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ARTICLE

Defensive emotions and evaluative judgements: Sensitivity to anger and fear predicts moral judgements, whereas sensitivity to disgust predicts aesthetic judgements

Alejandro Dorado[1] | **Martin Skov**[2,3] | **Jaume Rosselló**[1] | **Marcos Nadal**[1]

[1]Department of Psychology, University of the Balearic Islands, Palma, Spain

[2]Decision Neuroscience Research Cluster, Copenhagen Business School, Copenhagen, Denmark

[3]Danish Research Centre for Magnetic Resonance, Copenhagen University Hospital Hvidovre, Hvidovre, Denmark

Correspondence
Marcos Nadal, Department of Psychology, University of the Balearic Islands, Crta Valldemossa Km 7.5, Palma de Mallorca 07122 Spain.
Email: marcos.nadal@uib.es

Abstract

Aesthetic and moral evaluations engage appetitive and defensive emotions. While the role played by pleasure in positive aesthetic and moral judgements has been extensively researched, little is known about how defensive emotions influence negative aesthetic and moral judgements. Specifically, it is unknown which defensive emotions such judgements tap into, and whether both kinds of judgement share a common emotional root. Here, we investigated how participants' individual sensitivity to disgust, fear, anger and sadness predicted subjective judgements of aesthetic and moral stimuli. Bayesian modelling revealed that participants who were more sensitive to anger and fear found conventional and moral transgressions more wrong. In contrast, participants who were more sensitive to disgust disliked asymmetrical geometric patterns and untidy rooms more. These findings suggest that aesthetic and moral evaluations engage multiple defensive emotions, not just disgust, and that they may rely on different defensive emotions as part of their computational mechanism.

KEYWORDS

aesthetic judgements, anger, disgust, fear, individual differences, moral judgements, sadness

BACKGROUND

Evaluative judgements are assessments of the value of current, past and anticipated objects, actions and situations. They are the grounds for choices, decisions and plans (O'Doherty et al., 2017; Symmonds & Dolan, 2012). Among the most frequent evaluations people make are aesthetic and moral judgements. Moral judgements entail assessing whether an action or belief is good/appropriate or bad/inappropriate (Malle, 2021). Aesthetic judgements entail assessing whether an object is beautiful/pleasant or ugly/unpleasant (Skov & Nadal, 2021).

Moral and aesthetic evaluations are influenced by positive and negative hedonic states (Greene & Young, 2020; Skov, 2019). These states reflect the affective and motivational value of objects, actions and their outcomes, and are the basis of the pleasure and displeasure that sway positive and negative judgements (Greene & Young, 2020; Skov & Nadal, 2021). Much remains unknown about how emotions inform specific aesthetic and moral judgements, especially in the case of defensive emotions. Defensive emotions, including repulsion, anger, disgust, dread or fear, motivate behaviours that avoid dangerous or potentially harmful stimuli such as pathogens, predators or extreme environmental temperatures (Damasio & Carvalho, 2013; Mobbs et al., 2020). Yet, how they influence aesthetic and moral judgements is still poorly understood.

Most of what is known about the role of defensive emotions in moral and aesthetic evaluations derives from studies on disgust or disgust sensitivity. Different experimental manipulations have shown that disgust and disgust sensitivity are related to moral evaluations: (1) people's disgust sensitivity correlates with the severity of their judgements of moral transgressions, even when those transgressions do not involve physical disgust stimuli (Chapman & Anderson, 2014); (2) individual sensitivity to pathogen disgust predicts evaluative responses to political behaviours and beliefs (Petersen, 2017; Smith et al., 2011); (3) exposing people to disgust inducing odours (Schnall et al., 2008; Ugazio et al., 2012) or beverages (Eskine et al., 2011) leads them to respond with greater disapproval to examples of moral transgression; and (4) inhibiting the feeling of nausea with antiemetic ginger reduces disgust responses to judgements of moral transgressions (Tracy et al., 2019).

Evidence from different studies also suggests that disgust plays a role in judgements of ugliness and disliking: (1) briefly presented facial expressions of disgust decrease liking for abstract art (Flexas et al., 2013); (2) atypical facial morphologies can elicit disgust (Park et al., 2013; Ryan et al., 2012) and predict judgements of ugliness (Bull & Rumsey, 1988; Klebl et al., 2021); (3) faces that are perceived to be ugly often elicit avoidance behaviour (Kapp-Simon & McGuire, 1997; Strauss et al., 2007), suggesting that people treat ugliness as a proxy for unhealthiness (Zebrowitz & Rhodes, 2004), and, likewise, ugly buildings elicit greater disgust responses than beautiful buildings (Klebl et al., 2021); (4) images of objects that include adaptive disease cues are judged as uglier than counterparts without those cues: Participants rate pictures representing disgusting objects as uglier than pictures representing fear-inducing or sadness-inducing objects, suggesting that judgements of ugliness may be predominantly linked to disgust (Klebl et al., 2021).

Finally, there is evidence suggesting that moral and aesthetic evaluative judgements are influenced by negative emotions in a similar way: Aversion to geometric pattern deviancy correlates with aversion to perceived moral deviations and stigmatized individuals (Gollwitzer et al., 2017; Gollwitzer, Marshall, et al., 2020; Gollwitzer, Martel, et al., 2020). People who strongly dislike irregular patterns or distorted geometrical figures are more likely to reject social norm breakers, stigmatized individuals (Gollwitzer et al., 2017) and social minorities (Gollwitzer, Marshall, et al., 2020), and condemn purity and harm violations (Gollwitzer, Martel, et al., 2020). These results suggest that negative aesthetic and moral evaluations may have a common emotional root.

This body of work suggests that disgust plays a role in moral and aesthetic evaluations, that is, in human engagements in complex social interactions and with cultural objects. However, not all studies have found that disgust influences evaluations of moral behaviour. Experiments have questioned the effect of disgust on the severity of moral judgements (Ghelfi et al., 2020), and of incidental disgust on unethical behaviour (Kugler et al., 2020), moral condemnation (Jylkkä et al., 2021) and moral

judgement (Landy & Goodwin, 2015). Tracy et al. (2019) found inhibition of nausea to reduce the severity of moral transgressions only in the purity domain, not for moral transgressions in the harm/care, fairness, loyalty or authority domains. The authors suggested that when people say they are disgusted by moral transgressions in those other domains, they are using the word metaphorically to express outrage and indignation, more closely related to anger (Piazza & Landy, 2020; Russell & Giner-Sorolla, 2013).

Landy and Piazza (2019) tested the hypothesis that the relationship between disgust and moral evaluations is not special. They showed that emotional sensitivity influenced evaluative judgements in different domains: evaluations of moral and conventional transgressions, evaluations of imprudent actions, evaluations of competence and aesthetic evaluations. They concluded that general sensitivity to affective stimuli amplifies evaluative judgements of different sorts. Thus, it is possible that the evidence for the involvement of disgust in negative moral and aesthetic judgements is one specific case of negative emotions, in general, shaping evaluative judgements of different classes, and that other negative emotions may be better predictors of some negative moral and aesthetic judgements (Piazza & Landy, 2020; Russell & Giner-Sorolla, 2013; Tracy et al., 2019).

In sum, defensive emotions influence moral and aesthetic evaluative judgements, but several issues require clarification before it is understood how and why this is the case. One of these is the issue of specificity vs. generality: are evaluative judgements influenced specifically by disgust, or by defensive emotions in general? Another of these is the issue of distinctiveness vs. commonality: are the defensive emotions that influence moral and aesthetic evaluations distinct or common?

The purpose of this study was to address both these issues. We examined how participants' sensitivity to disgust, fear, anger and sadness (the disposition to respond more or less intensely to eliciting stimuli) predicted aesthetic judgements of geometric designs, the tidiness of rooms and the attractiveness of faces and moral judgements of conventional and moral transgressions.

METHODS

Participants

Sixty-five students (53 women) at the University of the Balearic Islands participated in this experiment. Their ages ranged between 19 and 44 years ($M = 20.87$, $SD = 3.41$). In consideration of their well-being, we made sure none of them had a strong fear of insects, animals or other stimuli classes that they would be shown during the experiment. Before the experiment, participants were briefed about the tasks they would be asked to perform. They read and signed an informed consent, which stated that at one point in the experiment they would be asked to look and rate some unpleasant images, and that they were free to quit the experiment at any point. Participation was compensated with course credit. Data for one of the participants were lost for technical reasons and was therefore not included in the analyses.

Materials

Sensitivity to transgressions

We measured participants' sensitivity to transgressions using eight neutral action scenarios, eight conventional transgression scenarios and eight moral transgression scenarios developed by Chapman and Anderson (2014) and later used by Landy and Piazza (2019). The 48 original scenarios are set in the context of a high school, where there are many social norms that are familiar to our participants. The 16 moral transgressions describe clear and deliberate moral offences, including harm, theft or humiliation, the 16 conventional transgressions describe violations of school rules, such as not wearing the proper clothes or speaking without permission and the 16 neutral actions describe

everyday events, such as making plans, catching up or asking for materials. We translated the 48 scenarios into Spanish and, from the 16 neutral scenarios, we selected the eight that would be most familiar and easiest to relate to for our participants. For instance, we excluded those scenarios that mentioned lockers, hockey and school plays. To make sure that our Spanish translation of the moral and conventional transgression scenarios preserved their original design intention, we asked 43 psychology students at the University of the Balearic Islands to judge whether each of the conventional and moral transgression scenarios was morally appropriate or not. None of these participants took part in the main experiment. We then selected the eight moral transgression scenarios that had been rated overall as most morally inappropriate and the eight conventional transgression scenarios that had been rated overall as least morally inappropriate. The final set of eight neutral, conventional transgression and moral transgression scenarios are included in Appendix A, together with their Spanish translations.

Sensitivity to room tidiness

We measured participants' sensitivity to room tidiness using photographs of bedrooms, kitchens and living rooms in different states of tidiness. We took photographs of the same bedrooms, kitchens and living rooms in three states of tidiness: very tidy, intermediate and very untidy. For each room, we made sure only to alter the arrangement of objects, not to add new objects (Figure 1). We then asked 58 psychology students at the University of the Balearic Islands to rate how tidy they considered each room to be on a 1 to 5 scale. None of these participants took part in the main experiment. For each image, we obtained an average tidiness rating. To cover the whole tidiness–untidiness spectrum, we selected 12 images of each kind of room (bedroom, kitchen and living room) according to their average tidiness rating which was closest to evenly spaced percentile scores, from the untidiest to the tidiest.

FIGURE 1 Examples of the three levels of tidiness in bedrooms, kitchens and living rooms.

Sensitivity to symmetry

We measured participants' sensitivity to symmetry using 20 stimuli taken from Jacobsen and Höfel's (2002) set. These stimuli are solid black circles with a centred white square containing triangles that are combined to form designs of varying complexity and vertical, horizontal or diagonal mirror symmetry (Figure 2). We used the same subset of 10 symmetrical and 10 asymmetrical stimuli, matched for complexity (corresponding to the amount of constituting triangles), which we used in some of our prior studies on aesthetic sensitivity (Clemente et al., 2021).

Sensitivity to facial attractiveness

We measured participants' sensitivity to facial attractiveness using 12 photographs of male and 12 of female faces. We showed 60 photographs of faces (30 males and 30 females), taken from a larger set we used previously (Ferrari et al., 2015), to 58 psychology students at the University of the Balearic Islands and asked them to rate how attractive they considered each face to be on a 1 to 5 scale. These were the same students who rated the rooms and, as noted above, none of them took part in the main experiment. For each face image, we obtained an average attractiveness rating. To cover the whole attractiveness spectrum, we selected the 12 female and 12 male faces whose average attractiveness rating was closest to evenly spaced percentile scores, from the one rated the least attractive to the one rated the most attractive.

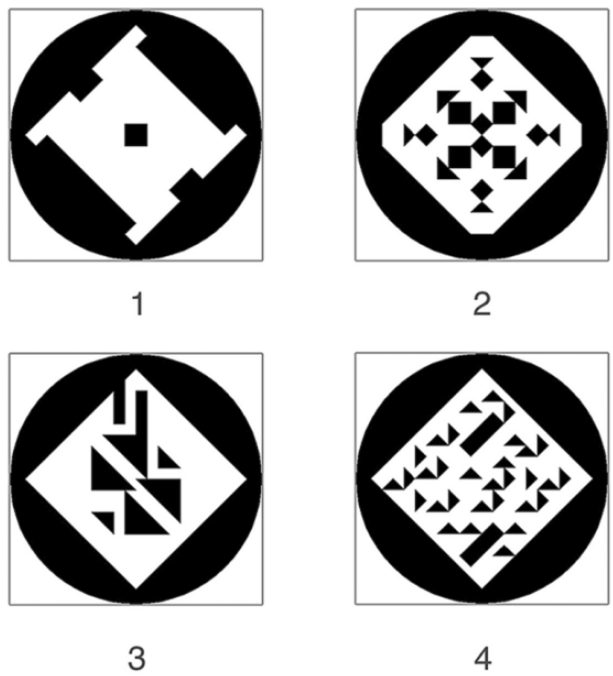

FIGURE 2 Examples of stimuli used to assess sensitivity to symmetry. They were either symmetric (1 and 2) or asymmetric (3 and 4), making sure to match the symmetric and asymmetric subsets for complexity (1 and 3 are simpler, and 2 and 4 are more complex).

Emotional sensitivity

Following Landy and Piazza (2019), we measured participants' emotional sensitivity using IAPS images (Lang et al., 1997) based on Mikels et al. (2005) study of emotional category correspondence and the Spanish norms (Moltó et al., 2013). To measure disgust sensitivity, we selected four images that corresponded to the emotional category of disgust (1271, 9140, 9290 and 9300) and four neutral images (9210, 7025, 5950 and 8160). To measure anger sensitivity, we selected four images that corresponded to the emotional category of anger (6520, 6836, 2751 and 2272) and four neutral images (5500, 5990, 7050 and 7233). To measure fear sensitivity, we selected four images that corresponded to the emotional category of fear (1120, 1201, 1525 and 8485) and four neutral images (7002, 7009, 7035 and 7170). To measure sadness sensitivity, we selected four images that corresponded to the emotional category of sadness (2900, 2276, 2205 and 2141) and four neutral images (7510, 7500, 7100 and 7830). For each of the emotional categories, we avoided including images that might produce extreme emotional reactions and assigned the neutral images randomly.

Emotion reactivity

We measured participants' emotion reactivity using our Spanish translation (Appendix B) of Nock et al.'s (2008) Emotion Reactivity Scale. This is a 21-item self-report measure of the extent to which people experience emotions in response to a broad range of events, emotion intensity and emotion persistence. Participants rated each item on a 0 to 4 scale (0 = not at all like me and 4 = completely like me), with total possible scores ranging from 0 to 84. This scale has strong internal consistency and convergent, divergent, incremental and criterion-related validity (Byrne et al., 2019; Nock et al., 2008).

Procedure

Participants undertook the experimental tasks in the psychology laboratory. They were first welcomed and briefed about the entire procedure. Each participant was then asked to enter one of the individual sound-attenuated testing cabins, all of which have the same computers, software and adequate light conditions. All tasks were explained with oral and onscreen instructions.

There were three blocks of tasks. All participants completed the three blocks in the same order, but the order of the tasks in the first and second blocks was counterbalanced across participants. All tasks began with a 300 ms fixation cross that served as a readiness signal. After the outset of the cross, each stimulus was presented for 2000 ms, after which the rating scale appeared and participants were able to respond. Stimuli were shown until response, and there was no time limit.

The first block included the moral and aesthetic evaluative judgements. In the moral evaluative judgement task, participants were asked to rate the wrongness of the actions described in each scenario (neutral, conventional transgression and moral transgression), using a 1 to 5 Likert scale with anchors 'not wrong' and 'very wrong' (Figure 3a). In the evaluative judgement task of symmetry and tidiness, participants were asked how much they liked the geometric figures or the rooms, using a 1 to 5 Likert scale with anchors 'do not like at all' and 'like very much'. In the evaluative judgement task of facial attractiveness, participants were asked how attractive they found the faces, using a 1 to 5 Likert scale with anchors 'not at all attractive' and 'very attractive' (Figure 3b).

The second block included the negative emotions tasks. In separate tasks, participants were shown the IAPS images and asked to indicate the extent to which they were expressive of anger, fear, disgust or sadness, using a 1 to 5 Likert scale, with anchors 'not at all' and 'very much'. For each of the emotion tasks, the neutral and emotional images were shown in random order (Figure 3c).

The third block consisted of the Emotion Reactivity Scale. Following Nock et al. (2008), participants were told that they were about to be asked questions about how they experience emotions on a regular

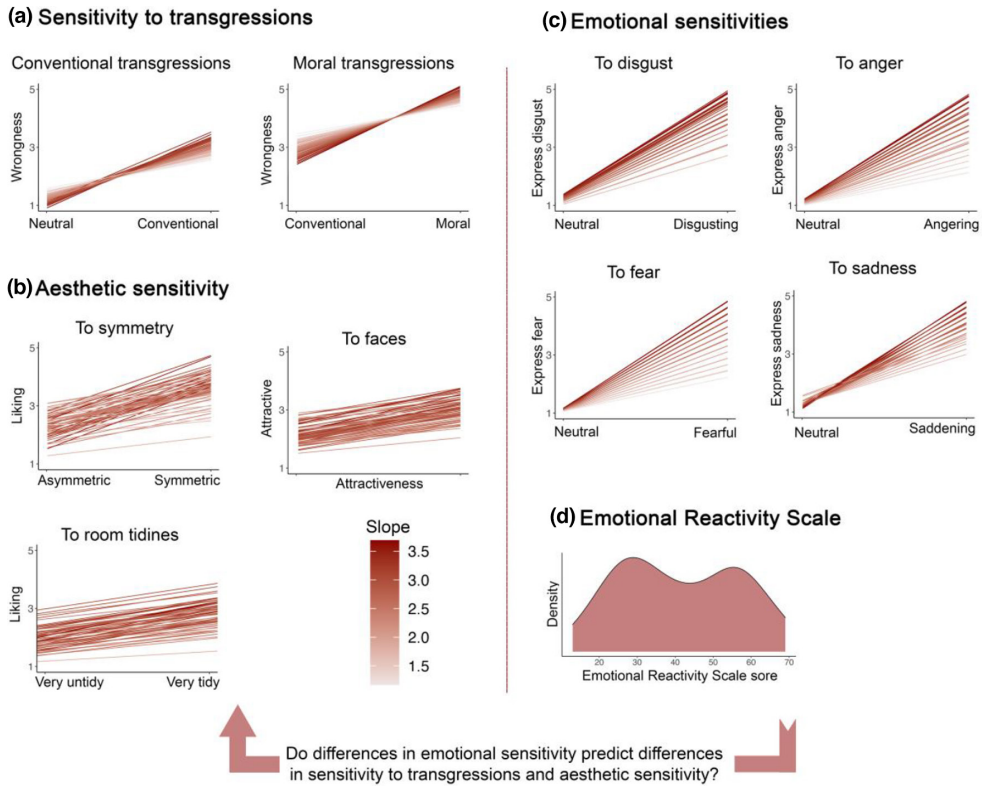

FIGURE 3 Procedure and results. Participants rated how wrong they found conventional and moral transgressions and how much they liked figures varying in symmetry, faces varying in attractiveness and rooms varying in tidiness. Using linear mixed-effects models we obtained, for each participant, a measure of (a) sensitivity to conventional transgressions, moral transgressions, and (b) aesthetic sensitivity to symmetry, facial attractiveness and room tidiness. Participants were then asked to rate four blocks of IAPS images containing neutral images or images expressive of disgust, anger, fear and sadness. For each participant, we obtained a measure of (c) sensitivity to each of these emotions. The darkness of the regression line indicates the slope for each participant: steeper slopes are drawn in darker shades, and flatter slopes are shown in lighter shades. Finally, (d) participants completed the emotional reactivity scale. We then used each of the participants' emotional sensitivity measures emotional reactivity score to predict their sensitivity to conventional and moral transgressions and their aesthetic sensitivity to symmetry, facial attractiveness and room tidiness.

basis, and that 'being emotional' referred to being angry, sad, excited or some other emotion, and to rate each item on a 0 to 4 scale, with 0 meaning 'not at all like me' and 4 'completely like me' (Figure 3d). After this last block, participants were debriefed and thanked for their time and participation.

Analyses

We analysed the data in two stages. In the first stage, we used linear mixed-effects models to obtain each participant's measure of sensitivity to transgressions (conventional and moral), symmetry, tidiness, attractiveness and negative emotions (disgust, fear, anger and sadness). We, thus, performed nine separate linear mixed-effects analyses. This method accounts simultaneously for the between-subjects and within-subjects effects of the independent variables (Baayen et al., 2008), and models random error at all levels of analysis simultaneously, relying on maximum-likelihood procedures to estimate coefficients. Therefore, it provides the most accurate analysis of hierarchically structured data in which, as is the case here, responses to stimuli are dependent on, or nested within, individual participants. Linear mixed-effects models provide other additional advantages, such as meaningful estimates of subject- and

group-level variance components, unbiased handling of outliers and the ability to handle incomplete and unbalanced data and to accommodate continuous and categorical predictors, and allow deriving conclusions that generalize to other participants besides those providing the data (Judd et al., 2017). They are especially well suited to the purposes of the current study because they provide estimates for both group-level effects, which can be compared with those of previous studies, and participant-level effects, which constitute our measure of individual aesthetic sensitivity, as in Clemente et al. (2021).

The models were designed to reflect the effect of the stimuli on participants' evaluative judgements (conventional transgressions, moral transgressions, symmetry, tidiness and facial attractiveness) and emotional ratings (anger, fear, disgust and sadness). To obtain participants' sensitivity to transgressions, we modelled participants' wrongness rating as a function of the type of scenario (*neutral*, *conventional* and *moral*). The reference level was *conventional*, and we obtained two measures of sensitivity: sensitivity to conventional transgressions (by contrasting conventional to neutral) and sensitivity to moral transgressions (by contrasting conventional to moral). To obtain participants' sensitivity to symmetry, tidiness and facial attractiveness, we modelled participants' liking or attractiveness rating as a function of each stimulus' symmetry, tidiness or attractiveness score. All of these continuous predictors were centred. To obtain participants' sensitivity to anger, disgust, fear and sadness, we modelled participants' ratings as a function of the type of stimulus (*neutral* and *emotional*). The reference level was *neutral*. All models included random intercepts within participants and stimuli, and the slope for each stimuli features as a random effect within participants, following Barr et al.'s (2013) recommendation to model the maximal random-effects structure justified by the experimental design.

Although the mixed-effects models produce group estimates, the main goal of this study was to obtain measurements of the extent to which the main predictors (type of transgression, symmetry, tidiness, facial attractiveness and the four negative emotions) influence participants' responses. In linear mixed-effects models, this corresponds to the individual slopes. Thus, we defined participants' sensitivity to conventional and moral transgressions, symmetry, tidiness, facial attractiveness, anger, disgust, fear and sadness, as the individual slope estimated from the models' random-effect structure. Therefore, after running each model, we extracted each participant's slopes. We used these values to describe individual sensitivities to conventional and moral transgressions (Figure 3a), symmetry, tidiness, facial attractiveness (Figure 3b), anger, disgust, fear and sadness (Figure 3c).

We performed these analyses within the R environment for statistical computing, v. 4.0.2 (R Core Team, 2020) using the *lmer()* function of the 'lme4' package (Bates et al., 2017) fitted with REML estimation. The 'lmerTest' package (Kuznetsova et al., 2012) was used to estimate the *p*-values for the *t*-tests based on the Satterthwaite approximation for degrees of freedom, which has been shown to produce acceptable Type-I error rates (Luke, 2017).

In the second stage, we used Bayesian inference to ascertain the effects of participants' sensitivity to negative emotions (disgust, fear, anger and sadness), and of their score on the Emotion Reactivity Scale, on their sensitivity to conventional and moral transgressions and on their sensitivity to symmetry, room tidiness and facial attractiveness. We performed this analysis using JASP (JASP Team, 2020), and followed van Doorn et al.'s (2020) and Wagenmakers et al. (2018) guidelines for Bayesian data analyses and results reporting.

Bayesian inference using JASP allowed us to attain three main goals:

1. We used Bayes factor hypothesis tests (Rouder et al., 2012) to determine whether sensitivity to negative emotions and emotion reactivity influences sensitivity to transgressions, symmetry, untidiness and attractiveness. Bayes factor hypothesis tests compare the predictive performance of competing models of the data, including the null model, models including only main effects and all models containing interactions. They can be understood as an odds ratio that quantifies the change in belief from the odds before the data have been considered to the odds after the data have been considered (Wagenmakers et al., 2018). The Bayes factor is a comparison among models, and as such, it is a relative measure of evidence: it quantifies the performance

of a model in relation to another. If BF_{10} equals 15, for instance, the observed data are 15 times more likely to occur under one model than under the null model. When BF_{10} equals 1, the observed data are equally likely under both models. Although one of the most interesting aspects of Bayesian inference is the continuous nature of its measures of strength of evidence, Schönbrodt and Wagenmakers (2018) provided the following heuristic to interpret Bayes factors: Between 1 and 3, the evidence for H_1 can be interpreted as anecdotal, between 3 and 10 as moderate, between 10 and 30 as strong, between 30 and 100 as very strong and greater than 100 as extreme.

2. To determine the size of those effects we relied on two sources, the inclusion Bayes factor and the 95% credible intervals. With several predictors, as is the case here, the number of models grows, making it cumbersome to consider each individual model. Bayesian model averaging is especially indicated when several competing models are viable. In the context of parameter estimation, Bayesian model averaging eliminates the unnecessary complexity imposed by several similarly plausible models and produces the estimates. Bayesian model averaging is less useful when the data are much more plausible under a single model than under all others (Hinne et al., 2020). JASP offers the possibility of computing model-averaged results, which show, for each of the predictors and their interactions, the prior and posterior inclusion probabilities, and the resultant inclusion Bayes factor. The prior inclusion probability is the sum of the prior model probabilities of all models which contain that predictor. The posterior inclusion probability is the sum of the posterior model probabilities of all models which contain that predictor. The inclusion Bayes factor quantifies the change from prior inclusion odds to posterior inclusion odds and can be interpreted as the evidence in the data for including a given predictor. The 95% credible intervals specify the range of values that has a 95% probability of containing the true value of the parameters (Wagenmakers et al., 2018).
3. To estimate the parameters of interest, we examined the posterior distribution, which reflects the relative plausibility of the parameter values after prior knowledge has been updated in light of the data. JASP summarizes the model-averaged posterior distributions of each level of each predictor and interaction with the posterior mean, the posterior standard deviation and the lower and upper bound of the 95% central credible interval (van Doorn et al., 2020; Wagenmakers et al., 2018).

RESULTS

Sensitivity measures

In this subsection, we present the results of the first stage of data analyses, in which we used linear mixed-effects models to obtain each participant's measure of sensitivity to transgressions (conventional and moral), symmetry, tidiness, attractiveness and negative emotions (disgust, fear, anger and sadness).

Sensitivity to disgust

The linear mixed-effect model ($ß_0 = 2.619$, $t = 17.77$, $p < .0001$) revealed that, overall, participants rated the disgusting images (4.09, [3.60, 4.58]) as significantly more expressive of disgust ($ß = 2.944$, $t = 10.19$, $p < .0001$) than the neutral images (1.15, [0.66, 1.63]). Participants' slopes ranged from 1.68, indicating a moderate difference in emotional response to the neutral and disgusting images, to 3.57, indicating a large difference in emotional response to the neutral and disgusting images ($M = 2.944$; $SD = 0.43$; Figure 3c: emotional sensitivity to disgust).

Sensitivity to anger

The linear mixed-effect model ($ß_0 = 2.444$, $t = 10.813$, $p < .0001$) revealed that, overall, participants rated the angering images (3.75, [2.98, 4.52]) as significantly more expressive of anger ($ß = 2.611$, $t = 5.815$, $p < .0001$) than the neutral images (1.14, [0.38, 1.90]). Participants' slopes ranged from 1.11, indicating a moderate difference in emotional response to the neutral and angering images, to 3.61, indicating a large difference in emotional response to the neutral and angering images ($M = 2.611$; $SD = 0.63$; Figure 3c: emotional sensitivity to anger).

Sensitivity to fear

The linear mixed-effect model ($ß_0 = 2.456$, $t = 29.59$, $p < .0001$) revealed that, overall, participants rated the fearful images (3.79, [3.51, 4.07]) as significantly more expressive of fear ($ß = 2.667$, $t = 16.63$, $p < .0001$) than the neutral images (1.12, [0.91, 1.33]). Participants' slopes ranged from 1.17, indicating a moderate difference in emotional response to the neutral and fearful images, to 3.69, indicating a large difference in emotional response to the neutral and fearful images ($M = 2.667$; $SD = 0.77$; Figure 3c: emotional sensitivity to fear).

Sensitivity to sadness

The linear mixed-effect model ($ß_0 = 2.730$, $t = 28.56$, $p < .0001$) revealed that, overall, participants rated the saddening images (4.25, [3.93, 4.58]) as significantly more expressive of sadness ($ß = 3.048$, $t = 15.51$, $p < .0001$) than the neutral images (1.21, [0.89, 1.52]). Participants' slopes ranged from 1.70, indicating a moderate difference in emotional response to the neutral and saddening images, to 3.70, indicating a large difference in emotional response to the neutral and saddening images ($M = 3.047$; $SD = 0.51$; Figure 3c: emotional sensitivity to sadness).

Sensitivity to transgressions

The linear mixed-effect model ($ß_0 = 3.035$, $t = 57.46$, $p < .0001$) revealed that, overall, participants rated the moral transgressions (4.86, [4.70, 5.01]) as significantly worse ($ß = 1.826$, $t = 15.30$, $p < .0001$) than the conventional transgressions (3.03, [2.83, 3.23]), and the conventional transgressions as significantly worse ($ß = 1.820$, $t = 15.43$, $p < .0001$) than the neutral scenarios (1.21, [1.05, 1.37]). Participants' slopes for the contrast between moral and conventional transgressions ranged from 0.97, indicating moral transgressions were rated as slightly worse than conventional ones, to 2.77, indicating moral transgressions were rated much worse than conventional ones ($M = 1.826$; $SD = 0.41$; Figure 3a: sensitivity to moral transgressions). Participants' slopes for the contrast between conventional transgressions and neutral scenarios ranged from 1.02, indicating conventional transgressions were rated as slightly worse than neutral scenarios, to 2.53, indicating conventional transgressions were rated much worse than neutral scenarios ($M = 1.82$; $SD = 0.40$; Figure 3a: sensitivity to conventional transgressions).

Sensitivity to symmetry

The linear mixed-effect model ($ß_0 = 2.960$, $t = 28.065$, $p < .0001$) revealed that, overall, participants liked symmetrical patterns (3.59, [3.29, 3.89]) significantly more ($ß = 1.259$, $t = 6.488$, $p < .0001$) than asymmetrical patterns (2.33, [2.04, 2.62]). Participants' slopes ranged from 0.17, indicating a relative

indifference towards symmetry, to 2.24, indicating a strong preference for symmetric designs (M = 1.26; SD = 0.50; Figure 3b: aesthetic sensitivity to symmetry).

Sensitivity to room tidiness

The linear mixed-effect model ($ß_0$ = 2.382, t = 29.80, $p < .0001$) revealed that, overall, the tidier the room, the more participants liked it (ß = 0.734, t = 20.11, $p < .0001$). Participants' slopes for the contrast between normal and ordered rooms ranged from 0.22, indicating a slight preference toward room tidiness, to 1.13, indicating a moderate preference for ordered tidiness (M = 0.734; SD = 0.21; Figure 3b: aesthetic sensitivity to room tidiness).

Sensitivity to facial attractiveness

The linear mixed-effect model ($ß_0$ = 2.583, t = 36.51, $p < .0001$) revealed that, overall, participants' liking rating reflected the faces' attractiveness scores (ß = 0.867, t = 13.17, $p < .0001$): the higher a face's attractiveness score, the higher the liking rating. Participants' slopes ranged from 0.20, indicating a slight preference towards attractiveness, to 1.30, indicating liking for the more attractive faces (M = 0.87; SD = 0.19; Figure 3b: aesthetic sensitivity to facial attractiveness).

Predicting sensitivity to transgressions

In this subsection, we present the results of the second stage of data analyses, in which we used Bayesian inference to determine the effects of participants' sensitivity to negative emotions (disgust, fear, anger and sadness) and their emotion reactivity (score on the Emotion Reactivity Scale) on their sensitivity to conventional and moral transgressions.

Sensitivity to conventional transgressions

Model comparison

The model that was best supported by the data was the one that predicted sensitivity to conventional transgressions from sensitivity to anger and sensitivity to fear: the observed data are over four times more plausible under this model than under the competing models, including the null model, which specifies that none of the predictors have effects (BF_M = 4.694). The evidence favouring the model that includes sensitivity to disgust and to anger is anecdotally stronger than the evidence for the models that include only sensitivity to fear (BF_{01} = 1.505) or only sensitivity to anger (BF_{01} = 1.652), and anecdotally or moderately stronger than the evidence for the rest of the models ($BF_{01} \geq 1.557$), including the null model.

Analysis of effects

The model-averaged results indicate anecdotal evidence in the data for including sensitivity to anger (BF_{incl} = 2.259) and sensitivity to fear (BF_{incl} = 2.754), and no conclusive evidence for the effects of the remaining predictors ($BF_{incl} < 1$).

Parameter estimates

The model-averaged posterior distribution analysis indicated that the posterior mean of anger sensitivity was 0.095 (SD = 0.086; [−0.014, 2.57]), meaning that each additional point in anger sensitivity leads to an average increase in 0.095 sensitivity to transgressions, and that the posterior mean of fear sensitivity

was 0.093 (*SD* = 0.077; [0, 0.231]) and meaning that each additional point in fear sensitivity leads to an average increase in 0.093 sensitivity to transgressions.

Sensitivity to moral transgressions

Model comparison

The model that was best supported by the data was the one that predicted sensitivity to moral transgressions from sensitivity to anger and sensitivity to fear: the observed data are over four times more plausible under this model than under the competing models, including the null model ($BF_M = 4.304$). The evidence favouring the model that includes sensitivity to disgust and to anger is anecdotally stronger than the evidence for the models that include only sensitivity to fear ($BF_{01} = 1.931$) or only sensitivity to anger ($BF_{01} = 1.595$), and anecdotally or moderately stronger than the evidence for the rest of the models ($BF_{01} \geq 1.210$), including the null model.

Analysis of effects

The model-averaged results indicate moderate evidence in the data for including sensitivity to anger ($BF_{incl} = 3.002$) and sensitivity to fear ($BF_{incl} = 3.128$), and no conclusive evidence for the effects of the remaining predictors ($BF_{incl} < 1$).

Parameter estimates

The model-averaged posterior distribution analysis indicated that the posterior mean of anger sensitivity was −0.121 (*SD* = 0.097; [−0.289, 0]), meaning that each additional point in anger sensitivity leads to an average increase of 0.121 sensitivity to moral transgressions and that the posterior mean of fear sensitivity was −0.110 (*SD* = 0.087; [−0.260, 0]), meaning that each additional point in fear sensitivity leads to an average increase in 0.110 sensitivity to moral transgressions.

Predicting aesthetic sensitivity

In this subsection, we present the results of the second stage of data analyses, in which we used Bayesian inference to determine the effects of participants' sensitivity to negative emotions (disgust, fear, anger and sadness) and their emotion reactivity (score on the Emotion Reactivity Scale) on their sensitivity to symmetry, room tidiness and facial attractiveness.

Sensitivity to symmetry

Model comparison

The model that was best supported by the data was the one that predicted sensitivity to symmetry from sensitivity to disgust: the observed data are over 10 times more plausible under the model that includes sensitivity to disgust ($BF_M = 10.453$) than under the competing models, including the null model. The evidence favouring the model that includes sensitivity to disgust is anecdotally stronger than the evidence for the model that includes sensitivity to disgust and sensitivity to fear ($BF_{01} = 1.576$), and moderately to extremely stronger than the evidence for the rest of the models ($BF_{01} \geq 3.088$), including the null model.

Analysis of effects

The model-averaged results indicate strong evidence in the data for including sensitivity to disgust ($BF_{incl} = 18.03$), and no conclusive evidence for the effects of the remaining predictors ($BF_{incl} < 1$).

Parameter estimates

The model-averaged posterior distribution analysis indicated that the posterior mean of disgust sensitivity was 0.411 (*SD* = 0.172; 95% CI [0, 0.676]). This means that each additional point in disgust sensitivity leads to an average increase of 0.411 sensitivity to symmetry.

Sensitivity to untidiness

Model comparison. The model that was best supported by the data was the one that predicted sensitivity to room disorder from sensitivity to disgust: the observed data are almost 11 times more plausible under this model than under the competing models, including the null model ($BF_M = 10.792$). The evidence favouring the model that includes sensitivity to disgust is anecdotally to moderately stronger than the evidence for the models that include, in addition, sensitivity to sadness ($BF_{01} = 2.266$), sensitivity to anger ($BF_{01} = 2.549$) or sensitivity to fear ($BF_{01} = 3.170$), and moderately stronger than the evidence for the rest of the models ($BF_{01} \geq 3.412$), including the null model.

Analysis of effects

The model-averaged results indicate strong evidence in the data for including sensitivity to disgust ($BF_{incl} = 14.172$), and no conclusive evidence for the effects of the remaining predictors ($BF_{incl} < 1$).

Parameter estimates

The model-averaged posterior distribution analysis indicated that the posterior mean of disgust sensitivity was 0.155 (*SD* = 0.140; [−0.003, 0.265]), meaning that each additional point in disgust sensitivity leads to an average increase in 0.155 sensitivity to room untidiness.

Sensitivity to facial attractiveness

Model comparison

The model that was best supported by the data was the null model: the observed data are more than six times more plausible under this model than under the competing models ($BF_M = 6.372$). The evidence favouring the null model is anecdotally stronger than the evidence for the models that include sensitivity to fear ($BF_{01} = 1.820$), sensitivity to disgust ($BF_{01} = 2.419$) or sensitivity to anger ($BF_{01} = 2.494$), and moderately stronger than the evidence for the rest of the models ($BF_{01} \geq 3.469$).

Analysis of effects

The model-averaged results indicate no conclusive evidence for the effects of any of the predictors ($BF_{incl} < 1$).

DISCUSSION

The purpose of this study was to address two issues: (1) Are moral and aesthetic evaluative judgements influenced specifically by disgust, or by defensive emotions in general? (2) Are the defensive emotions that influence moral and aesthetic evaluative judgements distinct or common? We examined how participants' sensitivity to disgust, fear, anger and sadness predicted sensitivity to the symmetry of geometric designs, the tidiness of rooms and the attractiveness of rooms, and sensitivity to conventional and moral transgressions.

Our results show that evaluations of conventional and moral transgressions could be predicted by participants' sensitivity to anger and fear. Participants who were more sensitive to anger and fear were also more sensitive to conventional and moral transgressions: the more angering and fearful participants found IAPS stimuli, the more wrong they found the conventional and moral transgressions. In contrast, our analysis showed that evaluations of aesthetic stimuli were best predicted by participants' sensitivity to disgust. Participants who were more sensitive to disgust were also more sensitive to symmetry and room untidiness: the more disgusting participants found IAPS stimuli, the more they liked symmetrical geometric patterns and the more they liked tidy rooms. We did not find sensitivity to any emotion to predict sensitivity to facial attractiveness.

These findings have implications for the two issues that motivated this study. Regarding the specificity vs. generality issue, our results support Tracy et al.'s (2019) hypothesis that, while disgust may play a specific role in evaluations of purity violations, it is not causally involved in evaluations of other kinds of moral transgressions. In situations where people assess the wrongness of social behaviour that involve non-purity transgressions, judgements may be driven primarily by emotions of fear and anger. However, more research is needed on other defensive emotions besides disgust to fully understand the nature of moral evaluations: only a few studies have tested the influence of other defensive emotions on moral evaluations (e.g. Piazza & Landy, 2020; Russell & Giner-Sorolla, 2013; Tracy et al., 2019).

Our results also contribute to the clarification of the role defensive emotions play in shaping negative aesthetic judgements. Current assumptions hold that negative aesthetic judgements, especially ugliness judgements, are derived from disgust responses to experienced stimuli. The little evidence for this rests mainly on inferences from one set of studies finding atypical faces to elicit disgust (e.g. Park et al., 2003, 2013; Ryan et al., 2012) to another set of studies finding atypical faces to be perceived as ugly (e.g. Bull & Rumsey, 1988). Few, if any, studies have tested if levels of disgust predict judgements of ugliness in the same subject cohort. Furthermore, very few studies have examined disgust and ugliness responses to stimulus categories other than faces, and other defensive emotions apart from disgust. An exception to this Klebl et al.'s (2021) study that collected self-reported measures of sadness, fear and disgust responses to pictures of faces, animals and buildings. Their results showed a pronounced tendency for all three types of stimuli to elicit enhanced disgust responses that could not be explained by the two other negative emotions (Klebl et al., 2021). Furthermore, Klebl et al. (2021) found ugly stimuli to increase disgust, but not beautiful stimuli to decrease disgust, suggesting that disgust is specific to negative aesthetic evaluations. We extend this finding by demonstrating that individual sensitivity to disgust, but not to fear, sadness or anger, predicts subjective disliking of untidy rooms and asymmetrical patterns. Our results support the hypothesis that aesthetic disliking of sensory stimuli reflects the generation of states of disgust, with negative aesthetic judgements scaling with the person's individual responsiveness to disgust-inducing features. We note, however, that our model did not find sensitivity to disgust to predict sensitivity to facial attractiveness. This null result possibly is explained by the particular task we used to assess attractiveness ratings: rather than asking people to report how much they liked the individual faces, we asked the participants to rate 'how attractive' they found the faces. It is possible that this formulation prompted our participants to map their emotional responses to a cognitive model of what 'attractiveness' is supposed to mean, thus diminishing the magnitude of negative judgements (Skov & Nadal, 2021).

Second, regarding the distinctiveness vs. commonality issue, we found evidence that negative moral and aesthetic evaluations tap into different kinds of defensive emotions: Variations in aesthetic judgements were best predicted by participants' sensitivity to disgust, while variations in moral judgements were best predicted by sensitivity to anger and fear. This dissociation suggests that moral and aesthetic evaluations differ with respect to the type of defensive emotions they rely on. The fact that none of the best models included participants' emotional reactivity scores also supports the idea that moral and aesthetic evaluations rely on specific defensive emotions, and not on general emotional responsiveness. Further investigation is required to determine whether this reflects differences between the two evaluations or a difference in more fine-grained task demands. However, given that our experimental design directly compared the relationship among fear, anger, sadness, disgust and the two categories of

evaluations, in the same group of participants, we interpret our findings as strong evidence against the position that moral and aesthetic evaluations are rooted in general emotional responsiveness.

The results of this study provide the basis for further work that could test the role of sex as a mediator of the effects of emotional sensitivity on moral and aesthetic evaluative judgements and the differential effects of using visual or verbal materials as stimuli, or that could directly contrast the effects of sensitivity to different emotions on moral and aesthetic moral evaluations of materials belonging to, and not belonging to, the purity domain.

In sum, we found evidence suggesting that moral and evaluative judgements are influenced by defensive emotions. The evidence shows that this influence is more nuanced than previously thought. Whereas the degree of condemnation of conventional and moral transgressions—outside the purity domain—is best predicted by the strength of responses to angering and fearful stimuli, liking for symmetry and tidiness is predicted by the strength of responses to disgusting stimuli. Thus, regarding the specificity vs. generality issue, we found that, at least outside of the purity domain, sensitivity to disgust is not related to moral evaluative judgements in a specific or special manner, although we did not find evidence for a general influence of all defensive emotions either. Regarding the distinctiveness vs. commonality issue, we found evidence supporting the role of distinctive defensive emotions in non-purity moral and aesthetic evaluative judgements.

To conclude, we found that individual differences in sensitivity to anger and fear predict the strength of condemnation of moral and conventional transgressions, and that individual differences in sensitivity to disgust predict liking for symmetry and tidiness. These results provide evidence for the role of defensive emotions in moral and aesthetic evaluative judgements, but suggest that moral and aesthetic evaluative judgements depend on different defensive emotions.

AUTHOR CONTRIBUTIONS

Alejandro Dorado: Data curation; formal analysis; software. **Martin Skov:** Conceptualization; investigation; supervision; writing – review and editing. **Jaume Rosselló:** Conceptualization; formal analysis; methodology; supervision; writing – review and editing. **Marcos Nadal:** Conceptualization; data curation; formal analysis; methodology; writing – original draft.

CONFLICT OF INTEREST

All authors declare no conflict of interest.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are openly available in Open Science Framework at https://osf.io/dypxa/.

ORCID

Martin Skov https://orcid.org/0000-0002-4895-4802
Jaume Rosselló https://orcid.org/0000-0003-4010-7868
Marcos Nadal https://orcid.org/0000-0002-9341-4688

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APPENDIX A

SCENARIOS SELECTED AND TRANSLATED FROM CHAPMAN AND ANDERSON

Neutral action scenarios

Original version Chapman and Anderson (2014)		Spanish translation
N1	A student laughs and jokes with her friends while they walk down the hall during the lunch break	Una estudiante se ríe y bromea con sus amigos mientras caminan por el pasillo durante la hora de la comida
N3	One student forgot his lunch at home, so he borrows lunch money from his friends	Un estudiante olvidó su almuerzo en casa, así que le pide prestado el dinero del almuerzo a sus amigos
N7	A student tells another student about a big fight she had with her boyfriend the night before	Un estudiante le cuenta a otro estudiante que tuvo una gran pelea con su pareja la noche anterior
N9	A student talks with his friends outside of the school before class starts for the day	Un estudiante habla con sus amigos fuera de la escuela antes de que comience la clase
N10	After school, a student reads a magazine while he waits for the bus home	Después de la escuela, un estudiante lee una revista mientras espera el autobús para ir a casa
N11	A student calls his friend after school and they make plans to watch a movie together	Un estudiante llama a su amigo después de la escuela y hacen planes para ver una película juntos
N14	A student asks the art teacher for some more paint to work on her project in art class	Un estudiante le pide al profesor de arte un poco más de pintura para trabajar en su proyecto en la clase de arte
N16	After school, two students play basketball together in the playground	Después de la escuela, dos estudiantes juegan baloncesto juntos en el patio

Conventional transgression scenarios

Original version Chapman and Anderson (2014)		Spanish translation
C1	A student stands up and walks out of the classroom without permission in the middle of class	Un estudiante se levanta y sale del aula sin permiso en medio de la clase
C2	A student rides his skateboard in the playground even though it is against the school rules	Un estudiante monta en monopatín en el patio aunque vaya en contra de las reglas de la escuela
C3	A student wears a t-shirt and jeans to school instead of the school uniform	Un estudiante viste una camiseta y unos tejanos en la escuela en lugar del uniforme escolar
C9	A student asks the teacher a question in class without raising her hand first	Un estudiante le hace una pregunta a la maestra en clase sin levantar la mano primero
C11	A student writes his name on his desk	Un estudiante escribe su nombre sobre su escritorio
C12	A student sends text messages to her friends on her cell phone in class	Un estudiante usa el móvil para enviar mensajes de texto a sus amigos durante la clase
C13	A student chews gum in class, although it is against the school rules	Un estudiante mastica chicle en clase, aunque va en contra de las reglas de la escuela
C14	A student does not hand her homework in on time	Un estudiante no entrega su tarea a tiempo

Moral transgression scenarios

Original version Chapman and Anderson (2014)		Spanish translation
M2	One student tells all her friends about a secret that another student told her	Un estudiante les cuenta a todos sus amigos un secreto que otro estudiante le contó en confianza
M6	One student laughs at another student who failed a math test, saying that he must be stupid	Un estudiante se ríe de otro estudiante que suspendió un examen de matemáticas, diciendo que debe ser estúpido
M10	A student makes fun of another student who is in a wheelchair, calling him a cripple	Un estudiante se burla de otro estudiante que está en una silla de ruedas, llamándolo tullido
M12	A student writes racist graffiti on another student's locker	Un estudiante hace un '*grafiti*' racista en la taquilla de otro estudiante
M13	A student makes fun of a girl who cannot afford cool clothes	Un estudiante se mofa de una chica que no se puede permitir la ropa que está de moda
M14	A student spreads nasty rumours about another student	Un estudiante difunde rumores desagradables sobre otro estudiante
M15	During lunch, a student enters a classroom and steals a teacher's purse from her desk	Durante la hora de la comida, un estudiante entra en la clase y roba la cartera de un profesor que tenía guardada dentro de su mesa
M16	A grade 12 student makes younger students give him their lunch money	Un estudiante de curso superior hace que los estudiantes más jóvenes le den el dinero para la comida

APPENDIX B

EMOTION REACTIVITY SCALE TRANSLATED FROM NOCK ET AL. (2008)

Item	Original version Nock et al. (2008)	Spanish translation
1	When something happens that upsets me, it's all I can think about it for a long time	Cuando sucede algo que me afecta, solo puedo pensar en ello durante bastante tiempo
2	My feelings get hurt easily	Mis sentimientos son fáciles de herir
3	When I experience emotions, I feel them very strongly/intensely	Cuando siento emociones, las siento de forma muy fuerte e intensa
4	When I'm emotionally upset, my whole body gets physically upset as well	Cuando estoy afectado emocionalmente, siento que también se afecta mi cuerpo
5	I tend to get very emotional very easily	Tiendo a emocionarme muy fácilmente
6	I experience emotions very strongly	Mis experiencias emocionales son muy intensas
7	I often feel extremely anxious	A menudo siento mucha ansiedad
8	When I feel emotional, it's hard for me to imagine feeling any other way	Cuando siento una emoción, me cuesta imaginar que me pueda sentir de otra forma
9	Even the littlest things make me emotional	Hasta los aspectos menos relevantes me hacen sentir emociones
10	If I have a disagreement with someone, it takes a long time for me to get over it	Si tengo un desacuerdo con alguien, necesito bastante tiempo para que superarlo
11	When I am angry/upset, it takes me much longer than most people to calm down	Cuando estoy enfadado/a o molesto/a, necesito más tiempo que la mayoría de las otras personas para calmarme
12	I get angry at people very easily	Me enfado con las personas muy fácilmente

Item	Original version Nock et al. (2008)	Spanish translation
13	I am often bothered by things that other people don't react to	A menudo me molestan cosas ante las que otras personas no reaccionan
14	I am easily agitated	Me irrito fácilmente
15	My emotions go from neutral to extreme in an instant	Mis emociones pasan de neutras a extremas en un instante
16	When something bad happens, my mood changes very quickly. People tell me I have a very short fuse	Cuando sucede algo malo, me cambia muy rápido el humor. La gente me dice que tengo una mecha muy corta
17	People tell me that my emotions are often too intense for the situation	La gente me dice que mis emociones suelen ser demasiados intensas para la situación
18	I am a very sensitive person	Soy una persona muy sensible
19	My moods are very strong and powerful	Mis humores son muy intensos
20	I often get so upset it's hard for me to think straight	A menudo me siento tan afectado/a que me cuesta pensar con claridad
21	Other people tell me I'm overreacting	La gente me dice que reacciono de forma exagerada