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Emotional Categorization of the International Affective Picture System in a Colombian Sample

Categorización Emocional de las Imágenes del Sistema Internacional de Imágenes Afectivas en una Muestra Colombiana

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The International Affective Picture System (IAPS) is a battery of images used to induce discrete emotional reactions. In this study an IAPS subsample of 200 images was analysed to elicit discrete negative emotions and propose a new categorization of them, according to which discrete negative emotions (disgust, fear, sadness, or anger) they induce, in contrast to a dimensional model of emotion including emotional valence, intensity, and dominance, usually used in the literature. Through a sample by convenience, 447 participants of 3 universities in Bogotá, Colombia, were recruited and shown 60 IAPS images and asked them to what extent they felt fear, sadness, disgust, anger, happiness, or satisfaction when looking at each image. By using the overlap of 95% confidence intervals of the mean of 6 emotions ratings for every image, results revealed that 51.5% of images induced simple emotions (19.5% fear, 16.5% sadness, 13.0% disgust and 2.5% anger), 43% of images induced complex emotions, including more than one negative emotion, 1.5% emotions mixed one negative and one positive emotion, and 4% were undetermined emotions.

Keywords: emotion, Colombian sample, International Affective Picture System, emotional induction

El Sistema Internacional de Imágenes Afectivas (IAPS) es una batería de imágenes utilizadas para inducir diversas reacciones emocionales. En este estudio se analizó una submuestra de 200 imágenes del IAPS para inducir emociones negativas específicas y proponer una nueva categorización de ellas, según las emociones específicas que inducen (asco, miedo, rabia o tristeza), en contraste a un modelo dimensional de las emociones que incluye valencia, intensidad y dominancia emocional, usualmente utilizado en la literatura. Se reclutó por conveniencia a 447 participantes de 3 universidades de Bogotá, Colombia, a quienes se mostraron 60 imágenes del IAPS, preguntándoles en qué medida sentían miedo, tristeza, asco, rabia, felicidad o satisfacción al ver cada imagen. Al utilizar la superposición de intervalos de confianza del 95% de la media de 6 valoraciones de emociones para cada imagen, los resultados revelaron que el 51,5% de las imágenes indujeron emociones simples (19,5% miedo, 16,5% tristeza, 13,0% asco y 2,5% rabia), 43% de las imágenes, emociones complejas, incluyendo más de una emoción negativa, 1,5% emociones mixtas, incluyendo una emoción positiva y una negativa, y 4% emociones indeterminadas.

Palabras clave: emoción, muestra colombiana, Sistema Internacional de Imágenes Afectivas, inducciones emocionales

Our study aimed to provide a novel categorization of the negative valence images from the International Affective Pictures System (IAPS) using a Colombian sample. The IAPS is an 1182 images battery and it includes images with positive, negative, and neutral emotional valence. The IAPS was created to study controlled emotional reactions in laboratory settings for experimental psychology and emotion research (Lang, Bradley, & Cuthbert, 2008). Literature suggests that at least some IAPS images induce specific, discrete emotions, such as disgust or anger rather than broader affective reactions (Barke, Stahl, & Kröner-Herwig, 2012; Mikels et al., 2005). Recent studies used IAPS on emotional neurophysiological responses in psychiatric patients (Csukly, Farkas, Marosi, & Szabó, 2016; Hägele et al., 2016; Tajima-Pozo et al., 2018), emotion recognition (Fernández-Alcántara et al., 2016), regulation (Fitzgerald et al., 2016; Van Dongen, Van Strien, & Dijkstra, 2016), and memory (Pompili, Arnone, D'Amico, Federico, & Gasbarri, 2016), among others.

Originally, the IAPS has been used assuming a dimensional model of emotion, classifying emotional reactions according to three broad dimensions: valence (i.e., positive or negative), intensity (i.e., an intense

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or moderate reaction), and dominance (i.e., emotion that dominates a person's actions or is controllable) (Bradley, Codispoti, Cuthbert, & Lang, 2001; Bradley & Lang, 1994; Bradley, Miccoli, Escrig, & Lang, 2008; Lang et al., 1998). Despite the usefulness of this model, specifically allowing to observe emotional reactions in different cultural contexts and not relying on language stimuli (Bradley & Lang, 1994), this model is not exempt from limitations. First, characterizing emotional reactions according to these three broad categories does not allow for more specific approaches, taking into account the evolutionary advantages and appraisals of different discrete emotions (Ekman, 2003). A related limitation is that a dimensional classification fails to reflect the distinctions between different negative emotions with equal intensity and dominance. For instance, anger and disgust reactions, with equal intensity and dominance, are associated to contrary effects in the endowment effect (Lerner & Keltner, 2000; Lerner, Small, & Loewenstein, 2004). A recent review (Lerner, Li, Valdesolo, & Kassam, 2015) suggests that adopting a dimensional model of emotion limits the possible operationalization of emotions and would occlude discrete emotion effects in decision making. Indeed, authors point out that using qualitatively different discrete emotions allows for better explanatory power and narrower hypothesis than simpler dimensional models of emotion limited to valence, intensity, and dominance. A similar argument can be made for other research areas aiming to study its links with emotion (e.g., moral reasoning; Russell & Giner-Sorolla, 2011, 2013).

Discrete emotions models (Barke et al., 2012; Ekman, 2003; Mikels et al., 2005) assume that emotions are qualitatively different and that variation between them (e.g., between anger and disgust) cannot be reduced to variations in their valence, intensity, or dominance. A discrete emotion model does not contradict a dimensional model, but rather complements it (Harmon-Jones, Harmon-Jones, & Summerell, 2017). For instance, most discrete emotions can be classified dimensionally as having a positive or negative valence (e.g., anger and disgust have negative valence, whereas happiness and gratitude positive). Similarly, any discrete emotion can arise with varying degrees of intensity (e.g., being kind of sad or being very sad) and dominance (e.g., an irrepressible anger or controllable anger). However, studies in evolutionary psychology suggest that, despite these similarities, different emotions, such as anger, disgust, and fear, have specific evolutionary functions, entail specific behavioural consequences, exclusive appraisals, and unique facial expressions (Darwin, 1872; Ekman, 2003). Similarly, research in judgment and decision making reflects the specificities of qualitatively distinct emotions, suggesting that different emotions have different consequences in moral judgment (Cameron, Payne, & Doris, 2013; Landy & Goodwin, 2015; Russell & Giner-Sorolla, 2011; Russell & Piazza, 2015; Russell, Piazza, & Giner-Sorolla, 2013; Ugazio, Lamm, & Singer, 2012) and financial decision making (DeSteno, Li, Dickens, & Lerner, 2014; Han, Lerner, & Zeckhauser, 2012; Lerner et al., 2004; Lerner, Gonzalez, Small, & Fischhoff, 2003). Taken as a whole, these studies strengthen the importance of a discrete emotion model in research in judgment and decision making. Therefore, suitably designed materials to induce specific, qualitatively differentiable emotions is of paramount importance for this general research program (Harmon-Jones et al., 2017).

The IAPS has been extensively used and validated following a dimensional model of emotion (Constantinescu, Wolters, Moore, & MacPherson, 2017; Lang et al., 2008) in several countries (Barke et al., 2012), including Latin-American countries, like Chile (Dufey, Fernández Tapia, & Mayol, 2011; Silva, 2011) and Colombia (Gantiva Díaz, Guerra Muñoz, & Vila Castellar, 2011). These studies classify IAPS images following only a dimensional model of emotion. Nevertheless, some studies (Barke et al., 2012; Mikels et al., 2005) build up on this classification and propose a discrete emotion classification. Specifically, Mikels et al. (2005) recruited 60 American college students and presented them with a subset of IAPS images consistently classified as portraying negative emotions. After each image, students were asked to complete a series of seven-point scales about the emotion that each image elicited (anger, disgust, fear, and sadness). This study lead to a categorization of the IAPS according to discrete induced emotions, allowing researchers to use specific IAPS images to induce specific discrete emotions, such as fear or satisfaction, to be used as materials for in-lab studies.

Yet, there are some limitations to these findings. First, original results by Mikels et al. (2005) may not be directly applicable to samples outside the United States, because authors recruited exclusively United States participants. This limits the generalizability of their conclusions and, consequently, of their classification. This is especially relevant for several reasons. First, the IAPS includes several images (e.g., Ku Klux Klan members burning a cross) that presumably do not carry the same meaning for participants outside the United States. Second, emotional term translations may prove challenging, especially distinguishing culture-specific terms. Further, Mikels et al. (2005) failed to ask participants about both negative and positive emotions for each image, which excludes the possibility of determining whether

some images elicit mixed emotions (e.g., inducing sadness and happiness simultaneously). Finally, authors did not provide evidence about the intensity of the emotion induced by every image (Mikels et al., 2005). Briefly, this means that knowing that two images induce fear does not inform on how intense the fear induction is for each image. Yet, some studies (Schnall, Haidt, Clore, & Jordan, 2008; Ugazio et al., 2012) may require controlling for the intensity of the induced emotion on top of controlling for the discrete emotion induced. Our study addressed these limitations by asking for both positive and negative emotions for every image and by proposing a novel way to analyse data, in order to provide a ranking of how intense the emotional induction of each emotion is on a subset of negative images from the IAPS. We focused only on negative images.

Method

Participants

We recruited 447 participants (295 women, 3 undeclared; mean age 20.36, $SD = 2.74$) using a convenience sample in three public and private universities in Bogotá, Colombia (Universidad de los Andes, Universidad Externado de Colombia, and Universidad Nacional). All participants received partial course credit as incentive. Other than being an undergraduate student in one of these universities, being 18 years old or older, and being a native Spanish speaker, we did not set inclusion or exclusion criteria (see Table 1 for demographic information).

Table 1
Sample Demographics

Variable		*N*	%
Sex	Male	149	33.3
	Female	295	66.0
	Other/Would rather not say	3	0.7
Age	18	121	27.1
	19	89	19.9
	20	83	18.6
	21	45	10.1
	22	35	7.8
	23	23	5.1
	24	25	5.6
	25	6	1.4
	26	5	1.1
	27	4	0.9
	28	5	1.1
	29 or more	6	1.3
University	Universidad de los Andes	75	16.8
	Universidad Externado de Colombia	304	68.0
	Universidad Nacional	68	15.2
Religious affiliation	Roman Catholic	166	37.1
	Christian	42	9.4
	Evangelic	5	1.1
	Others	9	2.0
	Agnostic	28	6.3
	Atheist	15	3.3
	Don't feel identified with any of the above, but I consider myself a religious person.	112	25.1
	Don't feel identified with any of the above and I do not consider myself a religious person.	70	15.7

Instruments

International Affective Pictures System (IAPS). We selected the 200 images that induce negative valence, specific (e.g., anger only), and complex emotions (e.g., sadness and anger simultaneously), according to battery specifications (Mikels et al., 2005). In order to avoid mental fatigue (van der Linden, Frese, & Meijman, 2003) each participant was presented only 60 random images and answered six 7-point emotion rating scales (1 = *not at all*; 7 = *a lot*) about how strongly he/she felt a particular emotion (anger, disgust, fear, sadness, happiness, and satisfaction [rabia, asco, miedo, tristeza, felicidad, and satisfacción in Colombian Spanish]) when looking at each image. Emotion ratings and image order were randomized for every participant and every image. Images were presented continuously until the participant completed all scales.

Demographic questionnaire. We asked participants about their age, sex, university, and major they were enrolled in**.** We also included a self reported religiosity item in a 7-point Likert scale (Please tell us how religious you are: 1 = *No religious at all;* 4 = *Neutral;* 7 = *Strongly religious*) and self reported religious affiliation (Catholic, Christian, Evangelic, Episcopalian, Protestant, Muslim, Jewish, Hindu, Buddhist, Agnostic, Atheist, Not identified with any and I'm not a religious person and Not identified with any, but I am a religious person).

Procedure

We collected data in groups between 5 and 45 participants in computer rooms of the three universities, via an online survey. After giving their consent, answering a demographic questionnaire and viewing all 60 images in a random order, we debriefed participants and thanked them for their participation. To avoid emotional contagion, we instructed participants not to comment or react to any of the pictures aloud. To avoid excessive emotional reactions, we explicitly told participants that we would present them emotionally charged images that might make them uncomfortable. Also, we included similar sample images that did not belong to the IAPS in a training session and as basis for participants to decide whether or not to take part in the study. We did not exclude any participant and no one withdrew his/her participation for extreme emotional reactions to the images prior or during data collection or due to tiredness or other factors. There was no time limit for the whole participation nor for each image. Thus, we presented each image for as long as each participant took to answer all seven scales and click the next button for the next image to appear. Data collection took an average of 33 minutes per participant.

Data Analysis

For data analysis we closely followed Mikels et al. (2005). Each image was rated an average of 120 times. We computed the mean and 95% confidence interval (CI) of all six emotions ratings for every image. We determined categorization using the overlap of 95% CIs. For a given image, if the highest mean and CI did not overlap with any other CI, we classified the image as a simple emotion image (see Figure 1). If the highest mean and CI overlap with one or two other CIs, we classified the image as a complex emotion image (see Figure 2). If all negative emotion CIs overlap, we classified the image as undetermined emotion (see Figure 3). Finally, if the highest CI overlaps with a positive emotion's CI (i.e., happiness or satisfaction) we classified the image as a mixed emotion (see Figure 4). See Table 2 for a list of all simple emotion images.

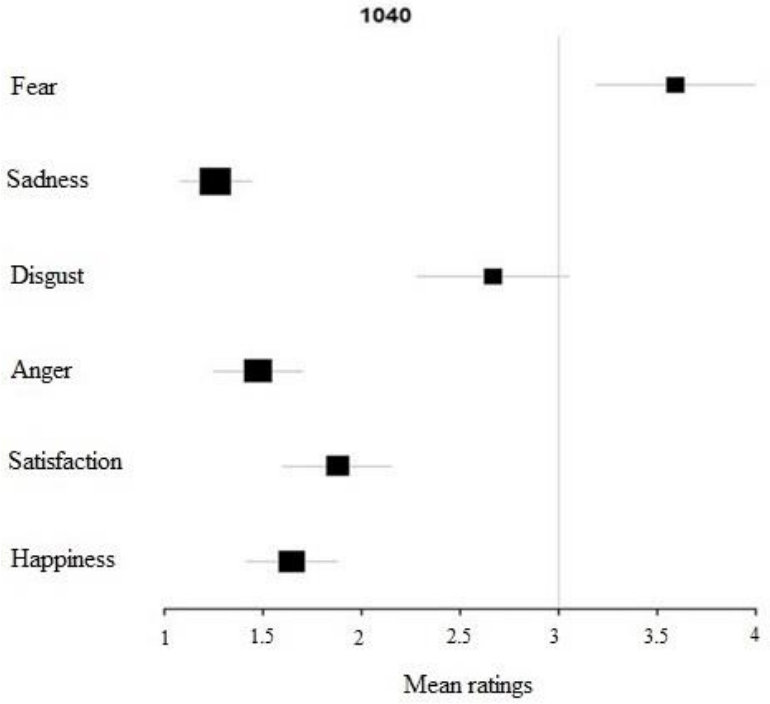

Figure 1. Mean ratings and 95% CI for image 1040 classified as simple emotion: fear. The vertical line shows a benchmark rating of 3 in all ratings.

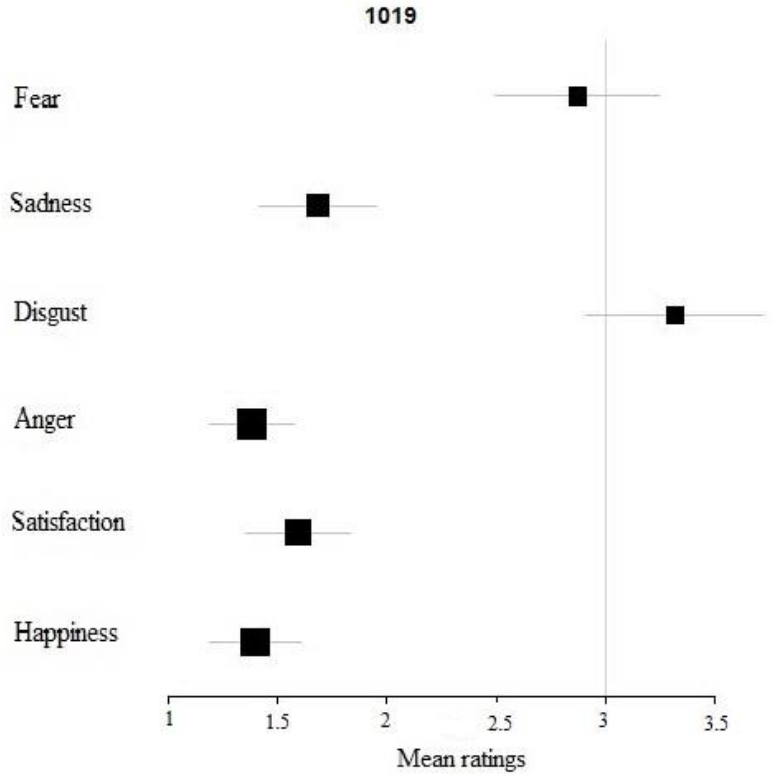

Figure 2. Mean ratings and 95% CI for image 1019 classified as complex emotion: disgust and fear. The vertical line shows a benchmark rating of 3 in all ratings.

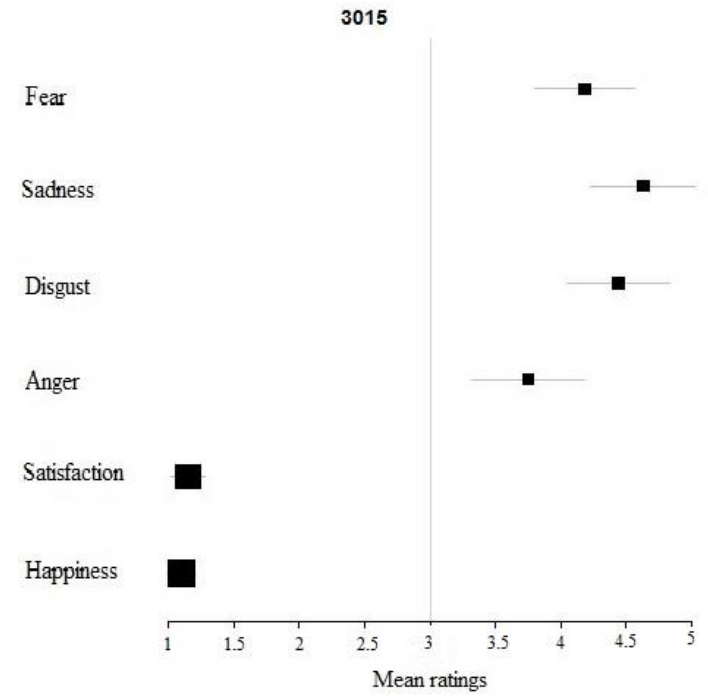

Figure 3. Mean ratings and 95% CI for image 3015 classified as undetermined emotion. The vertical line shows a benchmark rating of 3 in all ratings.

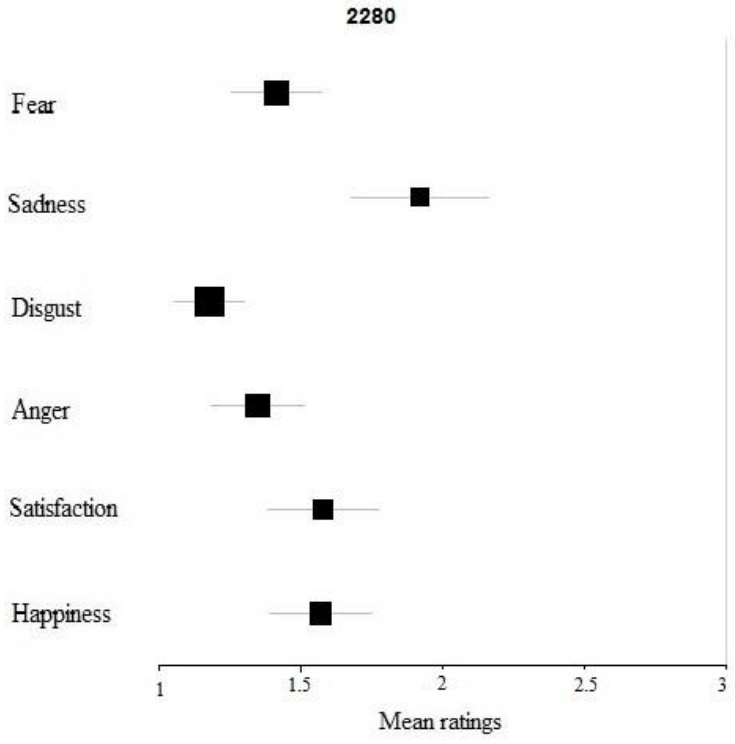

Figure 4. Mean ratings and 95% CI for image 2280 classified as mixed emotion. The vertical line shows a benchmark rating of 3 in all ratings.

Table 2
Upper and Lower 95% CI for the Main Emotion and Final Categorization of All Simple Emotion Images

Image	Upper limit of 95% CI	Lower limit of 95% CI	Main emotion
1022	4.01	3.21	Fear
1030	3.46	2.69	Fear
1040	3.99	3.19	Fear
1050	4.12	3.34	Fear
1051	3.86	3.11	Fear
1052	4.21	3.40	Fear
1070	4.03	3.22	Fear
1080	3.58	2.79	Fear
1090	3.51	2.77	Fear
1110	3.56	2.75	Fear
1111	4.83	4.04	Disgust
1113	3.96	3.18	Fear
1120	3.98	3.22	Fear
1270	4.92	4.14	Disgust
1274	5.21	4.42	Disgust
1275	5.16	4.35	Disgust
1280	5.38	4.57	Disgust
1300	4.34	3.59	Disgust
1301	3.71	2.95	Fear
1302	3.68	2.99	Fear
1321	3.41	2.73	Fear
1930	4.69	3.91	Fear
1931	4.25	3.45	Fear
1945	4.13	3.31	Disgust
2053	5.24	4.46	Sadness
2100	2.74	2.06	Fear
2110	2.53	1.93	Fear
2120	3.46	2.76	Fear
2141	5.18	4.52	Sadness
2205	5.55	4.88	Sadness
2271	2.43	1.81	Sadness
2276	4.84	4.10	Sadness
2312	4.19	3.39	Sadness
2490	3.96	3.19	Sadness
2520	3.69	2.94	Sadness
2590	3.70	3.01	Sadness
2692	4.75	3.95	Fear
2700	4.13	3.49	Sadness
2710	4.86	4.13	Sadness
2750	4.48	3.77	Sadness
2800	5.90	5.27	Sadness
2900	4.77	4.00	Sadness
3000	5.79	5.12	Disgust
3022	2.94	2.30	Fear
3060	5.24	4.51	Disgust
3071	5.16	4.39	Disgust
3080	5.18	4.45	Disgust
3140	5.29	4.58	Disgust
3150	5.59	4.84	Disgust
3220	5.53	4.86	Sadness
3230	5.44	4.79	Sadness
3250	4.81	4.02	Disgust

(continues)

Table 2
Upper and Lower 95% CI for the Main Emotion and Final Categorization of All Simple Emotion Images (Conclusion)

Image	Upper limit of 95% CI	Lower limit of 95% CI	Main emotion
3300	5.18	4.48	Sadness
3301	6.03	5.45	Sadness
3350	5.30	4.58	Sadness
3400	5.33	4.60	Disgust
5970	4.38	3.57	Fear
5971	4.77	4.07	Fear
5972	4.70	3.96	Fear
6020	4.49	3.69	Fear
6190	4.28	3.48	Fear
6210	3.91	3.18	Fear
6230	4.63	3.86	Fear
6250	4.09	3.34	Fear
6260	4.28	3.53	Fear
6300	5.15	4.44	Fear
6312	4.96	4.23	Anger
6370	4.73	3.94	Fear
6560	6.09	5.45	Anger
6834	5.44	4.80	Anger
6836	4.23	3.47	Anger
7360	5.05	4.31	Disgust
7361	5.05	4.29	Disgust
7380	5.99	5.38	Disgust
8010	3.28	2.63	Sadness
8480	3.64	2.93	Fear
9040	5.92	5.34	Sadness
9042	4.71	3.91	Disgust
9050	5.25	4.57	Sadness
9080	3.76	3.01	Fear
9182	5.17	4.43	Sadness
9190	3.03	2.39	Sadness
9210	3.38	2.71	Sadness
9250	5.23	4.52	Sadness
9290	5.08	4.36	Disgust
9300	6.60	6.16	Disgust
9320	6.43	5.92	Disgust
9331	3.58	2.90	Sadness
9373	4.18	3.40	Disgust
9390	3.56	2.85	Disgust
9400	4.78	4.00	Sadness
9405	5.44	4.78	Disgust
9415	5.40	4.73	Sadness
9421	5.24	4.53	Sadness
9433	5.05	4.29	Sadness
9561	6.21	5.69	Sadness
9582	3.88	3.14	Disgust
9584	3.80	2.98	Disgust
9592	3.58	2.88	Fear
9594	3.66	2.82	Fear
9620	4.75	4.05	Fear
9800	4.27	3.50	Sadness
9921	4.65	3.88	Sadness

Also following Mikels et al. (2005) suggestions, we tried to determine the intensity of the emotional induction for every image relative to the mean induction intensity for every emotion. This allows researchers to determine not only which specific emotions are induced by any given image, but also the intensity of that emotional induction. In order to do that, we computed a series of one-sample two-tailed *t* tests using Bonferroni correction, comparing average scores for every image and every emotion to average score of that emotion across all images. These tests and corresponding effect sizes allow for the direct comparison of the strength of any emotional induction relative to the mean induction intensity for that emotion. This information, as well as the full proposed categorization, is available through the Open Science Framework (OSF). See OSF (https://osf.io/m3ywx/) for raw data, data analysis scripts, emotional categorization and a complete categorization of emotional inductions for all images.

Results

Our first procedure resulted in 103 images (51,5%) that we categorized as inducing a simple categorical emotion, 86 images (43%) as inducing a complex emotion, eight images (4%) as undetermined negative emotions and three images (1,5%) as mixed emotions. Specifically, 39 images (19,5% of all images) induced fear, 33 (16,5% of all images) induced sadness, 26 (13% of all images) induced disgust and only five (2,5% of all images) induced anger (see Table 3).

Table 3
Final Classification Compared to Mikels et al. (2005)

Induced emotion	This study		Mikels et al. (2005)	
	N	%	*N*	%
Simple	103	51.5	85	41.9
Fear	39	19.5	12	5.9
Sadness	33	16.5	42	20.7
Disgust	26	13.0	31	15.3
Anger	5	2.5	0	0.0
Complex	86	43.0	48	23.6
Mixed	3	1.5	-	-
Undetermined	8	4.0	70	34.5
Total	200	100	203	100

In Table 4 we present a sample summary for mean emotional ratings and whether they differ from 3 for a subsample of five images. For instance, image 1022 exhibits a relatively strong disgust induction, since its disgust score is different from the mean disgust induction for all the images and its effect size is large, $t(446) = -33.31$, $p < 0.001$, Cohen's $d = 0.71$, but exhibits a much stronger fear induction, Cohen's $d = 1.82$ (see Table 4). On the contrary, image 1111 exhibits a strong anger induction, $t(446) = -29.225$, $p < 0.001$, Cohen's $d = 2.84$.

Table 4
Descriptive Statistics for All Emotion Ratings in a Subsample of Five Images

Image	Emotion	Image mean rating	Image *SD* rating	Emotion mean	Emotion *SD*	Cohen's *d*	*t*	*p*
Image 1019	Fear	2.87	2.17	3.14	1.255	1.03	-35.92	0.166
	Sadness	1.68	1.56	3.06	1.022	-0.68	-48.41	< 0.001
	Disgust	3.31	2.35	2.48	0.841	1.76	-29.51	0.429
	Anger	1.38	1.10	2.71	0.996	-1.19	-53.20	< 0.001
	Satisfaction	1.59	1.39	1.32	0.415	0.13	-29.21	< 0.001
	Happiness	1.39	1.22	1.27	0.346	-0.21	-32.80	< 0.001
Image 1022	Fear	3.61	2.27	3.14	1.255	1.82	-34.11	0.029
	Sadness	1.18	0.65	3.06	1.022	-2.48	-76.44	< 0.001
	Disgust	2.40	2.09	2.48	0.841	0.71	-33.31	< 0.001
	Anger	1.32	1.04	2.71	0.996	-1.32	-54.77	< 0.001
	Satisfaction	1.75	1.53	1.32	0.415	0.40	-26.86	< 0.001
	Happiness	1.73	1.52	1.27	0.346	0.36	-27.05	< 0.001
Image 1030	Fear	3.07	2.28	3.14	1.255	1.29	-34.48	0.720
	Sadness	1.08	0.38	3.06	1.022	-3.27	-91.10	< 0.001
	Disgust	2.09	1.97	2.48	0.841	0.33	-35.20	< 0.001
	Anger	1.22	0.86	2.71	0.996	-1.69	-60.38	< 0.001
	Satisfaction	2.32	1.99	1.32	0.415	1.22	-20.84	< 0.001
	Happiness	2.25	1.98	1.27	0.346	1.16	-20.74	< 0.001
Image 1111	Fear	3.07	2.28	3.14	1.255	1.29	-34.48	0.720
	Sadness	3.36	2.31	3.15	1.255	1.59	-33.97	0.316
	Disgust	1.19	0.76	3.07	1.022	-2.26	-71.82	< 0.001
	Anger	4.44	2.27	2.48	0.841	2.84	-29.23	< 0.001
	Satisfaction	1.34	1.11	2.71	0.996	-1.24	-53.06	< 0.001
	Happiness	1.32	0.96	1.32	0.415	-0.60	-39.22	< 0.001
Image 1274	Fear	2.96	2.27	3.15	1.255	1.17	-34.84	0.345
	Sadness	1.06	0.34	3.07	1.022	-3.43	-93.97	< 0.001
	Disgust	4.81	2.36	2.48	0.841	3.26	-27.96	< 0.001
	Anger	1.54	1.37	2.71	0.996	-0.75	-46.96	< 0.001
	Satisfaction	1.11	0.63	1.32	0.415	-1.42	-52.28	< 0.001
	Happiness	1.13	0.70	1.27	0.346	-1.31	-50.32	< 0.001

Note. All t tests compare observed ratings to 3.

Conclusions

The main purpose of our study was to offer a new categorization of a subset of images from the IAPS (Lang et al., 2008) in a Colombian convenience sample. The IAPS has been widely studied in Latin-American contexts (Dufey et al., 2011; Gantiva Díaz et al., 2011; Silva, 2011). However, these studies assume a dimensional model of emotion that classifies emotional induction according to valence, intensity, and dominance (Constantinescu et al., 2017; Lang et al., 2008) which might limit its usability to induce discrete emotions in experimental settings (Lerner et al., 2015). Here, we offer an alternative categorization of the IAPS images following a discrete emotions model that assumes that emotions are qualitatively different but that can also be characterized beyond their perceived valence, intensity and dominance. This model of emotion is preferred for research in judgment and decision-making since it allows for better predictive power and specific hypothesis testing (Lerner & Keltner, 2000; Lerner et al., 2015).

Following limitations in previous studies, we observed both positive and negative emotional ratings about all images and offered quantitative evidence on the intensity of emotional inductions for every image and emotion induction. Results exhibit a limited correspondence between Colombian and United States convenience samples in images categorization. In fact, we observed more images inducing exclusively fear and anger than previous studies. In addition, we obtained more complex and less undetermined emotion images than United States based study. These results cannot only be explained by larger statistical power in

our study due to larger sample size compared to Mikels et al. (2005). Indeed, a larger statistical power would apply across all categories and emotions and would imply more images across all simple emotion categories. However, we did not observe more sadness and disgust images than Mikels et al. (2005) did, but did observe more complex images (i.e., images that induce a maximum of two simultaneous negative emotions). This suggests that discrepancies between the United States and Colombian samples are not due to simple statistical power differences between samples, but rather to cultural differences in how participants interpret IAPS images. Future work should build up on these results to determine how disgusting and sad images, as opposed to scary and angering ones, are interpreted in both cultural contexts, which may shed some light into this puzzling pattern of results. Additionally, our results suggest that at least some images are too complex for a clear-cut induction of a simple emotion. Rather, these images reflect complex and nuanced emotional reactions. Future research could apply qualitative methods to determine exactly the type of emotional reactions the complex emotion images cause and the specific features that might reliably induce simple and complex emotions.

Limitations

A possible limitation of our study is using a convenience sample of university students in Bogotá, Colombia. Indeed, it is possible that this sample limits the external validation of our results to samples with different life experiences (e.g., rural versus urban population) or education levels, even within Colombian society. Given that most experimental studies in decision making recruit these convenience samples (Henrich, Heine, & Norenzayan, 2010), we believe that the first step in validating these materials is using a university students convenience sample. Future studies should adapt this methodology to diverse populations prior to using these images for experimental purposes.

Also, our study was limited to images inducing negative emotions based on previous studies (Mikels et al., 2005). At first sight, this procedure might have biased our results by sensitizing participants to negative emotions along data collection. However, random order of image presentations controls for this possible bias at the image level. It is true that for every individual, responses at the end of data collection might be, in average, slightly different than those at the beginning of data collection, because of chronic induction of negative emotions or simple fatigue due to the high number of responses elicited. However, since we presented the images at random to participants, each image was seen equally as frequently at the beginning and at the end of data collection which, overall, controls for this bias, as well as order and learning effects in general.

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