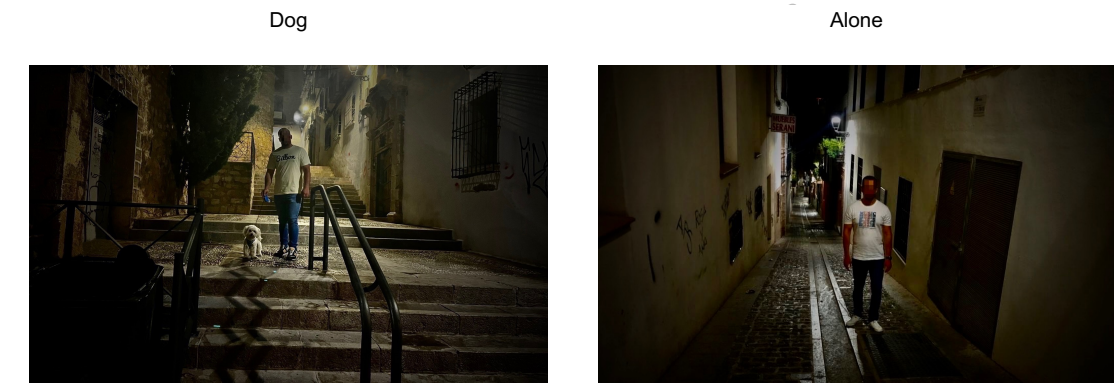
| Scales | Pleasant | Neutral | Dog | Alone | *Test results* |
|---|---|---|---|---|---|
| Valence | 7.3 (1.2)[a] | 5.7 (0.9)[b] | 2.6 (1.3)[c] | 2.4 (1.2)[c] | $F = 285.55$, $p < 0.001$, partial $\eta^2 = 0.84$ |
| Arousal | 5.3 (1.5)[b] | 3.4 (1.2)[c] | 7.7 (1.2)[a] | 7.9 (1.1)[a] | $F = 202.69$, $p < 0.001$, partial $\eta^2 = 0.79$ |
| Threatening/safe | 6.8 (1.1)[a] | 6.5 (1.1)[a] | 1.9(1.1)[b] | 1.7 (0.9)[b] | $F = 444.75$, $p < 0.001$, partial $\eta^2 = 0.89$ |

*Note.* Values are presented as means (SD). Pleasant and neutral pictures were obtained from the IAPS (Lang et al., 2008). Dog corresponds to pictures of men appearing without a dog in threatening contexts, who will be shown with a dog in the experimental study. Alone corresponds to pictures of men appearing alone in threatening contexts, who will also be shown alone in the experimental study. We performed mixed analysis of variance (ANOVA) for each affective dimension, using country (Spain vs. Colombia) as the between-participants factor and picture category (pleasant, neutral, dog, and alone) as the within-participants factor. The three ANOVAs yielded a significant picture category effect, which are included in the *Test results* column. For valence and arousal, all picture categories differed from one another at $p < 0.001$, except for the comparison between dog and alone, which did not differ from one another (valence, $p = 0.111$; arousal, $p = 0.106$). Regarding threatening/safe, pleasant and neutral (which did not differ from one another; $p = 0.502$) prompted stronger feelings of safety than dog (both $ps < 0.001$) and alone (both $ps < 0.001$). Dog and alone had similar ratings on the threatening/safe dimension ($p = 0.220$). These statistics are represented in the table (within rows) with letters: the same letter indicates no significant differences, and different letters indicate significant differences. The picture category × country interaction was not significant for any scale.

The six men (alone [$n$=3] and with a dog [$n$=3]) were depicted in urban contexts with physical characteristics associated with threat, namely high levels of concealment (i.e., physical occlusion of a space big enough to hide a potential offender; Nasar, 2000) and entrapment (i.e., a situation from which a person would have difficulty escaping when confronted by a potential offender; Nasar, 2000). Moreover, since lighting seems to be one of the most important variables predicting social safety ratings (Loewen et al., 1993), all scenes were shot after dark. There were no people in the pictures apart from the man (alone condition) or man/dog (dog condition). Moreover, given that humans' faces are powerful affective signals, we pixelated the man's face (Jack & Schyns, 2015). All actors were aged between 30 and 40 years. The dogs were adults, to avoid any effect of features directly related to puppyhood; moreover, they were leashed because unleashed dogs are perceived to reflect inappropriate owner behavior and assessed negatively (Arnberger & Haider, 2007).

The dog breeds were wire-haired Dachshund (black hair), Maltese (white, short hair), and Maltese-like mixed-breed (black, short hair); all three were small in size. During the picture-taking process, we ensured that the dogs (and the human actors) did not suffer any harm. Figure 1 shows sample pictures.

**Figure 1.**
Example pictures from the dog and alone conditions.






*Picture reactivity*

The *Self-assessment Manikin*/SAM (Bradley & Lang, 1994) is a non-verbal pictorial rating scale with nine levels of intensity (from 1 [lower end] to 9 [upper end]), represented by five human-like drawings and the four spaces that separate the manikins. Participants were asked to pick the manikin or the space between manikins that best represents how they feel "right now" as they are responding (i.e., immediately after each picture was presented). The SAM represents three distinct emotional states experienced in response to the pictures; valence (unpleasant vs. pleasant), arousal (relaxed vs. activated), and dominance (feeling controlled vs. feeling in control) experienced in response to the pictures. We carefully followed the original instructions when explaining the SAM scales to the participants (see Lang et

al., 2008 for the original instructions and Miccoli et al., 2014 for the Spanish version). For the valence dimension, participants had to click on one extreme (frowning figure) if they felt completely unhappy, annoyed, unsatisfied, melancholic, despaired; however, they had to click on the other end (smiling figure) if they felt completely happy, pleased, satisfied, contented, hopeful while viewing the picture. For the arousal scale, participants were invited to click on the extreme depicting the calming figure if they felt completely relaxed, calm, sluggish, dull, sleepy, unaroused; however, they had to click on the extreme representing the exciting figure if the felt completely stimulated, excited, frenzied, jittery, wide-awake, aroused. For the dominance dimension, they had to click on one extreme (very small, dominated figure) if they felt completely controlled, influenced, cared-for, awed, submissive, guided; however, they had to click on the other extreme (very large, dominant figure) if they felt completely controlling, influential, in control, important, dominant, autonomous. The central figure in the three SAM scales represented neutral responses (feeling neither unhappy/calm/controlled nor happy/excited/in control).

In addition to the SAM, we used the TSS, which was developed by the authors (Delgado-Rodríguez, Carriquí Madroñal, et al., 2022) to assess "the threat/safety level that the scene causes you". The TSS assesses the threat/safety levels on a 9-point scale ranging from 1 (very threatening) to 9 (very safe); lower and higher scores indicate that images prompt a great sense of threat and great sense of safety, respectively. Participants were invited to click on 1 if they felt threatened, in danger, insecure while viewing the picture, and to click on 9 if they felt very safe, secure. If participants did not feel any sense of threat or security, they had to click on 5.

*Questionnaires*

To assess the general perceived unsafety, we asked participants to indicate their level of worry about crime and perceived likelihood of personally being a victim of crime. Based on Jackson (2009), we asked women to indicate their level of worry about (1=not once in the last month, 4=everyday) and perceived likelihood (1=definitely not going to happen, 5=certain to happen) of being robbed by an unknown person on the street, harassed or threatened on the streets, and robbed in a non-violent way. Higher scores indicate greater perceived unsafety. The internal consistency of the six items was 0.78 for the Spanish sample, 0.82 for the Colombian sample, and 0.85 for the whole sample.

The Spanish sample's *attitudes towards animals* were assessed with the 20-item Animal Attitude Scale/AAS-20 (Herzog et al., 2015; Spanish version Suárez Yera et al., 2021), which consists of statements scored on a 5-point Likert scale related to attitudes toward animal welfare; the scores range from 20 to 100, with higher scores indicating more concern for animal welfare. The Cronbach's α of the AAS-20 in the current Spanish sample was 0.80. The AAS was not used for the Colombian sample because it was not validated in this population; instead, we used the Composite Respect for Animals Scale Short version (CRAS-S; Randler et al., 2019; Colombian version, Randler et al., 2021). The CRAS-S consists of 20 items scored via a 5-point Likert-type format, for which total scores, i.e., the mean score of the responses to all items, range from 1 to 5; higher scores reflect more pro-animal attitudes. The Cronbach's α of the CRAS-S for our Colombian sample was 0.76.

Procedure

We recruited female undergraduates from the University of Jaén (Spain) and University of Los Andes (Colombia) to participate in the study. In the Spanish university, we described the study to potential participants in several lecture classrooms and asked the women who were interested in participating to add their name and email to a list (accompanied by a session timetable). One day before their session, they received a reminder by email. In Colombia, researchers recruited participants from the university campus. If the women were interested in participating after being provided with study information, they accompanied the researchers to the laboratory. The same study information was provided to both samples during recruitment and in the laboratory. The first thing that the participants did on arrival at the laboratory was sign the informed consent form; after that, they completed the whole experiment, which was divided into four blocks. In block 1 ("passive viewing"), participants were presented with the 12 images twice (which were introduced in the Stimuli section: 3 pleasant, 3 neutral, 3 man with a dog, and 3 man alone images) for 4 seconds each. Four pseudorandomized picture orders were used across participants, each one starting with a different image category; more than two repetitions of images from the same category were avoided. After viewing the pictures, the participants were provided with the scale and assessment task instructions (block 2: "instructions"). Block 3 ("image assessment") consists of the image assessment task. This task was divided into two parts: in the *first part*, participants were presented with three trial pictures (1 pleasant [IAPS code: 8163], 1 neutral (IAPS code: 7235), and 1 unpleasant [IAPS code: 9905] picture from the IAPS) to familiarize them with the picture presentation procedure and scale usage. After assessing the trial pictures, the *second part* started: participants were presented with the 12 images (randomly presented) previously viewed twice. The procedure was

the same in the first and second task: after each image (presented for 6 seconds), the scales appeared one by one, and remained present until the participants had provided their responses[2]. Block 4 involved completing sociodemographic and dog-related questions and questionnaires. At the end of the experiment, the participants were debriefed and thanked.

### Statistical analysis

First, we calculated the mean valence and arousal dimension ratings for each picture, separately for the Spanish and Colombian participants. Then, we plotted each image as a function of its mean valence (vertical axis) and arousal (horizontal axis) ratings. We also performed separate mixed analysis of covariance (ANCOVA) for each affective scale (valence, arousal, dominance, and TSS), using country (Spain vs. Colombia) as the between-subjects factor and picture category (pleasant, neutral, man with dog, and man alone) as the within-subjects factor. Age was included as a covariate due to the significant between-group difference in this variable. We set the level of significance at 0.05, and performed the Greenhouse-Geisser adjustment as necessary. Partial $\eta^2$ was calculated as a measure of the effect sizes for the main effect of picture category and the picture category × country interaction. Moreover, Cohen's d was calculated as a measure of the effect size of the comparisons between picture categories. Significant main and interaction effects were further examined using post-hoc contrasts, with the Bonferroni procedure applied for multiple comparisons. All data were analyzed using JASP (version 0.17.2.1; JASP Team, 2023).

## Results

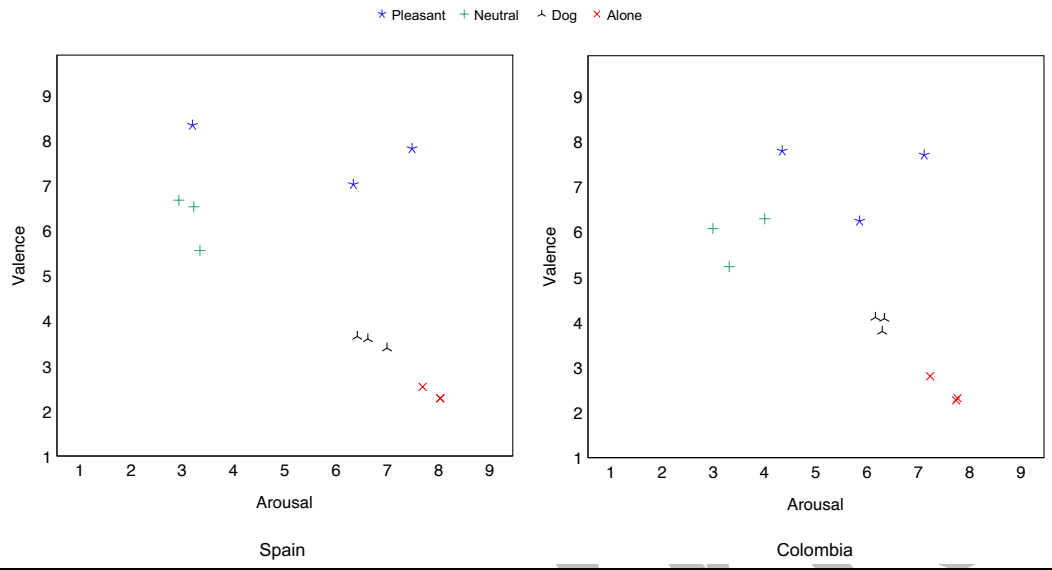
We have organized the results as follows: first, we graphically show the emotional space that each picture category occupies in the bidimensional affective space, in particular highlighting the position of the pictures depicting a man with a dog in threatening scenes. Second, we show the results in each dimensional scale, including the significant picture category effect and picture category × group interaction. For significant interactions, we describe within-group picture category comparisons, given that our interest was to examine differences between the man with dog, man alone and neutral pictures. Finally, we summarize the results, including in terms of their associations with the RQs and hypothesis.

Affective space for the IAPS, dog and alone pictures

Figure 2 shows the distribution of the 12 images in the bidimensional space of valence and arousal for Spanish (Left panel) and Colombian participants (Right panel). For participants from both countries, pleasant pictures were situated in the upper (i.e., appetitive) arm, and neutral pictures in the left-center (i.e., neutral) arm. Pictures depicting a man alone in a threatening context were situated in the lower (i.e., defensive) arm, i.e., they were processed as highly negative by participants from both groups. Pictures depicting a man accompanied by a dog in a threatening context were also processed as negative, since they were situated in the lower arm in both samples; however, they were clearly less negative than images of the man alone.

**Figure 2.**

Affective space.




*Note.* Bidimensional plot of each image as a function of its mean valence (vertical axis) and arousal (horizontal axis) ratings for the Spanish (left panel) and Colombian (right panel) participants. Each point in the plot represents, within each group, the valence and arousal ratings for an image.



Valence ratings

The ANCOVA yielded a main effect of picture category, $F_{(3, 744)} = 31.28$, $p < 0.001$, partial $\eta^2 = 0.112$, 95% CI [0.07, 0.15]; pleasant pictures had the highest valence ratings, followed by the neutral, man with dog, and ultimately, men alone pictures (all categories significantly differed from each other at $p < 0.001$, except that for dog vs. men alone; $p = 0.006$). The ANCOVA also yielded a significant picture category ×country interaction, $F_{(3, 744)} = 9.39$, $p < 0.001$, partial $\eta^2 = 0.036$, 95% CI [0.01, 0.06]. Because our main interest was the reactivity patterns within each sample, we performed *post hoc* comparisons between picture categories within each country. The reactivity patterns were the same for the Spanish and Colombian samples (all categories significantly differ from one another): pleasant pictures had the highest valence ratings, followed by neutral, man with dog, and ultimately, man alone

pictures (all *p*s < 0.001 for both countries). Therefore, as Figure 3A shows, although the man with dog category had lower valence ratings than neutral social scenes (Spanish: $p < 0.001$, Cohen's d = 2.274; Colombian: $p < 0.001$, Cohen's d = 1.567), depicting the man with a dog buffered the negative valence elicited by the man alone in threatening contexts for both samples (i.e., man with dog had higher valence than man alone for Spanish: $p < 0.001$, Cohen's d = 0.995 and Colombian: $p < 0.001$, Cohen's d = 1.278). Statistical indexes (e.g., 95% CIs for mean difference and Cohen's d, Cohen's d, *p*-values, etc.) of each pairwise picture category comparisons can be found in the supplementary data file.

Arousal ratings

The ANCOVA yielded a main effect of picture category, $F_{(3, 744)} = 41.20$, $p < 0.001$, partial $\eta^2 = 0.142$, 95% CI [0.10, 0.19]. For the entire sample, activation was highest when viewing pictures of man alone, followed by man with a dog, pleasant scenes, and ultimately, neutral scenes (all *ps* < 0.001, except for man with dog vs. pleasant; $p = 0.005$). These results indicate that, although the man with the dog elicited more arousal than the neutral scenes ($p < 0.001$, Cohen's d = -2.314), participants from both countries were less activated when viewing the dog accompanying the man in threatening contexts vs. images of the man alone ($p < 0.001$, Cohen's d = -0.932; Figure 3B).

Dominance ratings

The ANCOVA yielded a main effect of picture category, $F_{(3, 744)} = 31.15$, $p < 0.001$, partial $\eta^2 = 0.112$, 95% CI [0.07, 0.15]; pleasant and neutral images (which did not differ from each other; $p = 0.217$), evoked more dominance than the man with dog

and man alone pictures (all *p*s < 0.001), moreover, man with dog pictures evoked more dominance than man alone pictures ($p < 0.001$). The ANCOVA also yielded a significant picture category × country interaction, $F_{(3, 744)} = 3.36$, $p < 0.05$ partial $\eta^2 = 0.013$, 95% CI [< 0.001, 0.03]. The pattern of reactivity was slightly different between the Spanish and Colombian samples. For the Spanish participants, all stimulus categories were significantly different from one another (all *p*s < 0.001), in the order pleasant > neutral > man with dog > man alone. However, the Colombian participants felt most dominant in the context of pleasant and neutral pictures (which did not differ from each other; $p > 0.99$), followed by the man with dog and man alone pictures (all *p*s < 0.001; pleasant = neutral > man with dog > man alone; Figure 3C). Therefore, the man with the dog prompted in both Spanish and Colombian participants more feeling of control than the man alone (Spanish: $p < 0.001$, Cohen's d = 1.019 and Colombian: $p < 0.001$, Cohen's d = 1.287). Conversely, the man with dog category produced weaker feelings of control than the neutral category in both samples (Spanish: $p < 0.001$, Cohen's d = 2.062 and Colombian: $p < 0.001$, Cohen's d = 1.854).

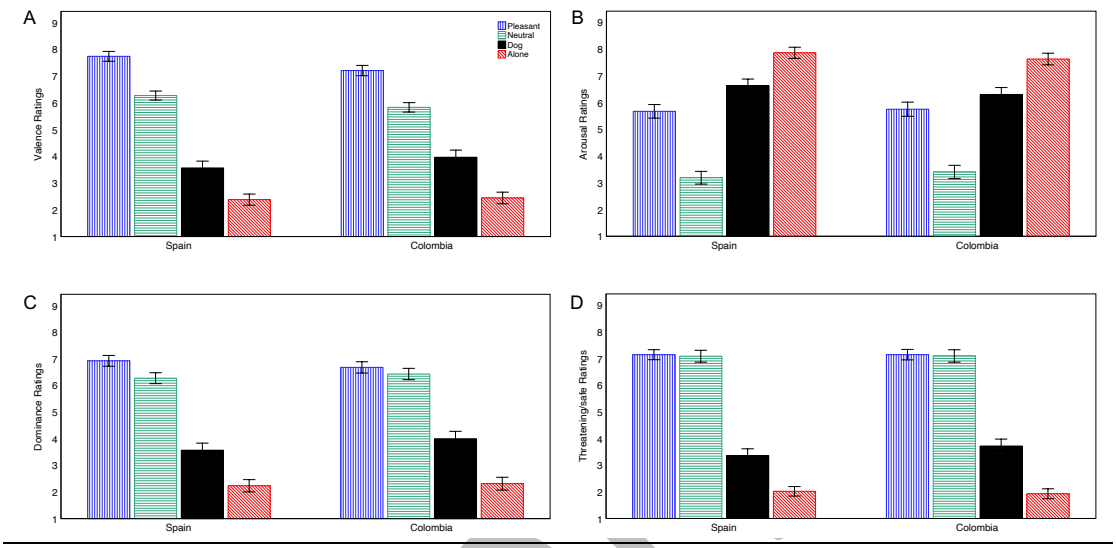
Threatening/safe ratings (TSS scale)

The ANCOVA yielded a main effect of picture category, $F_{(3, 744)} = 51.44$, $p < 0.001$, partial $\eta^2 = 0.172$, 95% CI [0.12, 0.22]. Participants felt most safe when viewing pleasant and neutral social contexts (which did not differ from each other; $p > 0.99$), followed by man with a dog and, ultimately, by man alone (all *p*s < 0.001). In conclusion, although the man with the dog category evoked a greater sense of threat than the neutral category ($p < 0.001$, Cohen's d = 2.919), participants from both

countries felt safer when facing the man with the dog than the man alone ($p < 0.001$, Cohen's d = 1.287; Figure 3D).

**Figure 3.**

Emotional reactivity across picture categories.




*Note.* Ratings on the threatening/safe scale (d) can be interpreted as follows: lower ratings indicate pictures that prompt a greater sense of threat; conversely, higher ratings indicate a greater sense of safety. Error bars represent 95% confidence intervals.

Summarizing, the ANCOVAs showed that women from Jaén (safe city) felt significantly more positive valence, dominance, and safety, and less arousal, to the man with dog than man alone pictures. At the same time, they felt significantly less positive valence, dominance, and safety, and more arousal, to man with dog than neutral pictures. Those results are in line with *hypothesis 1* (RQ 1). Moreover, the results indicated that women from Bogotá (less safe city) showed the same pattern of emotional reactions to man with dog, man alone, and neutral pictures as women from Jaén, which rejects our *hypothesis 2.*

## Discussion

We aimed to assess the magnitude of the dog effect (i.e., the effect of a dog accompanying a man) on emotional reactivity to threatening social scenes (RQ 1) in participants from societies differing in safety levels (RQ 2). For this purpose, women from Jaén and Bogotá (societal contexts with higher and lower safety levels, respectively) were exposed to pictures of a man alone or with a dog in threatening scenes, along with pleasant and neutral social scenes. As we hypothesized (*hypothesis 1*), women from Jaén felt worse when viewing the man with the dog than neutral scenes, however, they felt better when viewing the man with the dog than the man alone. These findings indicate that pictures of a man accompanied by a dog in threatening contexts are processed as slightly negative; i.e., they activate the defensive motivational system to a lesser degree than images of a man alone in threatening contexts. The same results from the Jaén sample were found in the women from Bogotá, rejecting our *hypothesis 2*. Therefore, the presence of a dog accompanying a man in images of threatening scenes buffered negative emotional reactions to these negative scenes in women from societies with different safety levels.

In both samples, pictures of men accompanied by a dog elicited less negative reactions than pictures of men alone in threatening scenes. Specifically, participants felt less negative valence and activation (i.e., less arousal), and more in control (i.e., dominance) and safer, when they observed images of threatening scenes containing a man with a dog. Remarkably, the Cohen's d for these comparisons (man with dog vs. man alone) ranged from -0.932 (in arousal scales) to 1.287 (in dominance [for Colombian] and TSS scales), indicating large effect sizes (mean differences of around 1 *SD*) in each dimension. These results are in line with previous studies indicating that dogs positively affect participants' emotional state in aversive scenes, such as

threatening social contexts (Delgado-Rodríguez, Carriquí Madroñal, et al., 2022) and dental procedures that children perceived as distressing (Havener et al., 2001). The emotional improvement found in the current study (when a dog was present with a man in threatening scenes) might be due to the attribution of positive social characteristics to individuals depicted with a dog. By depicting the dog on a leash in the picture, participants likely perceived the man as its owner. In this sense, owning a dog is seen as caretaking and altruistic behaviors, as well as a signal of empathy (Serpell & Paul, 2011; Tifferet et al., 2013). These characteristics might enhance attributes related to social safety even in the context of threatening scenes (Delgado-Rodríguez, Mena Cabrera, et al., 2022). This enhancement of the man's social characteristics (prompted by dog ownership) might underlie the improvement in emotional reactivity to threatening scenes; however, this interpretation is speculative given that we assessed the participants' emotional reactivity (i.e., how they felt while passively viewing pictures), and no attribution variables were measured that would have allowed us to connect emotional reactivity to dispositional attributions. Moreover, apart from the dog leash, no other information that may have led participants to think that the man was the dog's owner was presented, unlike other studies (e.g., one study including the words "owns a dog"; Tifferet et al., 2013), and we did not ask participants to indicate if they considered the man to be the dog's owner. Regardless of the mechanisms underlying the emotional improvements found in the current study, our results have clinical implications for individuals who fear public places (e.g., individuals with a pathological fear of crime); such people could benefit from this dog accompanying effect during exposure-based treatment sessions (e.g., by decreasing the initial intensity of negative emotions when exposed to urban public scenes). Our results also support the use of dogs in therapeutic interventions or

academic contexts associated with stressful activities (e.g., dental procedures or sitting examinations).

In addition, compared with other studies (Delgado-Rodríguez, Carriquí Madroñal, et al., 2022; Tifferet et al., 2013; Wells & Perrine, 2001b), our novel study design (i.e., including pleasant and neutral social scenes along with threatening social scenes with and without a dog) provides a more in-depth understanding of the dog effect. Specifically, this study was the first to show that depicting a dog accompanying a man in images of threatening scenes improves emotional reactivity to these cues in both samples, but still activates the defensive motivational system; in bidimensional space, images depicting the man with the dog were situated in the lower arm (among neutral and men alone pictures), indicating that, as hypothesized (*hypothesis 1*), they moderately activated the defensive system (Bradley et al., 2001). These results can be explained by the fact that we tested the dog accompanying effect in threatening social contexts; we selected contexts with physical aspects that potentiate women's sense of unsafety (e.g., high levels of concealment and/or entrapment, and low light levels; Loewen et al., 1993; Nasar, 2000). According to the literature, a threat signal does not inhibit defensive system activation even when it is associated with a positive cue (Bradley et al., 2005). In this sense, viewing a potentially dangerous situation (e.g., a man in a lonely alley after dark with no other passers-by), even if it is depicted in an image, triggers caution, aversive anticipation, and preparation for avoidant or defensive behavior (Bradley et al., 2005; Bublatzky et al., 2018, 2020; Grillon et al., 1991; Morato et al., 2021). Responses to images of a man with a dog in threatening social contexts involve preparatory activation of the defensive system, and are adaptative in that potential harm (e.g., a hypothetical attack by a man) to the organism

can be avoided or reduced. Similar results have been found in the literature when examining emotional reactivity to positive cues in a threatening context; for example, Bublatzky et al. (2022) exposed participants to images depicting loved or unknown faces, and pictures from each category were associated with threatening/ shocking or safety signals. The results indicated that viewing images of loved faces did not modulate physiological or subjective emotional reactivity in the threat condition. Taken together, the results indicate that the defense system remains in a state of readiness even with the inclusion of a safety cue (i.e., a dog or loved face); this strategy seems to be more evolutionarily advantageous (to avoid future harm) than considering dog or loved face cues safe by default.

The second aim of the current study was to examine the dog accompanying effect on emotional reactivity to threatening contexts in samples from cities differing in safety levels. Considering that greater fear of being victimized negatively impacts on social relationships (Lee & Cho, 2018; Palmer et al., 2005) and the perceived trustworthiness of others (Blanco & Ruiz, 2013), we hypothesized that the dog accompanying effect will be hindered in a less safe city (*hypothesis 2)*. To test this, we selected Jaén as a safe city (Spain; Numbeo, 2023a; Spanish Ministry of Interior, 2021), where a previous study showed that the dog accompanying effect was in operation (Delgado-Rodríguez, Carriquí Madroñal, et al., 2022), and Bogotá as a less safe city. Bogotá was selected because its homicide rates were seven times higher than in Madrid (for which the rate significantly exceeds that in Jaén; EPDATA, 2022; Spanish Ministry of Interior, 2021) during 2017 (Bogotá Chamber of Commerce, 2018), and walking alone in this city (especially at night) is classified as "very low safety" (vs. Jaén, which is considered a safe city; Numbeo, 2023a, 2023b). This

between-cities difference in perceived safety was also seen in the current study; women from Bogotá were significantly more worried, and perceived the likelihood of being victimized on the street as higher, than women from Jaén (Table 1). The emotional reactivity results indicated that women from both countries showed the same emotional pattern; i.e., reactions to man with dog pictures were "worse" and "better" than those to neutral images and those depicting a man alone, respectively. Therefore, this study was the first to show that depicting a dog accompanying a man moderates negative reactions to threatening social contexts regardless of safety level, indicating that the positive dog accompanying effect on participants' emotional state does not depend on the societal context.

Although our results showed a positive effect of presenting a dog accompanying a man–in pictures–in both samples, we performed additional analyses to examine if the demographic and dog-related questions included in Table 1 affected our results. First, we ran ANOVAs to examine if living with dogs affected the results. To that end, picture category was included as a within-subject variable and living with dogs as a between-subject variable. Participants who live with dogs (currently and/or the past) formed the "live" group (n = 194) and the other participants constituted the "do not live" group (n = 57). There was no significant picture category × living with dogs interaction. To assess the impact of fear of dogs on our results, we ran the same ANCOVAs described in the Results section, but excluded participants who reported fear of dogs (Spanish, n = 10; Colombian, n = 13). The results did not change; we found, in both samples, the same response patterns described in the Results section. Therefore, in line with previous studies (Delgado-Rodríguez, Carriquí Madroñal, et al., 2022), fear of dogs was not an important factor in the present study, which may be

related to how dogs were depicted, i.e., as leashed, which could promote perceptions that dogs are under the control of their handlers (Arnberger & Haider, 2007). Finally, we tested the possible impact of attitudes toward animals. Given that there is no validated Spanish and Colombian questionnaire to assess attitudes toward animals, we had to use a separate questionnaire for each sample in order to increase the reliability of our measurement: the AAS-20 (Suárez Yera et al., 2021) for the Spanish sample and the CRAS-S (Randler et al., 2021) for the Colombian sample. Considering this drawback, we performed four independent simple regression analyses for each country; in each model, attitude toward animals was the predictor and emotional reactivity to pictures depicting a dog (in terms of valence, arousal, dominance, or TSS) was the outcome variable. All regressions were non-significant, indicating that emotional reactivity to images depicting a man with a dog in a threatening scene was not related to attitude toward animals. Those findings are in line with previous literature indicating that attitudes toward animals do not modulate the effect of the presence of a dog on participants' perceptions (Friedmann et al., 1993; Schneider & Harley, 2006).

Another strength of our study is that we performed a pilot study to confirm that men appearing with the dog (n=3) did not differ from men portrayed alone (n=3) when they were depicted without the dog. The pilot study showed that women from Spain and Colombia provided the same valence, arousal, dominance, and threat ratings for both categories (Table 2). Therefore, the differences in emotional reactivity to men alone and men with a dog in threatening contexts in the experimental study are attributable to the inclusion of the dog. Moreover, in the experimental study, the results of the emotional assessment of pleasant and neutral social scenes from the

IAPS are consistent with previous literature on emotion processing (Bradley et al., 2001; McManis et al., 2001), thereby indicating the methodological and theoretical reliability of the ratings for pictures including dogs and of men alone.

Despite the positive dog accompanying effect found in this study (buffering negative emotional reactivity to images of threatening social scenes) and described in the above-mentioned literature (e.g., regarding owner's physical health [Friedmann et al., 2013] and psychological well-being [Crossman et al., 2020]), there are studies that point in another direction. For instance, some studies found that pet ownership did not have an impact on human physical or mental health. In this sense, Herzog (2010) found no differences between owners and nonowners in terms of the likelihood of describing themselves as "very happy", and Gilbey et al. (2007) showed that acquiring a dog as a companion animal did not decrease the person's loneliness 6 months later. Moreover, other studies indicated that a dog only has a positive effect under certain circumstances (e.g., Havener et al., 2001). In other cases, dog ownership has been shown to have a negative effect; for example, Parker et al. (2010) found that (in a sample of 425 heart-attack victims) pet owners were more likely than non-pet owners to die or suffer remissions within a year of suffering their heart attack. Those results led some authors to argue that the pet effect remains inconclusive (e.g., Herzog, 2011), highlighting the need for more high-quality experimental research to clarify these contradictory data in the human-animal interaction field and identify the circumstances under which pets make people happier and healthier.

***Limitations***

We included only young women (mean age = 20.4 years, *SD* = 3.7) in this study, which does not allow us to generalize the results to men and other age groups. Men differ from women in terms of the cues that prompt threat responses, and in terms of behaviors and attitudes toward animals (Blöbaum & Hunecke, 2005; Boomsma & Steg, 2014; Herzog, 2007). In addition, although we controlled for age in the analysis, the relative youth of the sample could have affected the general trend of our results, considering that previous research showed differences in negative affect regulation (Kessler & Staudinger, 2009) and behaviors that decrease victimization (Greve et al., 2017) across age groups. To improve generalizability to men and other age groups, future studies should consider including women and men and a wider range of ages. Another limitation relates to the type of dogs that we used. The three dogs were all small-sized, with physical characteristics associated with high "agreeableness" (e.g., they had floppy ears; Hecht & Horowitz, 2015) and cuteness (e.g., short limbs; Wells, 2004); such dogs tend to have better relationships with humans (Thorn et al., 2015). Small-sized dogs are especially relevant to the threatening social scenes because they provoke a greater emotional improvement than dogs of other sizes (e.g., vs. medium-sized dogs; Delgado-Rodríguez, Carriquí Madroñal, et al., 2022), which may be due to the fact that "small" dogs provoke less fear in passers-by (Gazzano et al., 2013). Therefore, using other dogs differing in size should reveal if the dog accompanying effect found in the current study generalizes to other dogs with physical characteristics less associated with agreeableness and cuteness. In addition to dogs of other sizes, future studies should also consider using stigmatized breeds, given that such breeds can negatively impact observer perceptions (Gazzano et al., 2013) and that the stigma associated with those breeds seems to extend to the owner (Twining et al., 2000), factors that may have affected our results. We tested the dog accompanying

effect using images rather than real-life events. Therefore, our conclusions should be interpreted with caution, considering that we showed that non-stigmatized small-sized dogs buffered defensive emotional reactivity to threatening social scenes in static pictures. Finally, our two groups differed in terms of the incentives for participating; while the Spanish group received partial course credit, the Colombian group did not receive anything. In this sense, previous studies found that different types of incentives could influence participants' performance (i.e., response accuracy) in a cognitive task (e.g., memory task; Bowen & Kensinger, 2017). In our case, we did not record correct (vs. incorrect) responses; in fact, the participants were informed that they had to indicate how the felt while viewing each image, not existing correct or incorrect answers. For that reason, we believe that our results would have been minimally affected, or unaffected, by bias arising from the different incentives used at each university.

**Conclusions**

Our results indicated that women showed less negative reactions (in terms of valence, arousal, dominance, and TSS dimensions) when viewing images of a man accompanied by a dog in threatening scenes than images of a man alone in unsafe scenes. Conversely, images depicting a man with a dog in threatening contexts prompted more negative reactions than images of neutral social scenes. This response pattern was found in participants from two countries differing in safety levels. Overall, these data indicate that the inclusion–in pictures–of a dog accompanying a man in threatening social scenes buffered the negative emotional reactions to unsafe social situations regardless of societal safety levels, but still slightly activated the defensive motivational system, which is adaptative in that potential harm (e.g., a

hypothetical attack by a man) to the organism can be avoided or reduced. Our study provides deeper insight into the influence of dogs accompanying effect on women's emotional reactions in threatening contexts by clarifying the magnitude of this effect in societies differing in safety levels.

**Notes**

[1]The Global Peace Index (GPI) is produced by the Institute for Economics and Peace and is made up of 23 qualitative and quantitative indicators from highly respected sources, including both factors that are internal to a country and others that are external to it. The GPI's indicators measure peace across three domains: the level of societal safety and security, the extent of ongoing domestic and international conflict, and the degree of militarization. The GPI is the world's leading index of national peacefulness, providing the most comprehensive data-driven analysis of trends in peace, economic value, and how to develop peaceful societies.

[2]The experiment was conducted using E-prime 2.0 (Schneider & Zuccoloto, 2007; Psychology Software Tools, Inc., Sharpsburg, PA, USA)

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**Disclosure Statement**

The authors state there are no conflict of interest.

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