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ORIGINAL ARTICLE

SocialPICS: A Novel Validated Database of Socioeconomic-Content Images

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Abstract

The present study developed and validated an image database, SocialPICS, with information of socioeconomic status (SES) and affective space (i.e., valence and arousal). Images were selected from public-domain websites and a pilot study pre-selected the images to compose the database. A sample of 132 participants (mean age = 24.3 ± 9.4; 61% women, 36% men, and 3% other) responded a questionnaire and rated the SES, the valence, and the arousal of the images displayed. Results showed that the instrument is validated for the Brazilian context. The image dataset covers a broad range of SES levels in a continuum ranging from lower- to higher-status images and provides subsets of images in a categorical classification (high, medium, and low). In addition, the affective space analysis showed that SES image ratings are positively associated to valence, and negatively associated to arousal. It is likely that SocialPICS portraits social differences regarding power, prestige, and control of resources that SES status communicates. As a theoretical outcome, we argue that SES images are emotional images. SocialPICS is a novel, high-quality resolution, standardized database of 429 SES static images composed of 136 human action images, 157 clothing images, and 136 landscape images. These three subsets comprise stimuli usually employed by researchers in social cognition and neuroscience. Its use should simplify and favor original and replication studies with a higher level of standardization and control over visual SES-content stimuli. Information on physical proprieties is provided for each image. Download SocialPICS: https://osf.io/3t9r2/.

Keywords Image database · Socioeconomic status · Social status · Affective visual stimuli · Social cognition

We rely on our sensory systems to navigate the world and, like other social animals, we extract sensorial information about the ones we interact with in everyday life. For example, when we have a job interview, our evaluation on the facial movements of the

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recruiter, such as a smile, or a look to our dirty shoes, trigger cognitive processes and behaviors in response to the interaction with the interviewer to analyze our chance of approval for the work position. Thus, our social perception is affected by the target (i.e., the person we are interacting with), by the observer (i.e., ourselves), by the context in which both are inserted, and by their interaction (Hehman et al., 2019; Mattan et al., 2017). The human visual system has evolved as an efficient pattern classifier for facial and corporal cues such as: moving faces and bodies, eye gaze, audiovisual combination of speech, identity, race, ethnicity, and emotions, along with social status (Jack & Schyns, 2017; Pitcher & Ungerleider, 2021). Moreover, neurological studies showed brain regions specialized for social processing in nonhuman primates and humans, mainly in the superior temporal sulcus (Gangopadhyay et al., 2020; Sadeghi et al., 2022). In addition to these visual inputs, we use prior knowledge organized into categories to comprehend our social experiences rapidly and accurately (or adaptly), which could lead us to stereotypic associations and prejudice (Allidina & Cunningham, 2023; Bodenhausen and Richeson, 2010; Kawakami et al., 2021).

In this context, social status or position of an individual or group symbolizes prestige, control of resources, and power. It is not easy to define this concept, as it is constituted by financial, fitness, intellectual, and moral elements (Diemer et al., 2013; Mattan et al., 2017, 2019). Therefore, socioeconomic status (SES) is conceived in psychology as a multidimensional construct, which might rely on objective (e.g., income and educational level) and subjective measures (e.g., the MacArthur Scale of Subjective Social Status, that evaluates individual's perceived position in social hierarchy, Adler et al., 2000). Both measures are fundamental to explain our social interactions (see Easterbrook et al., 2020; Manstead, 2018; Navarro-Carrillo et al., 2020).

Different theoretical frameworks elucidate SES information processing. A race perception study conducted by Freeman et al. (2011) presented a neural network model of person categorization and the role of high- and low-level inputs in SES categorization. They argue in favor of a continuous back and forth activation of lower- and higher-level input. The model's connectionist pattern suggests that, as the race codification unrolls, there will be activation of two divergent routes composed by activation and restriction flow pathways. For instance, one factor may become more relevant activating one pathway (e.g., social status cues), and restricting the other (e.g., skin color). Moreover, perception can be modulated by high-level cognitive operations. Otten et al. (2017) proposed that priors and likelihood are two top-down streams that influence our perception in multiple hierarchical levels. Memories, goals, emotional states, and other cognitive contexts compose the base priors, while the sensory inputs provide ongoing feedback of the errors and mismatch on the predictive signal sent in any part of the hierarchical level. These results are supported by studies showing a specialized neural circuitry for status-based evaluation, which involves social-selective cortical regions: amygdala, intraparietal sulcus, hippocampus, superior temporal sulcus, ventromedial prefrontal cortex, superior temporal gyrus, anterior temporal lobe, and ventral striatum (Mattan et al., 2018).

Accordingly, visual basic information is used as SES cues, being part of our emotional perception, trait attribution (e.g., trustworthiness, intelligence) and social

categorization processes (Brambilla et al., 2018; Chaney et al., 2021; Lange et al., 2022; Mattavelli et al., 2022, 2023; Stolier et al., 2020). For instance, Freeman et al. (2011) demonstrated that race categorization was influenced by the clothing of the face of a graphic model (i.e., a computer-generated face). Low SES attire (e.g., blue-collar outfit) increased the likelihood of categorization as black, while high SES attire (e.g., suit and tie) increased the likelihood of categorization as white. Such influence grew stronger as the race became more ambiguous. In another study, faces in a morphing continuum ranging from Asian to White faces were presented to US-American and Chinese participants in their home countries. The faces were embedded in a typically US-American, neutral, or typically Chinese landscape, and the participants were asked to judge each face ethnically. For both nationalities, a face was more likely to be categorized as Asian or White when in an Asian or US-American context, respectively (Freeman et al., 2013). These two studies are among the first to reveal a complex intersection of dimensions for social categorization (see Petsko et al., 2022).

Recently, studies have shown that high social status individuals are commonly more positively perceived (vs. low social status) in many sceneries (Brown-Iannuzzi et al., 2019; Dupree et al., 2021, Mattan et al., 2019; Moore-Berg & Karpinski, 2019; Urbiola et al., 2022). Nevertheless, in situations where status is strictly defined in terms of wealth or power (i.e., control over resources), the hierarchy shifts, and high-status is negatively perceived (Mattan et al., 2017). Thus, further investigation is needed to elucidate the emotional evaluation of SES along the affective dimensions of valence (i.e., negative–positive) and arousal (relaxed-aroused), which are subserved by distinct neural networks (see Wade-Bohleber et al., 2020).

Emotional databases describe an inverse relation between valence and arousal in general, i.e., positive evaluated images are commonly categorized as more relaxing, and negative images as highly arousing (Dan-Glauser & Scherer, 2011; Haberkamp et al., 2017; Marchewka et al., 2014; Redies et al., 2020; for an exception see Lang et al., 2008). In the experimental psychology and cognitive neuroscience fields, there are several databases of emotional images available (e.g., International Affective Picture System – IAPS, Lang et al., 2008; Nencki Affective Picture System – NAPS, Marchewka et al., 2014; Erotic subset for the Nencki Affective Picture System – NAPS ERO; Wierzba et al., 2015; DIsgust-RelaTed-Images – DIRTI, Haberkamp et al., 2017), including stimuli with discrete or dimensional emotional states (e.g., FACES, Ebner et al., 2010; Karolinska Directed Emotional Faces – KDEF, Goeleven et al., 2008; Chicago Face Database – CFD, Ma et al., 2015), and highly aroused positive images (e.g., erotic images in IAPS and NAPS ERO). However, to our knowledge, there is no image database that presents socioeconomic validation, neither in Brazil, that faces many social inequalities (Brazilian Institute of Geography and Statistics – IBGE, 2022), nor elsewhere.

Social neuroscience and cognition studies have been utilizing their own images of landscapes and clothing with SES cues for their studies (Freeman et al., 2011, 2013, 2015; Oh et al., 2019; Ratcliff et al., 2011). However, there is no open source, standardized, and validated set of SES images available. The employment of lab-made SES pictorial stimuli hampers the replicability and comparability among studies. In addition, a stimuli set must be tailored for its cultural, social and economic context

given the high wealth inequality among nations (Cikara et al., 2022). Therefore, it is important to develop instruments and experiments adapted to the Brazilian context, that could be different compared to countries of the global north (for instance, see Antunes et al., 2023). In light of the growing field of the social cognition and neuroscience, and given the importance to provide methodological tools for its investigation, we aimed at developing and validating an image database, SocialPICS, with information of socioeconomic status (SES) and affective space (i.e., valence and arousal).

Method

The present study is divided into two parts: (1) development and validation of SocialPICS, and (2) investigation of the association between SES and the affective space. First, we provided a high-quality static image database with information of SES and affective space (i.e., valence and arousal), the SocialPICS database (available at https://osf.io/3t9r2/). We built and validated 429 images with SES information in three categories: Actions (i.e., an action or situation, performed by people in everyday tasks); Clothing (i.e., torsos with attire in the focus of the image, with a faceless gray mannequin); and Landscapes (i.e., places of social spaces, public or private, especially buildings in urban spaces, which may contain people, but these are not in the focus of the figure). SocialPICS covers a broad range of SES levels in a continuum ranging from lower to higher-status images, and also provides subsets of images in a categorical classification of SES (high, medium and low) for Actions, Clothing, and Landscapes. In addition, we provided stimuli's physical main proprieties for the users. Finally, we investigated the association between SES and the affective space, providing evidence that SES images are emotional, i.e., positively associated to valence, and negatively associated to arousal.

Stimuli

Images were selected from online websites by ABSMA, or shot by ABSM, RRS, and RMJ. The images were selected to compose three main categories (i.e., image subsets): Actions, Clothing, and Landscapes. On the selection of stimuli, high, medium, and low SES were considered and categorized by the authors. To compose the database in the Landscapes category, the keywords *skyscraper*, *urban*, *warehouse*, *parking*, *living room*, *poverty*, *favela*, and others were used in the searches of the images on the Internet. The Actions keywords were *industrial*, *homeless*, *sweeper*, *business*, *cooking*, and others. Clothing keywords were *overalls*, *t-shirts*, *jacket*, *suit*, *formal wear*, *jacket*, *polo shirt*, *plaid shirt*, *uniform*, *blazer*, *overcoat*, *tank tops*, and others.

We selected 585 images from our search in 10 public-domain websites, (*pixabay.com*, *pexels.com*, *unsplash.com*, *morguefile.com*, *picjumbo.com*, *imagebase.net*, *freepik.com*, *pngwing.com*, *pngpix.com*, *dlpng.com*). As selection criteria, the images should contain the following: (1) little or no writing/alphanumeric inscriptions; (2) little or no geographic cues; and (3) little or no advertisement or logos.

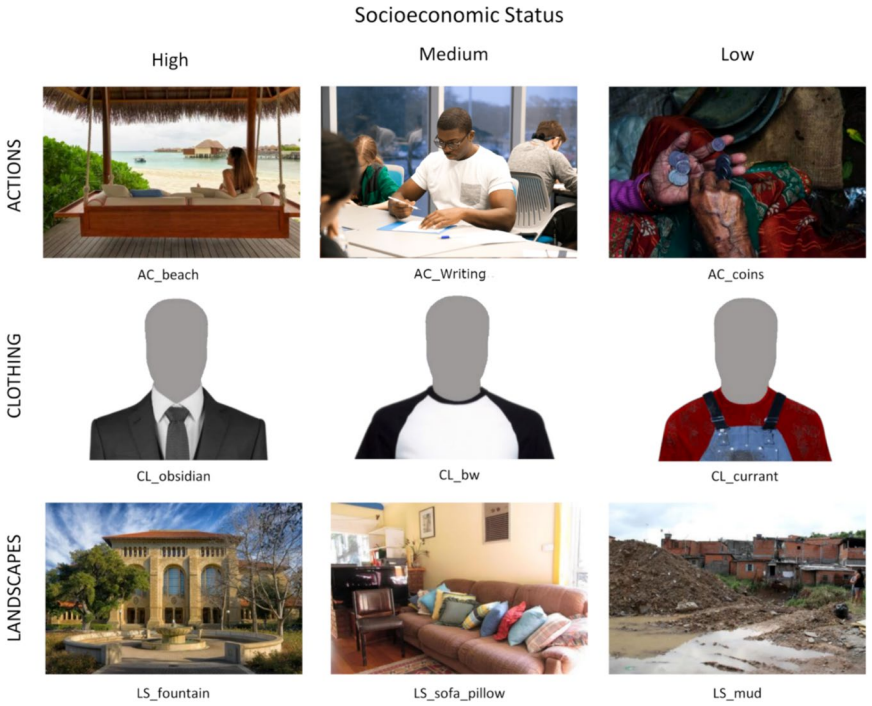
To fit the criteria, some images were edited using Photoshop (Adobe Inc., San José, USA). Due to the difficulty in finding culturally matched Landscape images of medium SES, the authors shot photos in the Brasília area (Federal District, Brazil) and selected 26 images to compose the image set. All selected Actions and Landscape images are horizontally oriented with a resolution of 1920 × 1280 pixels (some images were edited to fit the height and width by adding a gray frame). For the elaborations of the Clothing subset, the images were selected if they meet two additional criteria as follows: (1) they should be frontal; and (2) the view of the collar and shoulders should be free of logos, hair, accessories, or other objects. Some of the images were edited by adding socioeconomic cues arranged on the garment (e.g., stains or small logos of a truck or a broom). These symbols were taken from the same websites as the garments and were not associated to any brand or company. Clothing images are vertically oriented with a resolution of 581 × 563 pixels.

The final and validated dataset (see the "Results" section) comprises 429 socioeconomic images (Actions = 136, Clothing = 157, and Landscapes = 136). For each image we provide median ratings of SES, valence, and arousal. SocialPICS also provides stimuli's physical proprieties for those interested or in need of low-level visual information: mean channel values in CIE L*a*b color space, grayscale luminance, grayscale contrast, and JPEG file size (as a measure of complexity). In addition to the original database, SocialPICS is also available in a grayscale version with normalized luminance and contrast per stimuli subset. Figure 1 exemplifies images of the three categories (Actions, Clothing, and Landscapes) in the three levels of SES (high, medium, and low). All images and their information are available and can be downloaded from https://osf.io/3t9r2/.

Pilot

In order to exclude images with ambiguous or highly discrepant evaluation of SES, we performed a pilot study to pre-select the images to compose the image database. All 611 selected images were presented to a convenience sample of 10 participants [four women; Mean (M) = 28.25 years, standard deviation (SD) = 3.89; and six men; M = 27.50 years, SD = 3.89]. Volunteers reported normal or corrected-to-normal visual acuity. They had to answer "What level of socioeconomic status do you assign to this image?" using a 9-point Likert scale. All the images were rated for all the participants and the responses were computed in an electronic spreadsheet. The selection of images in the pilot was based on the following: (1) the percentage of agreement (PA; Alexandre & Coluci, 2011), and (2) the SD of the average SES for each image.

The first criterion was based on the PA of socioeconomic level. The ordinal responses were categorically transformed to one of the SES levels: high, medium, or low. To establish the status levels, evaluations ranging from 7 to 9 were categorically defined as a high SES, 4–6 as medium SES, and 1–3 as low SES. The PA was calculated for each image by dividing the response frequency of the most frequent category by the total number of participants and multiplying the ratio by 100 [$PA = (category\ frequency/10) \times 100$]. Images were selected when they



Note. The median image ratings for socioeconomic status (SES), valence (V), and arousal (A) are as follows: AC_beach: SES = 93, V = 96, A = 3; AC_writing: SES = 55, V = 70, A = 24; AC_coins: SES = 5, V = 7, A = 70; CL_obsidian: SES = 85, V = 51, A = 38; CL_bw: SES = 50, V = 51, A = 39; CL_currant: SES = 18, V = 50, A = 50; LS_fountain: SES = 100, V = 91, A = 14; LS_sofa_pillow: SES = 50, V = 74, A = 19; LS_mud: SES = 1, V = 1, A = 89.

Fig. 1 Examples of high, medium, and low socioeconomic status images from SocialPICS

reached a minimum PA[1] of 50%. The second criterion was based on the SD of the average rating of the SES responses. Images were selected if they had an SD lower than two. Thus, 182 images were excluded due to extreme deviation from the average and low PA.

We then created a list of the images that best represented the status levels (high, medium, or low) in each category. In all, 429 images were selected (Actions = 136, Clothing = 157, and Landscapes = 136). All data of the pilot

[1] Marchewka et al. (2014) performed an assessment of three trained judges to fit the stimuli in five emotional categories and reached 99% agreement. Ebner et al. (2010), Ma et al. (2015), and Haberkamp et al. (2017) resorted to judges' evaluations but did not report their criteria. Only Marchewka et al. (2014) reported their Percentage of Agreement (PA). In our study, we set a loose PA since SES is a subjective construct and there is no correct category for a dimensional evaluation. Nevertheless, we adopt standard deviation as an additional parameter for stimulus ambiguity.

study is available in pilot_exclusion_analysis.xls in the Supplementary information at https://osf.io/3t9r2/.

Participants

We considered the following as eligibility criteria: being Brazilian, be 18 years or older, and have normal vision. Volunteers were recruited via online social media, and on message boards of the university facilities. Sample size was set considering a minimum of ratings each image should achieve ($n = 40$). Thus, a total of 132 participants ranging from 18 to 64 years old (M = 24.31, SD = 9.36) took part in the study. Table 1 summarizes sociodemographic characteristics of the sample. All participants were selected to take part conveniently, reported normal or corrected-to-normal visual acuity, and are from Brazil's Midwest region. Moreover, participants read and agreed to the informed consent form approved by the Human and Social Sciences Research Ethics Committee of the University of Brasília (CAAE: 30,539,820.9.0000.5540).

Procedure

All participants were randomly allocated to one of the following groups: Actions ($n = 43$), Clothing ($n = 45$), and Landscapes ($n = 44$), and rated all the images of

Table 1 Sample ($n = 132$) characterization regarding sociodemographic variables

Sociodemographic variable		*n*	%
Gender			
	Women	81	61.36
	Men	47	35.61
	Other	4	3.03
Age (M = 24.30; SD = 9.32)			
	≤ 24	103	78.03
	25–34	17	12.88
	35–44	3	2.27
	45–54	5	3.79
	≥ 55	4	3.03
Race			
	Asian	1	0.76
	White	70	53.03
	Indigenous	1	0.76
	Mixed race	41	31.06
	Black	19	14.39
Education level			
	Elementary school	3	2.27
	High school	22	16.67
	Undergraduate	82	62.12
	Graduate	25	18.94

their respective category[2] (approximately 145 images). The PsyToolkit (Stoet, 2010, 2017) presented the images and collected the responses online and individually. To better adjust the image display on a variety of monitors in an online setting, stimuli were presented at a resolution of 780 × 520 pixels for Actions/Landscapes images and at a resolution of 581 × 563 for Clothing images. This encompasses 21.2 × 14.4 and 15.7 × 15.2 degrees of visual angle (width × height) for Actions/Landscapes and Clothing, respectively, when considering a 13.3-inch screen 40-cm away from the observer.

After providing informed consent, participants were told that the study was investigating SES and affective aspects depicted in an image. A definition of high, medium, and low SES was presented to the participant based on the MacArthur scale (Adler et al., 2000), and followed by three images illustrating each level of SES. Subsequently, the questionnaire started, and each image was presented one at a time, centered at the top of page, and three 0–100 sliding scales were presented below each image. In the first scale, participants were asked "What level of socioeconomic status do you assign to this image on a scale of 1 (low status) to 100 (high status)?". In the second scale, participants were asked to "Complete the sentence 'When you see this image, you rate it as …' (from 1 = unpleasant/negative to 100 = pleasant/positive, with 50 = neutral)". And in the third scale, participants were asked to complete the sentence: "Confronted with this image, you are feeling: … (from 1 = calm/relaxed to 100 = excited/aroused, with 50 = neutral/ambivalent)". In order to respond, the participants had to move a circle over a horizontal axis using the cursor. The first image, along its scales, that was presented right after the instructions was not part of SocialPICS and was used for training purposes. The questionnaire was self-paced and lasted approximately 60 min. The detailed instructions are available as Supplementary information.

Results

No data were lost during data collection or excluded during data analysis. Each image of the dataset was considered as a case in the statistical analysis. On average, each image was rated by 44 participants. No images were excluded from the image dataset after the pilot study. Descriptive statistics for the ratings of SES, valence, and arousal in the three stimuli subsets (i.e., Actions, Clothing, and Landscapes) are summarized in Table 2. Ratings did not fit a normal distribution as evidenced by the Shapiro–Wilk normality test. Data distribution was also checked by density plots, Q-Q plots, and the Anderson–Darling goodness-of-fit test. Thus, the median rating of SES, valence, and arousal was taken as the response variable. All statistical analysis was conducted using Microsoft Excel (Microsoft Corp., Redmond, USA) and

[2] In validation studies of datasets containing a large number of images, participants often rate a subset of images: 41 of 490 images in Goeleven et al., (2008), 362 of 1,356 images in Marchewka et al. (2014), 95 of 1128 images in Zamora et al. (2020), 10 of 158 images in Ma et al. (2015), and 200 of 10,696 images in Kim et al. (2018), for example.

Table 2 Socioeconomic status, valence, and arousal of the three categories of images

	Socioeconomic Status				Valence				Arousal			
Stimuli	*Md*	*IQR*	*M*	*SD*	*Md*	*IQR*	*M*	*SD*	*Md*	*IQR*	*M*	*SD*
Actions	53.28	21.11	53.98	15.07	61.71	30.32	61.27	21.17	39.85	33.90	38.64	23.53
Clothing	54.49	27.15	54.55	18.40	50.94	18.64	55.59	20.49	39.50	44.56	33.29	24.19
Landscapes	47.67	17.63	48.64	13.75	49.31	30.31	50.22	20.33	48.80	37.95	48.52	24.40

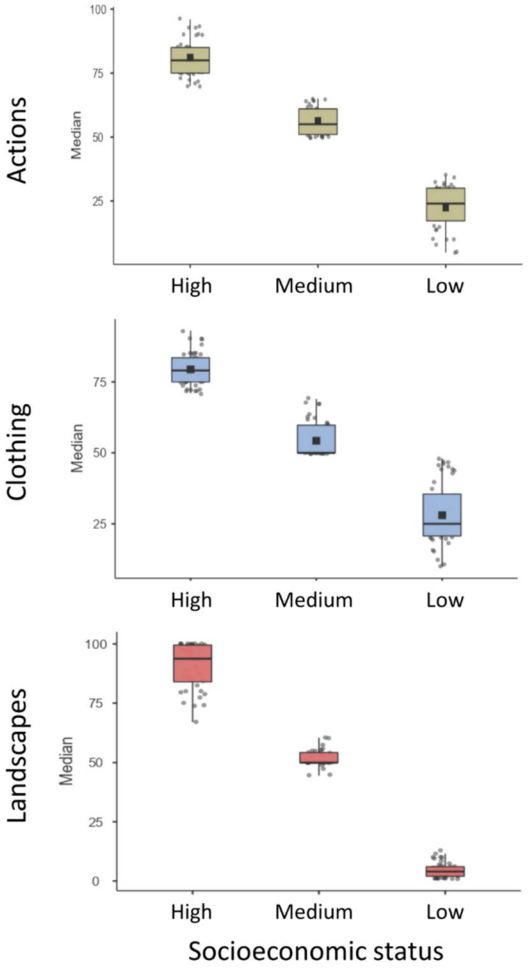
Md, median; *IQR*, interquartile range; *M*, mean; *SD*, standard deviation of the three categories integrating SocialPICS, in three ratings: socioeconomic status, valence, and arousal

jamovi (The jamovi project, 2021). Raw and processed data, descriptive measures, and statistical analyses of all the images are presented as Supplementary information (see https://osf.io/3t9r2/). The following analysis describes: (1) the SocialPICS validation, and (2) the association between SES and affective space in the image dataset.

Validation

SES measures for each image were calculated by computing the median and the interquartile range. We assumed that images depict highly variable social cues in a spectrum that encompasses images ranging from very low to very high SES. Therefore, we ranked the stimuli by the SES median, from highest to lowest for each stimuli subset. The maximum difference of SES found between one rank and the previous ($rank\ difference = rank_{n} — rank_{n-1}$) was 5 for Actions, 3 for Clothing, and 10 for Landscapes. The mean difference [$rank\ difference_{mean} = \sum (rank_{n} — rank_{n-1}) / N_{ranks}$] was 0.67, 0.53, and 0.73 for Actions, Clothing, and Landscapes, respectively. Therefore, the dataset present distinct but smoothly spaced levels of SES in the 0–100 rating scale employed for all stimuli categories. Hence, researchers now can employ a fine-grained control over images depicting SES information.

Often researchers also compare experimental conditions of high vs. low SES. Thus, SocialPICS also offers a categorical classification of SES level for practical purposes. In the stimuli subset of Actions, Clothing, and Landscapes, most images were classified as high, medium, and low SES. Two cutoff points divided the stimuli rankings in three terciles: low SES (first tercile), medium SES (second tercile), and high SES (third tercile). We selected the images that better fit to their level of SES by eliminating 10 images surrounding the cutoff between high-medium SES and 10 images surrounding the cutoff between medium–low SES. Color differentiation of the discrete levels of SES can be seen in the Supplementary information, see table validation_SES_categorical.xls. Non-colored entries in the table indicate stimuli not considered in the discrete classification since they are in the most likely areas of ambiguity for SES categorization. The median rating of images categorized as high, medium, and low SES level for the Action, Clothing, and Landscape subsets of SocialPICS are shown in Fig. 2. To assure that high, medium, and low category-labeled images depict different levels of SES, we ran a nonparametric one-way



Note. Median ratings for each image subset, compared by three status levels: high, medium, and low.

Fig. 2 Actions, Clothing, and Landscapes plotted by high, medium, and low socioeconomic status

ANOVA (Kruskal–Wallis) for all image subsets. When necessary, Dwass-Steel-Critchlow-Fligner pairwise comparisons were conducted. The significance level was set at 5% (two-tailed).

In Actions, of the total of the 136 images, we eliminated 10 intersection images between high-medium (5 high images and 5 medium), and 10 images of medium–low intersection (5 medium images and 5 low). Therefore, the high SES category is composed of 40 images, 35 medium, and 41 low. A significant difference was found among SES levels, χ^2 (2) = 101; $p < 0.001$, $\varepsilon^2 = 0.89$. In order to identify in which levels the difference was found, pairwise comparisons were carried

out between high and low, high and medium, and low and medium SES (all with $p < 0.001$).

In Clothing, 137 out of the total of 157 images composed the analysis, 47 high SES images, 42 medium, and 48 low, as we eliminated the intersection images. A significant difference was found among SES levels, χ^2 (2) = 121; $p < 0.001$, $\varepsilon^2 = 0.89$. Pairwise comparisons were carried out between high and low, high and medium, and low and medium SES (all with $p < 0.001$).

In Landscapes, 116 out of the total of 136 images composed the analysis, 40 high SES images, 35 medium and 41 low, as we eliminated the intersection images. A significant level of difference was also found among SES levels, χ^2 (2) = 102; $p < 0.001$, $\varepsilon^2 = 0.89$. Pairwise comparisons were carried out between high and low, high and medium, and low and medium SES (all with $p < 0.001$).

The results showed that SocialPICS presents valid and diverse images that comprise a continuum in SES. The database also presents a categorical organization of the images; and low, medium, and high SES sets significantly differ from each other.

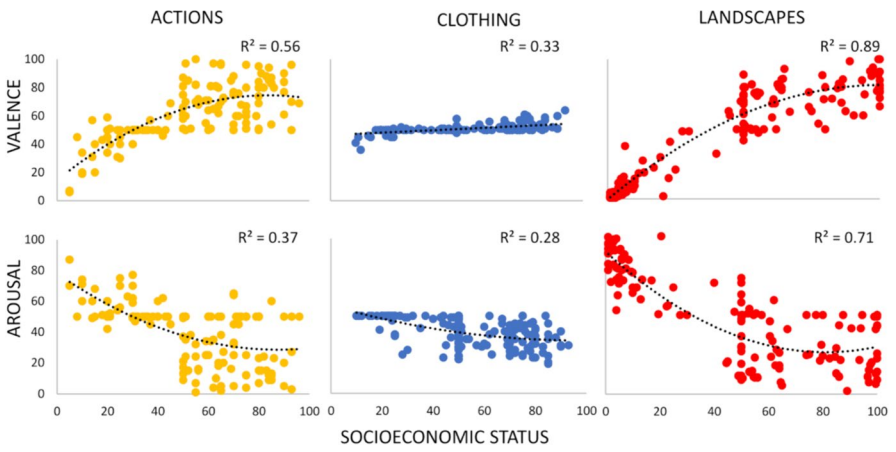
Affective Space Analysis

Emotional stimuli are broadly used in neuroscience and cognition research. Appropriate and validated stimuli are required to assess and induce emotional, psychological, and physiological states (Goeleven et al., 2008; Marchewka et al., 2014). Neural regions engaged in affective responses (e.g., amygdala, insula) are also associated in status-based activity that leads to cognitive component changes and potential discrimination consequences (Mattan et al., 2017, 2018). Thus, we conducted regression models to investigate the relationship amid SES, valence, and arousal in Actions, Clothing, and Landscapes subsets (see the scatter plots in Figs. 3 and 4 along with the fitted equations as notes) and reported the Spearman's rho coefficient (two-tailed, significance level set at 5%).

We carried out regression models to analyze the relation between SES and valence for the Actions subset. A best fit of the model was found for a polynomial function ($R^2 = 0.56$), and a high positive correlation[3] was found between the measures ($r_s = 0.71$, $p < 0.001$). To investigate the association between SES and arousal, a polynomial function showed the best fit of the model ($R^2 = 0.37$) and a moderate negative correlation was found ($r_s = -0.56$, $p < 0.001$). In addition, a polynomial function fit the data between valence and arousal ($R^2 = 0.80$) and a high negative correlation was found ($r_s = -0.90$, $p < 0.001$).

In the Clothing subset, a logarithmic function showed the best fit when we analyzed the relation between SES and valence ($R^2 = 0.33$) and a moderate positive correlation was found ($r_s = 0.62$, $p < 0.001$). A polynomial function showed the best fit of the model for the association between SES and arousal ($R^2 = 0.28$) and a negative moderate correlation was found ($r_s = -0.54$, $p < 0.001$). Similarly, a polynomial

[3] We used the rule of thumb of Hinkle et al. (2003) for interpreting the correlation coefficients.



Note. Ratings for valence (V), arousal (A), and socioeocnomic status (SES) in each category. Each dot represents the median rating for a particular image. Their fitted equations follow: Actions: V – SES ($y = -0.0085x^2 + 1.4335x + 14.553$); A – SES ($y = 0.0065x^2 - 1.1322x + 78.084$); Clothing: V – SES ($y = 3.6948\ln(x) + 36.651$); A – SES ($y = 0.0024x^2 - 0.4676x + 56.605$); Landscapes: V – SES ($y = -0.0082x^2 + 1.6414x - 0.5331$); A – SES ($y = 0.0097x^2 - 1.5761x + 90.205$).

Fig. 3 Valence, arousal, and socioeconomic status level of Actions, Clothing, and Landscapes subsets

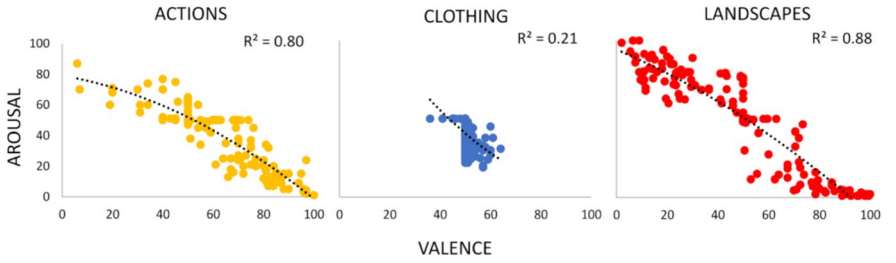
function fit the data between valence and arousal ($R^2 = 0.21$) and a moderate negative correlation was found ($r_s = -0.61$, $p < 0.001$).

In the Landscapes subset, a polynomial function showed the best fit when we analyzed the relation between SES and valence ($R^2 = 0.89$) and a high positive correlation was found ($r_s = 0.88$, $p < 0.001$). A polynomial function showed the best fit of the model for the association between SES and arousal ($R^2 = 0.71$) and a negative high correlation was found ($r_s = -0.76$, $p < 0.001$). Finally, a polynomial function fit the data between valence and arousal ($R^2 = 0.88$) and a very high negative correlation was found ($r_s = -0.93$, $p < 0.001$).

In summary, results showed that SocialPICS' images convey emotion and are affective visual stimuli in a dimensional approach. In general, SES pictorial cues are positively associated to valence, and negatively associated to arousal. In addition, our SES-content images present a negative association between valence and arousal.

Discussion

Here we sought to develop and validate a database of SES-content images, the SocialPICS. We also aimed to investigate the association between SES and the affective space (i.e., valence and arousal). Images of human actions, clothing, and



Note. Ratings for valence (V) and arousal (A) in each category. Each dot represents the median rating for a particular image. Their fitted equations follow: Actions: V – A ($y = -0.0052x^2 - 0.2844x + 79.218$); Clothing: V – A ($y = 0.0116x^2 - 2.5259x + 138$); Landscapes: V – A ($y = -0.0037x^2 - 0.6834x + 94.372$).

Fig. 4 Valence and arousal ratings for Actions, Clothing and Landscapes subsets

landscapes were selected. The results showed that SocialPICS presents images with distinct but smoothly spaced levels of SES, presenting a continuum of diverse images depicting SES information. The database also presents a categorical organization of the images: low, medium, and high SES-level subsets, which significantly differ from each other. The study showed that the SES level has a positive association to valence, and a negative association to arousal. In addition, a negative association was observed between images' valence and arousal ratings.

Our image database allows two systems of classification as follows: (1) categorical (i.e., high, medium, and low), which is commonly used to categorize SES (e.g., Brown-Iannuzzi et al., 2019; Freeman et al., 2011; Mattan et al., 2019), and (2) dimensional, an innovative approach, where SES is thought as a low-to-high spectrum. Both systems present evidence of validity, and together may be useful for most theoretical frameworks, study designs, and practical issues (Allidina & Cunningham, 2023; Cikara et al., 2022). These results provide evidence that SocialPICS depicts social differences regarding power, prestige, and control of resources, which constitutes SES (Dupree et al., 2021; Navarro-Carrillo et al., 2020). As we evolved as a social species, social information activates specific brain pathway and structures while we perceive a face, body, body movement, or other social cues relevant to social interaction (Mattan et al., 2018; Pitcher & Ungerleider, 2021). Moreover, information about a person, a group, priors, and expectations also influence early stages of perception (Krosch, 2022; Otten et al., 2017). These neural and perceptual mechanisms support SES processing when we perceive and evaluate Actions, Clothing or Landscapes images.

The validation of an image database of SES information is a relevant methodological outcome of the present study. In addition, we contribute to the literature by showing that SES images (especially for Actions and Landscapes) convey emotional information, i.e., SES is related to the dimensional affective space: higher SES levels are associated to positive valence and lower arousal; and lower SES is associated to negative valence and higher arousal. Such inverse association between valence

and arousal in emotional stimuli was found in recent studies (see Yik et al., 2023). Moreover, this pattern between valence and arousal evaluation was also found in previous studies, which were conducted in the same cultural background (e.g., Dal Fabbro et al., 2021), or used bipolar semantic scales to rate valence and arousal (e.g., Haberkamp et al., 2017; Ma et al., 2015; Marchewka et al., 2014), in contrast to the Self-Assessment Manikin (SAM) scale.

In contrast, our data for the Clothing category showed a weaker correlation between valence and arousal. This result might be explained by two reasons. First, the image complexity, insofar as the Clothing category does not have background information, different from the Actions and Landscapes categories (see the image complexity in the Supplementary information). Thus, Clothing images may not encompass emotional content, and, to our knowledge there is no study that evaluates clothes as a stimulus for affect induction. Second, the Clothing subset also presented low variety because free of copyright appropriate stimuli were scarce, and this required more work in the elaboration of stimuli, adding stains and other cues that aided the quality of the stimuli in the dataset. The lack of diversity in Clothing images may also be related to the weaker relationship found between SES and the affective space in this image subset. Nevertheless, the Clothing category showed good variability regarding SES. Future studies can implement procedures such as Torres et al. (2019), that took photographs of real people, since they portray the reality of a social context and thus present greater ecological validity.

Furthermore, our results support the bipolar hypothesis, in which valence is a unidimensional construct, i.e., positive and negative affects exist on a single continuum (Joseph et al., 2020; Malezieux et al., 2023). Although recent studies are challenging this view to explain complex phenomena as ambivalent affect (e.g., Vaccaro et al., 2020), the bipolar-bivariate debate remains unsolved (see Moore & Martin, 2022). Irrespective of new theoretical-methodological proposals in the emotion field (e.g., Cowen et al., 2019; Shanahan, 2020), valence and arousal dimensions taken together are powerful to predict emotional experiences, especially in contexts of high biological relevance such as physical and social threats (Olofsson et al., 2008; Tskhay & Rule, 2018).

Emotion induction is a fundamental methodological issue (for a review, see Joseph et al., 2020) and pictorial databases supply a great number of images validated as effective emotional inductors (Barrett & Kensinger, 2010; Colden et al., 2008; Ebner et al., 2010; Kim et al., 2018; Marchewka et al., 2014). As SocialPICS could induce emotions, and negative images produce stronger reactions than positive ones (i.e., negativity bias, Yik et al., 2023), we suggest that future research using this database should evaluate participants' mood state at the beginning and at the end of the experimental session.

The variability of daily social interactions is vast, and literature is dedicated on investigating differences on SES levels and cultural influences on social encoding (e.g., Cikara et al., 2022; Freeman et al., 2011, 2013; Torres et al., 2019). For instance, eastern and western cultures are known to think differently. East Asians usually are reported as holistic and collectivist, and US-Americans account as individualist and analytic thinkers (Ji et al., 2023; Kawakami et al., 2022). It is important to notice that Brazilians tend to be more holistic than US-Americans and Chinese (de Oliveira & Nisbett, 2017), and our social, historical, and cultural atmosphere

influence our social judgements. Therefore, our results on SES images validated in a Brazilian sample should be seen as culturally dependent and used with care in other contexts. Cross-cultural studies could favor the understanding of the social phenomenon that occurs in the evaluation of SES pictorial cues. In addition, cultural validations of SocialPICS are encouraged.

Some limitations and cautions must be acknowledged. Not all SES images of SocialPICS depict emotion. As mentioned, we found a weaker relationship between SES and the affective space for Clothing images. However, Actions and Landscapes images present a clear correlation of SES, valence, and arousal. In addition, we intended to develop a racially diverse image dataset when portraying individuals, mainly in the Actions subset. However, the free and commercial image databases reproduce inequity in the relation between SES and race found in societies (e.g., Lima & de Moraes, 2021). We consider the image curation was well succeeded in our goal of racial variability, but there is still room for improvement. Finally, free of copyright online databases can provide a large pool of images, but there are some staged images that can account as less resembling to reality.

The present study developed and validated a socioeconomic-content image database, SocialPICS. Here we also investigated the association between SES and the affective space of the selected images. As a methodological outcome, the instrument is validated for the Brazilian context. As a theoretical outcome, we argue that SES images are emotional images. SES images are positively associated to valence, and negatively associated to arousal. SocialPICS is a novel, high-quality resolution, standardized database of 429 socioeconomic static images composed of 136 Actions, 157 Clothing, and 136 Landscapes photographs. These three subsets comprise stimuli usually employed by researchers in social cognition and neuroscience. Measures of SES, valence, arousal, and physical properties are provided for each stimulus. The full database, along with raw and validation data, are available for non-commercial use only at https://osf.io/3t9r2/. Its use should simplify and favor original and replication studies with a higher level of standardization and control over visual SES-content stimuli.

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Author Contribution ABSMA and RMJ contributed to the conceptualization and study design. RMJ contributed to the supervision and project administration. ABSMA, LGB, and RMJ contributed to the investigation. ABSMA contributed to the questionnaire programming. ABSMA, IBFG, and RRS contributed to the stimuli development and curation. ABSMA, IBFG, and RMJ contributed to the formal analysis. ABSMA contributed to the visualization. ABSMA wrote the original draft that was reviewed and edited by LGB and RMJ.

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Data Availability Data and material are available at https://osf.io/3t9r2/.

Declarations

Ethics Approval and Consent to Participate Informed consent was obtained from all individual participants included in the study. The present investigation was approved by the Human and Social Sciences Research Ethics Committee of the University of Brasília (CAAE: 30539820.9.0000.5540).

Conflict of Interest The authors declare no competing interests.

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