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Cognitive Psychology

The Medical Intervention Picture Database (MIPD): Validation of a Picture Database Related to Medical Interventions

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A growing body of research has been dedicated to investigating anxiety in relation to medical procedures, as this anxiety disorder is among the most prevalent and has a substantial impact on quality of life. However, no standardized image database currently exists that specifically targets these types of fears. The present study aims to establish an image database that reliably represents the relevant emotional reactions associated with medical fears. The images were categorized into four groups (Fear-related, Disgust-related, Mixed, and Neutral) based on the emotions they evoke. This process yielded 111 pictures depicting various medical procedures, injuries, medical situations, and equipment. In an online survey, 557 (420 female; age range: 18-80; mean age=27.7; SD=11.1) participants rated the images along four dimensions (arousal, disgust, threat, valence) on a 9-point Likert scale. Although the initial categories differed across dimensions, cluster analysis indicated that arousal provided the most meaningful classification, resulting in three categories: high-threat, moderate-threat, and neutral images. The present findings suggest that intensity (arousal) rather than discrete emotions (such as fear or disgust) primarily drives evaluations of medical-related stimuli. Differences by sex and medical qualification further validated the database. This new resource offers a reliable tool for research on fears associated with medical procedures.

Introduction

Until now, there has been no image database specifically focused on medical procedures. Blood-injury-injection phobia (BII phobia) is a specific anxiety disorder where the intense anxiety is related to the sight and thought of medical interventions (American Psychiatric Association, 2013), such as medical screenings, blood draws, or flu shots. Previous studies showed that the prevalence of BII phobia is 3% (Wardenaar et al., 2017). However, fears associated with other medical procedures can be more prevalent, for example, fear of injections and blood affects around 20-50% of the younger population (McLenon & Rogers, 2019), while 19.5% of the adult population (Kose & Mandiracioglu, 2007). People with these conditions tend to avoid medical screenings or interventions (Birkás et al., 2022; McLenon & Rogers, 2019; Wright et al., 2009), which makes it difficult to diagnose diseases in time or to start the treatment in an early stage. Therefore, the quality of their life can be lower, and they could expect a shorter lifespan (Caplan, 2014; Spleen et al., 2014). For this reason, it is essential to examine the factors that contribute to the development and maintenance of fears related to medical procedures in detail.

Standardized image sets are reliable and convenient to elicit medical fear (e.g., blood–injection–injury, needles, dental scenes) in both experimental and clinical settings, preserving experimental control and enabling reproducible comparisons across studies or samples (Marchewka et al., 2014; Michałowski et al., 2017). Pictures allow researchers to detect behavioral, psychophysiological, and cognitive mechanisms (e.g., avoidance; event-related potential, attentional biases) linked to the subjective experience of fear, helping to understand fear-related responses and specific triggers (Alexopoulos et al., 2019; Zhou et al., 2021). Moreover, image-based paradigms also contribute to identifying moderator factors (e.g., disgust and anxiety sensitivity) that shape fear responses to medical stimuli (Stevens et al., 2021). Given the high prevalence and potential severe consequences of medical fears, validated picture databases can be considered as an essential tool for identifying and perhaps reducing medical fears (McLenon & Rogers, 2019).

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However, until now, there has been no image database specifically focused on medical procedures. While existing image databases contain related images, they often fail to display all relevant aspects of medical fears. The absence of a database containing such images could be due to key emotional (fear, disgust) and observer-related (experience, sex) factors that play a role in the development and maintenance of medical fears thus, it is challenging to present these factors adequately. When creating a picture database focusing on medical fears, it is essential to present these visual features and allow for the measurement of relevant observer-related factors.

Emotional Factors

There are two key emotional dimensions, fear and disgust, associated with BII-phobia. Consequently, stimuli related to medical scenarios are strongly associated with these emotions. (Kiss et al., 2022; Olatunji, Ebesutani, et al., 2012; Sawchuk et al., 2002).

Fear is an adaptive response to a possible threat, as it helps to preserve our physical integrity by avoiding situations that carry the risk of such injuries (Crombez et al., 2005). However, in medical procedures, this bodily harm is caused to improve health or preserve life. Medical procedures frequently involve tissue damage or cause harm to the integrity of our bodies (Olsen et al., 2020). Such interventions may include the removal of a malignant tumor, ligament repair in the knee, or even getting an injection. These interventions share characteristics with accidental injuries, including cutting ourselves with a knife or breaking our leg. Medical interventions are often followed by pain, a powerful signal that usually indicates a health or physical problem within the body (Johansen & Fields, 2004; Turk & Wilson, 2010; Zsido et al., 2025). Accordingly, the onset of pain may encourage individuals to seek medical help. On the other hand, pain can also be a side effect of certain procedures, which may occur either immediately (e.g., after an injection) or persist for a longer period following a medical intervention (e.g., after knee surgery). The lack of reliable information about the pain associated with such interventions may increase uncertainty and increase the probability of avoidance behavior (Markfelder & Pauli, 2020; Simon et al., 2022). Taking together, these findings support the prominent role of fear in medical-related stimuli.

Disgust is another key emotion that helps to facilitate avoidance behavior in particular situations. Unlike fear, it is significant in cases where the threat does not pose a physical danger to our body, but carries the possibility of contamination. Accordingly, certain situations related to BII phobia cannot cause physical harm rather, they can cause infection. These can be, for instance, a rash on the skin, someone coughing, or the sight of blood. The disease-avoidance model suggests that disgust is an emotional response that can help us avoid such potentially contagious situations (Davey, 2011; Matchett & Davey, 1991). Even though medical interventions are focusing on improving our health, during these interventions, we can encounter such contagious stimuli. Furthermore, secondary infection remains a problem in modern healthcare, as it can cause further unwanted complications after a successful operation (Gillespie et al., 2021). Thus, disgust plays a crucial emotional factor in how individuals perceive stimuli related to medical interventions.

Due to the elicited fear and disgust, BII-related stimuli can be generally evaluated as negative and unpleasant. Reflecting the aversive and negative nature of injuries and possible contaminations. In addition to the emotional impact of images, how intensely (arousing) we perceive them is also important. Numerous studies have shown that elevated arousal levels play a significant role in the activation of the neural network that controls avoidance behavior (Lundqvist et al., 2014, 2015; Reisenzein, 1994; Zsidó, 2024; Zsido et al., 2020), as it can increase physiological activation. An elevated level of arousal can help us to notice fearful or disgusting stimuli .(Zsidó, 2024; Zsido et al., 2020). Therefore, in addition to fear and disgust, the perceived valence and arousal of stimuli can also influence their evaluation.

Observer-Related Factors

In addition to the fear, disgust, and arousal elicited, other observer-related factors may also influence the evaluation of such visual stimuli. Females tend to report higher levels of medical fears (Birkás et al., 2023; Kiss et al., 2022), are more likely to be affected by various anxiety disorders (Kessler et al., 2005; Magee et al., 1996; Wardenaar et al., 2017), and they also report a higher level of disgust sensitivity than males (Al-Shawaf et al., 2018; Haidt et al., 1994; Rozin et al., 1999). Prior relevant experience could reduce the elicited fear or disgust (Coelho et al., 2021; Coelho & Purkis, 2009; Meindl et al., 2019; Olatunji, Ciesielski, et al., 2012). It is important to emphasize that this previous experience must be harmless, as individuals are better able to exercise control in such an environment (Coelho & Purkis, 2009). Consistent with this, recent findings show that in the case of dental procedures, regular non-invasive, benign interventions decreased the level of dental anxiety (Zsido et al., 2025). Despite the aforementioned individual differences, it is essential that an appropriate image database can accurately represent fears related to medical procedures and serve as a reliable measuring tool.

The Present Study

The overachieving goal of this study was to develop and validate a standardized image database of medical procedures that reliably presents content related to fear and disgust. Such a database can be later used to explore how these emotions influence the perception of medical-related situations. Further explore factors that influence the evaluation of content related to medical intervention. We used the circumplex model of affect to measure participants' emotional responses. The images were evaluated on four dimensions: (1) arousal, referring to the level of emotional intensity the image evokes; (2) disgust, referring to the level of repulsiveness of the images; (3) threat, referring to the level of fear of the image evokes, (4) valence, referring to the level

of negativity or positivity of the image. Based on prior theoretical frameworks, we hypothesized that the images can be categorized into four distinct group (H1)s: Fear-related images, which depict possible harm to physical integrity (e.g. sterile medical tools); Disgust-related images, which show the possibility of infection without possible physical damage (e.g. coughing person); Mixed images, which represents elements for both fear and disgust (e.g. bloody medical equipment); Neutral control images similar to medical instruments and procedures, but with neutral content. Further, we hypothesized that (H2a) female participants will report a higher level of fear and disgust, and they will find the pictures more negative and more intense (arousal) compared to male participants. In addition, we suggested that (H2b) prior medical experience will decrease the level of reported fear and disgust, and they will be associated with less negative and less intense picture ratings.

Method

Participants

We did not conduct a prior sample size estimation. During data collection, however, we aimed to obtain responses from more than five times as many participants as there were images. A total of 588 participants took part in the study, of whom 59 participants only partially completed the survey, as the pictures were presented in random order; partial completions didn't mean exclusion from analysis. After the initial data collection, we examined the responses for outliers. We excluded 31 respondents with unusually low response variability to the main scales, which we defined as either above ninety percent of the answers being the same or a very low (the lowest ten percent) standard deviation of the responses. Consequently, the final dataset that we analyzed comprised data from 557 participants, aged 18-80 (mean age=27.7, SD=11.1). Table 1 shows the detailed demographic characteristics of the final sample. The research was approved by the Ethical Committee of the University of Pécs Medical School (BMEÜ/2449-3/2022/EKU) and was carried out following the Code of Ethics of the World Medical Association (Declaration of Helsinki). Informed and written consent was obtained from all participants. The results of the survey, the pictures, and the dataset supporting the conclusions of this article are available in the Open Science Framework repository (https://osf.io/j736n).

Picture Material

Picture Categories

The pictures were collected from websites that share freely available images to the public. We selected only images labeled for non-commercial reuse in order to ensure that the set could be used without copyright limitations. We gathered the pictures along four theoretically driven categories. The first category was the fear-related pictures, which contained pictures associated with the possible harm to the integrity of the body and pain without the possibility of infection, e.g., a hypodermic needle, a room for operation, etc. For the second disgust-related category, we gathered pictures that are associated with possible infections without physical harm, e.g., sick people, rash on skin, etc. In the third category for the mixed pictures, we collected pictures that can be associated with both fear and disgust, e.g., infected wound, used medical equipment, etc. In the fourth category, we collected neutral control images that present visually similar images as in the previous categories but are not medically related and have no negative effect, e.g., body parts without harm, tools similar to medical equipment. Overall, we selected a total of 111 pictures: 26 Fear-related, 27 Disgust-related, 30 Mixed, and 28 neutral control.

Rating Process and Rating Dimensions

Our data comes from a non-representative online survey designed to assess emotional responses to pictures depicting medical procedures and settings. We collected data online with the help of Qualtrics. The questionnaire was distributed via university e-mail lists and via social media. First, participants completed sociodemographic and prior medical procedure related questions. Then they filled out various questionnaires assessing anxiety, medical fears, fear of pain, disgust sensitivity, pathogen disgust, and probability of giving first aid. In the present study we focus solely on the picture ratings and demographic questions to report standard values for various groups. Although we do not analyze the results of the questionnaires here, we make the dataset available in full, including all study variables on the OSF site of the study. After answering the questions, the participants could move on to rate 111 medical-related images in multiple blocks.

We asked participants to rate images according to how they felt while watching them along four dimensions: threat (non-threatening - threatening), disgust (not disgusting-disgusting), arousal (weak-strong), and valence (negative-positive) on a 9-point Likert scale. For all dimensions, 5 marked the neutral rating. The pictures were presented in 9 different blocks (~12 pictures in one block), the blocks contained pictures from each category and were presented in randomized order. Participants could rate all 111 images. It took approximately 45 minutes to complete the survey.

Statistical Analysis

In our study, as we are interested in the patterns and differences visible in the responses to the pictures, we calculated the mean score of the four scales given by the 557 respondents, resulting in a picture-level database, where each picture (N = 111) has four mean values based on the collected individual responses. In the analysis, we not only use data from participants who rated each image, but also partial completions. All analyses were conducted using the R software and RStudio (Posit team, 2025; R Core Team, 2021). Descriptive statistics for the analyses are only presented in Figures within the article, while detailed tables of

Table 1. Demographic characteristics of the sample by biological sex, place of residence, level of education, and medical qualifications.

Variable	Category	Count	Percentage (%)
Sex	Female	420	75,40
	Male	133	23,88
	Prefer not to say	4	0,72
Place of Residence	Village	141	25,31
	Town	212	38,06
	County Seat	148	26,57
	Capital city	55	9,87
	Other	1	0,18
Level of Education	Primary education	9	1,62
	Vocational training	6	1,08
	Secondary education	263	47,22
	Post-secondary vocational qualification	47	8,44
	BA/BSc	149	26,75
	MA/MSc	67	12,03
	Doctoral degree (PhD)	10	1,80
	Other	6	1,08
Medical qualification	Yes	303	54,40
	No	254	45,60

descriptive statistics are provided as Supplementary Materials 1 and 2, and are also available on the OSF page.

We analyzed the differences between our suggested theoretical categories using analysis of variance. We use a series of ANOVAs that account for heteroskedasticity or use the trimmed means to compare groups across the four scale measures (see Delacre et al., 2019; Wilcox, 2012).

To uncover patterns in the aggregate means of the pictures, we employ a simple approach using k-means cluster analysis (see Everitt et al., 2011), where we determine the optimal number of clusters by examining the changes in the within-clusters sum of squares (elbow method), the gap statistic, and silhouette analysis (Yuan & Yang, 2019).

For group comparisons between male and female respondents and those with or without a previous medical experience, we repeated the averaging process only for the given group of respondents and focused on the differences between aggregate mean values. For sex and medical experience-based dichotomous comparisons, we rely on robust t-tests (Ruxton, 2006).

Results

First, we investigated differences between the Initial Categories along the Rating Dimensions. Descriptive statistics for these comparisons are presented in Figure 1. Detailed statistical results of the main effects are presented in Table 2, and the Post-hoc analyses are reported in Supplementary Material 3. While the pictures showed variability, comparing the four original picture groups (Neutral, Mixed, Disgust-related, Fear-related) also revealed notable differences. On all four scales, pictures containing Mixed and Disgust-related content were perceived similarly by the respondents. In contrast, Neutral pictures generally scored lower on arousal, disgust, and threat, and higher on valence. Threat-related pictures were between these two extremes, suggesting that they elicited a more moderate response compared to Mixed and Disgust-related pictures. In sum, our results suggest that the contents of the picture were related to different emotional responses, implying that contents related to medical procedures affect people differently, with an especially negative response to Mixed and Disgust-related pictures. However, the results also showed that the Disgust-related and Mixed images were hard to separate along the dimensions of fear and disgust.

Next, we sought to test whether our original starting point of a four-group categorization would be the best solution or if a simpler differentiation exists using k-means cluster analysis. Based on the consensus of the elbow method and the silhouette analysis, the analysis suggested that a three-cluster solution is the best fit (see Supplementary Material 4.). Table 4 shows the mean of the scales, alongside the standardized values, across the three groups. Although this did not confirm our original four-group categorization, it still proved theoretically meaningful. Cluster 1 (Moderate-threat) comprised pictures for which respondents gave an "average" response across the four scales. Contrary to this, the other two clusters received differing types of reactions. Cluster 2 (Neutral) consisted of pictures which respondents found to be neutral (represented by a more positive valence score and below average scores on the other three negative emotional scales). While Cluster 3 (High-threat) received more negative valence, and above

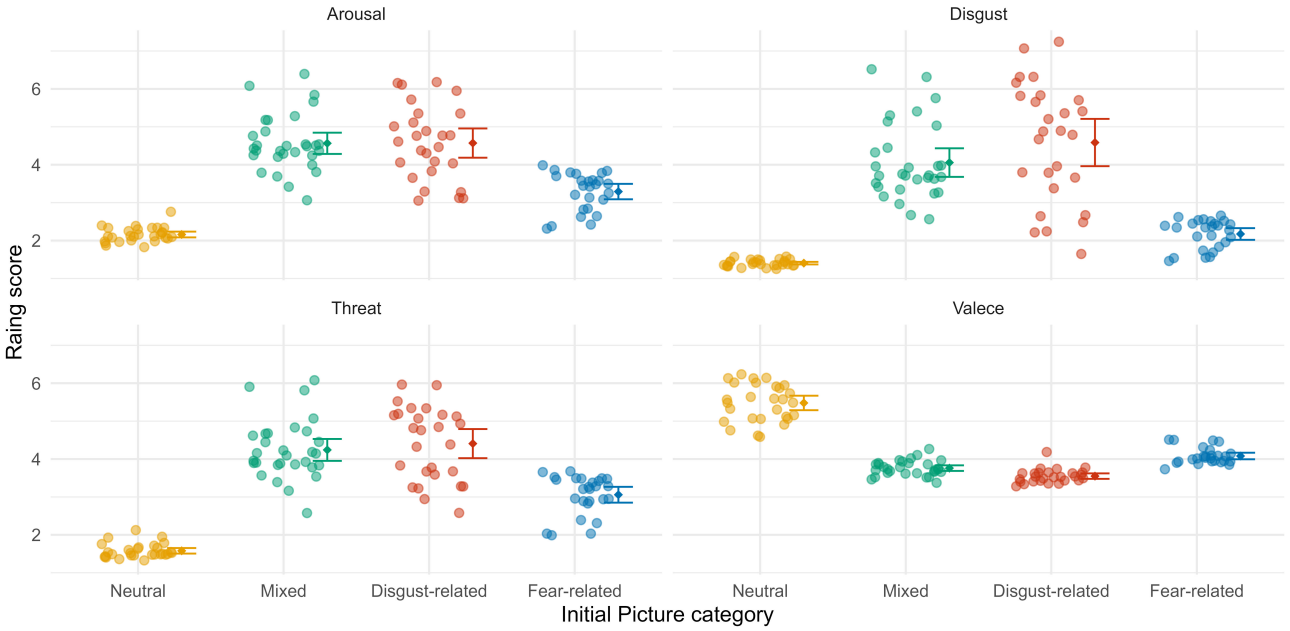

Figure 1. Mean comparisons of the Initial Categories (Neutral, Mixed, Disgust-related, Fear-related) along the four rating dimensions: arousal, disgust, threat, valence.

Table 2. ANOVA and post-hoc results for the comparison of the Initial Categories of the images.

Scale	Welch ANOVA	p-value (Welch)	Robust ANOVA	p-value (Robust)	Eta^2
Arousal	161.5	<0.001	165.1	<0.001	0.91
Disgust	131.6	<0.001	89.9	<0.001	0.90
Threat	215.6	<0.001	276.2	<0.001	0.93
Valence	135.3	<0.001	107.8	<0.001	0.88

N = 111. Note: statistics are based on the mean scores of 557 respondents. Welch ANOVA accounts for the heterogeneity of variances, while robust ANOVA also account for outliers by using the trimmed means.

average arousal, disgust and threat responses. Descriptive statistics for these comparisons are presented in Figure 2. Detailed statistical results of the main effects are presented in Table 4, and the Post-hoc analyses are reported in Supplementary Material 5. In sum, it seems that, contrary to our expectations, medical fear-related pictures elicit a mix of threat and disgust and, thus best categorized based on their intensity (i.e., arousal), and partly on their valence.

In the following, we focus on the new categories (Moderate-threat, High-threat, Neutral), and investigate the differences between the categories along rating dimensions, sex (male or female), and previous medical experience (no or yes). Figure 3 presents the means per group, with corresponding t-test results in Table A5.

Regarding the sex differences, we found that females, compared to males, had higher arousal and valence ratings in the Moderate-threat picture category. Females had lower arousal, disgust, and threat scores in the Neutral category. Females scored higher on arousal, threat, and valence for the High-threat category, compared to males. Overall, we can see that females rated the Moderate and High threat pictures as more intense and threatening compared to males. However, they did not find these image categories as negatively as males did. Based on this, our hypothesis regarding differences between males and females was partially confirmed.

The results of the comparisons between the medical qualification groups showed that those who have a medical qualification had lower scores on arousal, threat, and on valence in the Moderate category. Participants with medical qualifications also scored lower on arousal and on threat but scored higher on valence in the High-threat category. Those who have a medical qualification reported a lower level of disgust and valence in the Neutral control category. The results show that, in the case of threatening images, those with a medical qualification found the images less arousing, threatening, and negative. Based on our results, medical qualification did not affect the assessment of disgust. Overall, our hypothesis was partially confirmed.

Discussion

A deeper understanding of the factors that play a prominent role in the development and maintenance of BII phobia is crucial to decreasing the level of anxiety in people with this condition. For this purpose a reliable picture data-

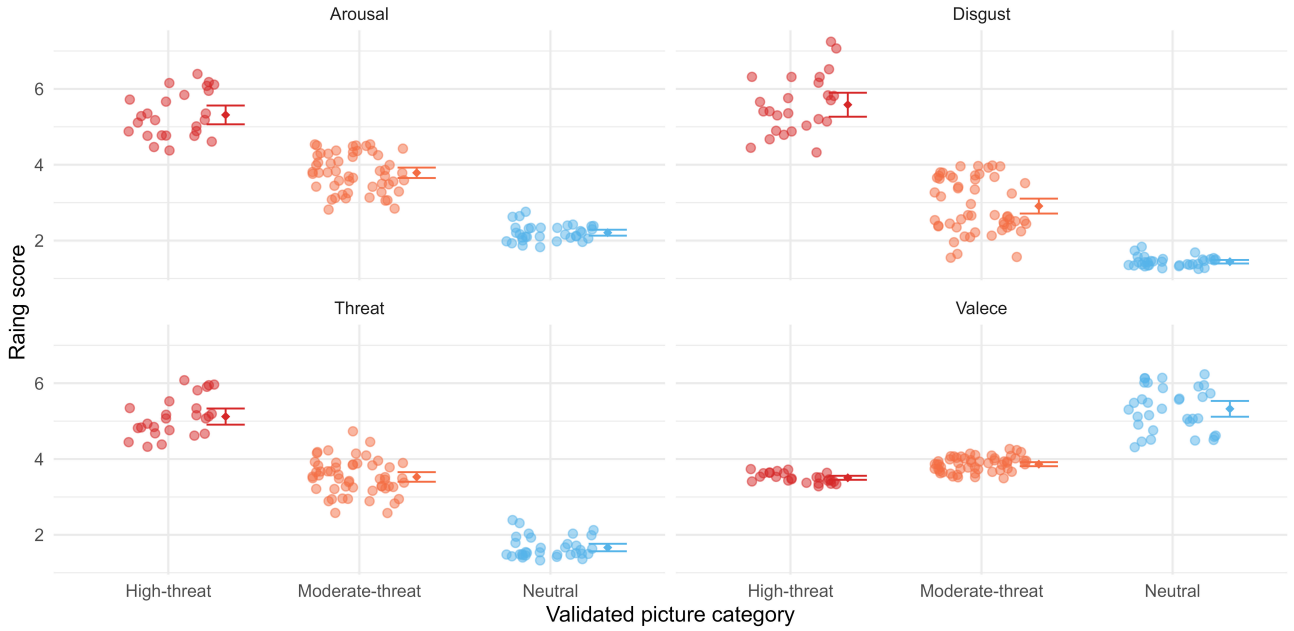

Figure 2. Mean comparisons of the Validated Categories (Neutral, Mixed, Disgust-related, Fear-related) along the four rating dimensions: arousal, disgust, threat, valence.

Table 3. Scale means per the Validated Categories.

Scale	Cluster 1 "Moderate-threat"	Cluster 2 "Neutral"	Cluster 3 "High-threat"
Arousal	3.79 (0.10)	2.21 (-1.19)	5.31 (1.36)
Disgust	2.91 (-0.10)	1.44 (-1.00)	5.58 (1.55)
Threat	3.53 (0.15)	1.67 (-1.26)	5.12 (1.35)
Valence	3.86 (-0.43)	5.32 (1.43)	3.51 (-0.87)

N = 111. Note: statistics are based on the mean scores of 557 respondents. Parentheses contains the standardized values.

Table 4. ANOVA for the Validated Catgeories

Scale	F-statistic (Welch ANOVA)	p-value (Welch)	F-statistic (Robust ANOVA)	p-value (Robust)	Eta^2
Arousal	436.5	<0.001	266.0	<0.001	0.94
Disgust	444.2	<0.001	292.0	<0.001	0.95
Threat	581.8	<0.001	506.0	<0.001	0.95
Valence	170.5	<0.001	98.2	<0.001	0.85

N = 111. Note: statistics are based on the mean scores of 557 respondents. Welch ANOVA accounts for the heterogeneity of variances, while robust ANOVA also account for outliers by using the trimmed means.

base with medical-related content is essential, which is yet not available. Therefore, our current research aimed to create a reliable image database representing fears related to medical procedures. We collected 111 images and categorized them into four categories (pictures eliciting mainly fear, mainly disgust, a mix of both, or neutral control) based on their visual content using previous theoretical approaches (Birkás et al., 2023; Kiss et al., 2022; Olatunji, Ebesutani, et al., 2012; Sawchuk et al., 2002). Although, there appear to be differences between these categories, this theoretical approach does not provide the most effective categorization. The evaluations suggest that the feelings of fear and disgust are less distinct, and the images can be categorized much more effectively along arousal and valence. The developed image database is validated by the

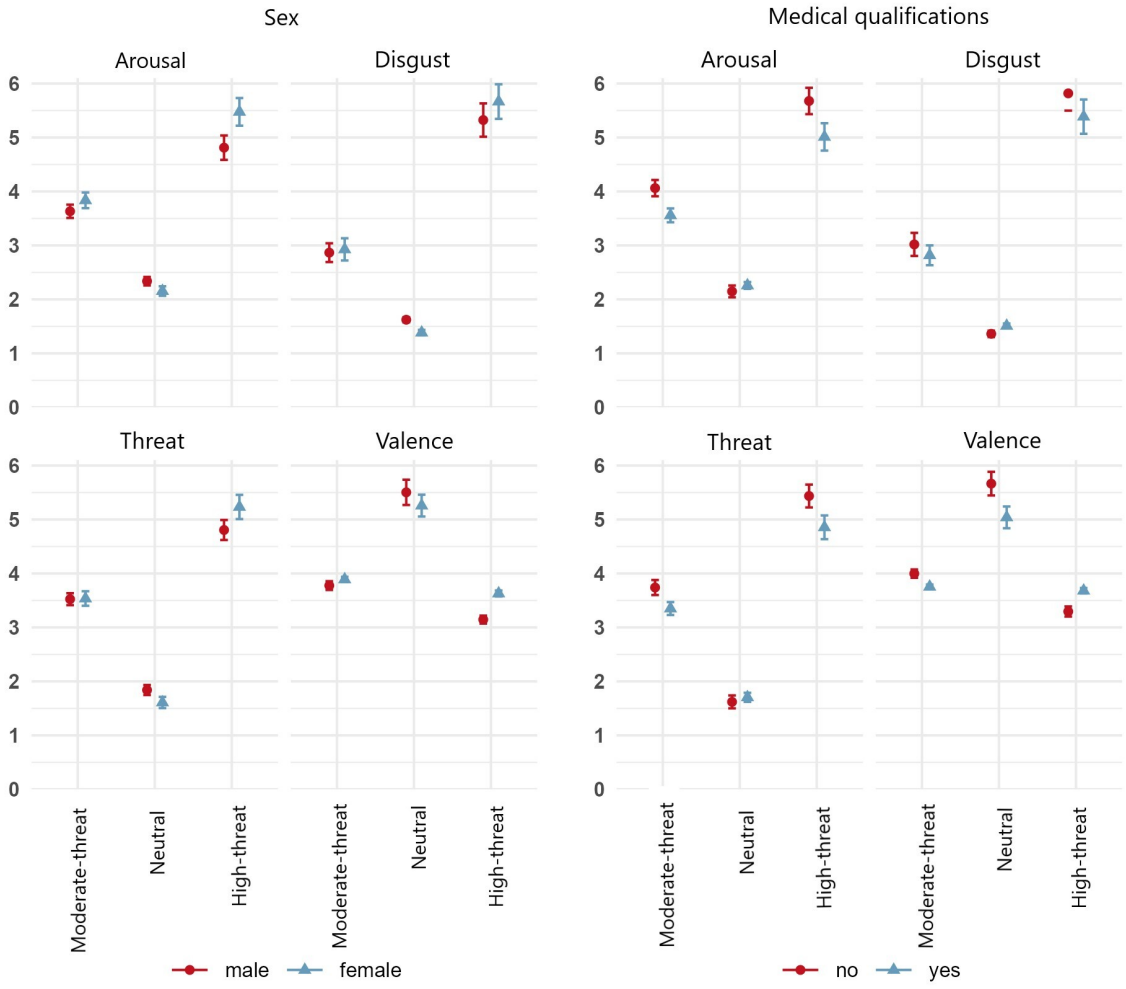

Figure 3. Mean comparisons per sex and medical experience, three clusters

differences in sex and health qualifications, and thus has proved to be a reliable measurement tool.

Our first hypothesis, that the images could be classified into four theoretically defined categories, was only partially confirmed. Although the Fear- and Disgust-related images and the Mixed images differed significantly from the Neutral images in terms of arousal, disgust, threat, and valence, the distinctions between the threatening image categories were less clear. Our results showed that Disgust-related images and Mixed images elicited significantly more intense, negative, threatening, and disgusting reactions than Fear-related images. However, the analysis based on ratings classified the images into three categories. The Neutral category had lower arousal, disgust, and threat values, and more positive valence ratings. There were also Moderate- and High-Threat categories. The former had more negative valence ratings and average arousal, threat, and disgust ratings, while the latter had very negative valence ratings and higher arousal, threat, and disgust ratings. These results suggest that images cannot be completely separated along the dimensions of disgust and fear; rather, arousal and valence determine the subjective evaluations. This does not mean that the categories we assumed on a theoretical basis did not elicit appropriate emotions. As expected, images associated with fear elicited more fear and less disgust (Crombez et al., 2005; Johansen & Fields, 2004; Olsen et al., 2020; Turk & Wilson, 2010). Images associated with disgust elicited a high disgust response (Davey, 2011; Matchett & Davey, 1991; Sawchuk et al., 1999), but also high fear response. Lastly the mixed images elicited a high fear and disgust response (Olatunji, Ebesutani, et al., 2012; Sawchuk et al., 2002). However, the newly created categories show that subjective judgment can be categorized more effectively along the dimension of arousal. This is consistent with the findings of previous studies (Lundqvist et al., 2014, 2015; Zsido et al., 2020), which demonstrate that changes in arousal levels play a significant role in the perception of threatening stimuli. This is because arousal levels play an important role in the development of threat avoidance behavior (Reisenzein, 1994). Consequently, the more intense an image is, the greater the reaction it elicits. Overall, these findings suggest that high levels of fear and disgust reactions are closely linked. The level of arousal also plays a critical role in determining how fearful and disgusting we find a given picture.

Concerning our second hypothesis, for the differences between females and males, we found that females reported significantly higher levels of arousal than males when view-

Table 5. Robust t-tests for group differences in the Validated Categories.

Scale	Cluster	t-statistic (Sex)	p-value (Sex)	Cohen's d (Sex)	t-statistic (Medical qualifications)	p-value (Medical qualifications)	Cohen's d (Medical qualifications)
Arousal	Moderate-threat	-2.2	0.034	0.42	-5.1	<0.001	0.99
	Neutral	3.2	0.002	0.78	1.8	0.082	0.44
	High-threat	-4.0	<0.001	1.13	-3.9	<0.001	1.10
Disgust	Moderate-threat	-0.5	0.653	0.09	-1.4	0.155	0.28
	Neutral	7.0	<0.001	1.72	4.1	<0.001	1.02
	High-threat	-1.6	0.119	0.45	-2.0	0.054	0.56
Threat	Moderate-threat	-0.1	0.889	0.03	-4.3	<0.001	0.83
	Neutral	3.4	0.001	0.83	1.2	0.247	0.29
	High-threat	-3.0	0.004	0.86	-3.9	<0.001	1.11
Valence	Moderate-threat	-2.4	0.018	0.47	-5.5	<0.001	1.07
	Neutral	1.6	0.110	0.40	-4.3	<0.001	1.05
	High-threat	-10.8	<0.001	3.07	7.5	<0.001	2.12

ing Moderate-threat images. When viewing High-threat images, females reported significantly higher levels of both arousal and fear. There was no significant difference between males and females in terms of disgust. This partially confirms our hypothesis, as previous studies have shown that females are more sensitive to threatening content (Filkowski et al., 2017; Robinson et al., 2021) and specifically to threatening stimuli related to medical interventions (Birkás et al., 2023; Kiss et al., 2022). At the same time, it is also apparent that, according to several studies, women report significantly greater disgust than men in the case of self-reported disgust (Al-Shawaf et al., 2018; Haidt et al., 1994; Rozin et al., 1999), but we were unable to replicate this effect.

Regarding medical qualification, our results show that those who have a medical qualification perceive the images as less intense, threatening, and negative. This is also consistent with previous research findings that prior personal experience can reduce the intensity of emotional responses in many specific phobias (Coelho et al., 2021; Coelho & Purkis, 2009), as well as in relation to medical interventions (Birkás et al., 2023; Kiss et al., 2022; Zsido et al., 2025).

Overall, significant differences can be seen in both between males and females, and regarding medical qualifications along the rating dimensions. However, regardless of sex and qualifications, the participants in general perceived the images as threatening, intense, disgusting, and negative. The significant differences suggest that the threshold values for each emotion differ between the groups. Therefore, male participants and those with medical qualifications also perceive the images as threatening, although to a lesser extent than female participants and those without medical qualifications.

Limitations

Some limitations of the study should be noted. In the study, we used only self-report questions to measure the emotions elicited by the images. In the future, it may be worthwhile to supplement subjective assessments with more objective physiological measurements (e.g., skin resistance) in order to increase the reliability of participants' responses. The participants had to rate valence on a two-ended scale (low value negative, high value positive). For more accurate measurement in the future, it may be worthwhile to use a scale where positive and negative values are listed on separate scales.

Conclusions

Despite these limitations, our research has resulted in the creation of a picture database capable of displaying the significant visual elements medical medical-related fears. Rather than using the theoretical categories that we had initially proposed, we have created a new classification criterion that categorizes images based on arousal and valence. Furthermore, we were able to validate the database based on differences between sex and medical qualifications. However, our results suggest that, in addition to subjective assessment of the pictures, physiological measurements should also be taken to more accurately explore the role of arousal.

Contributions

Conceptualization: B.L.K., B.B., and A.N.ZS. Data curation: B.L.K. and D.E. Formal analysis: D.E. Funding acquisition: B.L.K., B.B., and A.N.ZS. Investigation: B.L.K. Methodology: B.L.K. and A.N.ZS. Project administration: B.L.K. Supervision: B.B. and A.N.ZS. Visualization: B.L.K. and D.E. Writing - original draft: B.L.K. Writing - review & editing: D.E., B.B., and A.N.ZS.

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Competing Interests

The authors declare no competing interests.

Ethics Statement

The research was approved by the Ethical Committee of the University of Pécs Medical School (BMEÜ/2449-3/2022/EKU) and was carried out following the Code of Ethics of the World Medical Association (Declaration of Helsinki).

Data Accessibility Statement

The survey, the used pictures, the dataset and The R codes used in this article are available in the Open Science Framework repository (https://osf.io/j736n)

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References

Alexopoulos, J., Steinberg, C., Liebergesell-Kilian, N. E., Hoeffkes, B., Doering, S., & Junghöfer, M. (2019). Biased emotional attention in patients with dental phobia. *European Journal of Neuroscience*, *49*(2), 290–302. https://doi.org/10.1111/ejn.14295

Al-Shawaf, L., Lewis, D. M. G., & Buss, D. M. (2018). Sex Differences in Disgust: Why Are Women More Easily Disgusted Than Men? *Emotion Review*, *10*(2), 149–160. https://doi.org/10.1177/1754073917709940

American Psychiatric Association. (2013). *Diagnostic and statistical manual of mental disorders* (5th ed.). Author.

Birkás, B., Csathó, Á., Teleki, S., & Zsidó, A. (2022). Confirming the factor structure and improving the screening function of the Medical Fear Survey—Short in a Hungarian community sample. *Anxiety, Stress, and Coping*, *35*(2), 248–258. https://doi.org/10.1080/10615806.2021.1913490

Birkás, B., Kiss, B., Coelho, C. M., & Zsidó, A. N. (2023). The role of self-reported fear and disgust in the activation of behavioral harm avoidance related to medical settings. *Frontiers in Psychiatry*, *14*. https://doi.org/10.3389/fpsyt.2023.1074370

Caplan, L. (2014). Delay in Breast Cancer: Implications for Stage at Diagnosis and Survival. *Frontiers in Public Health*, *2*. https://doi.org/10.3389/fpubh.2014.00087

Coelho, C. M., Polák, J., Suttiwan, P., & Zsido, A. N. (2021). Fear inoculation among snake experts. *BMC Psychiatry*, *21*(1). https://doi.org/10.1186/S12888-021-03553-Z

Coelho, C. M., & Purkis, H. (2009). The origins of specific phobias: Influential theories and current perspectives. *Review of General Psychology*, *13*(4), 335–348. https://doi.org/10.1037/a0017759

Crombez, G., Van Damme, S., & Eccleston, C. (2005). Hypervigilance to pain: An experimental and clinical analysis. *Pain*, *116*(1), 4–7. https://doi.org/10.1016/j.pain.2005.03.035

Davey, G. C. L. (2011). Disgust: The disease-avoidance emotion and its dysfunctions. *Philosophical Transactions of the Royal Society B: Biological Sciences*, *366*(1583), 3453. https://doi.org/10.1098/RSTB.2011.0039

Delacre, M., Leys, C., Mora, Y. L., & Lakens, D. (2019). Taking Parametric Assumptions Seriously: Arguments for the Use of Welch's F-test instead of the Classical F-test in One-Way ANOVA. *International Review of Social Psychology*, *32*(1), 13. https://doi.org/10.5334/irsp.198

Everitt, B. S., Landau, S., Leese, M., & Stahl, D. (2011). *Cluster analysis*. Wiley. https://doi.org/10.1002/9780470977811

Filkowski, M. M., Olsen, R. M., Duda, B., Wanger, T. J., & Sabatinelli, D. (2017). Sex differences in emotional perception: Meta analysis of divergent activation. *NeuroImage*, *147*, 925–933. https://doi.org/10.1016/j.neuroimage.2016.12.016

Gillespie, B. M., Harbeck, E., Rattray, M., Liang, R., Walker, R., Latimer, S., Thalib, L., Andersson, A. E., Griffin, B., Ware, R., & Chaboyer, W. (2021). Worldwide incidence of surgical site infections in general surgical patients: A systematic review and meta-analysis of 488,594 patients. *International Journal of Surgery (London, England)*, *95*, 106136. https://doi.org/10.1016/j.ijsu.2021.106136

Haidt, J., McCauley, C., & Rozin, P. (1994). Individual differences in sensitivity to disgust: A scale sampling seven domains of disgust elicitors. *Personality and Individual Differences*, *16*(5), 701–713. https://doi.org/10.1016/0191-8869(94)90212-7

Johansen, J. P., & Fields, H. L. (2004). Glutamatergic activation of anterior cingulate cortex produces an aversive teaching signal. *Nature Neuroscience*, *7*(4), 398–403. https://doi.org/10.1038/nn1207

Kessler, R. C., Berglund, P., Demler, O., Jin, R., Merikangas, K. R., & Walters, E. E. (2005). Lifetime Prevalence and Age-of-Onset Distributions of DSM-IV Disorders in the National Comorbidity Survey Replication. *Archives of General Psychiatry*, *62*(6), 593. https://doi.org/10.1001/archpsyc.62.6.593

Kiss, B. L., Birkás, B., Zilahi, L., & Zsido, A. N. (2022). The role of fear, disgust, and relevant experience in the assessment of stimuli associated with blood-injury-injection phobia. *Heliyon*, *8*(12), e11839. https://doi.org/10.1016/J.HELIYON.2022.E11839

Kose, S., & Mandiracioglu, A. (2007). Fear of blood/injection in healthy and unhealthy adults admitted to a teaching hospital. *International Journal of Clinical Practice*, *61*(3), 453–457. https://doi.org/10.1111/j.1742-1241.2006.01150.x

Lundqvist, D., Bruce, N., & Öhman, A. (2015). Finding an emotional face in a crowd: Emotional and perceptual stimulus factors influence visual search efficiency. *Cognition and Emotion*, *29*(4), 621–633. https://doi.org/10.1080/02699931.2014.927352

Lundqvist, D., Juth, P., & Öhman, A. (2014). Using facial emotional stimuli in visual search experiments: The arousal factor explains contradictory results. *Cognition and Emotion*, *28*(6), 1012–1029. https://doi.org/10.1080/02699931.2013.867479

Magee, W. J., Eaton, W. W., Wittchen, H. U., McGonagle, K. A., & Kessler, R. C. (1996). Agoraphobia, simple phobia, and social phobia in the National Comorbidity Survey. *Archives of General Psychiatry*, *53*(2), 159–168. https://doi.org/10.1001/ARCHPSYC.1996.01830020077009

Marchewka, A., Zurawski, Ł., Jednoróg, K., & Grabowska, A. (2014). The Nencki Affective Picture System (NAPS): Introduction to a novel, standardized, wide-range, high-quality, realistic picture database. *Behavior Research Methods*, *46*(2), 596–610. https://doi.org/10.3758/s13428-013-0379-1

Markfelder, T., & Pauli, P. (2020). Fear of pain and pain intensity: Meta-analysis and systematic review. *Psychological Bulletin*, *146*(5), 411–450. https://doi.org/10.1037/bul0000228

Matchett, G., & Davey, G. C. L. (1991). A test of a disease-avoidance model of animal phobias. *Behaviour Research and Therapy*, *29*(1), 91–94. https://doi.org/10.1016/S0005-7967(09)80011-9

McLenon, J., & Rogers, M. A. M. (2019). The fear of needles: A systematic review and meta-analysis. *Journal of Advanced Nursing*, *75*(1), 30–42. https://doi.org/10.1111/JAN.13818

Meindl, J. N., Saba, S., Gray, M., Stuebing, L., & Jarvis, A. (2019). Reducing blood draw phobia in an adult with autism spectrum disorder using low-cost virtual reality exposure therapy. *Journal of Applied Research in Intellectual Disabilities*, *32*(6), 1446–1452. https://doi.org/10.1111/jar.12637

Michałowski, J. M., Droździel, D., Matuszewski, J., Koziejowski, W., Jednoróg, K., & Marchewka, A. (2017). The Set of Fear Inducing Pictures (SFIP): Development and validation in fearful and nonfearful individuals. *Behavior Research Methods*, *49*(4), 1407–1419. https://doi.org/10.3758/s13428-016-0797-y

Olatunji, B. O., Ciesielski, B. G., Wolitzky-Taylor, K. B., Wentworth, B. J., & Viar, M. A. (2012). Effects of Experienced Disgust on Habituation During Repeated Exposure to Threat-Relevant Stimuli in Blood-Injection-Injury Phobia. *Behavior Therapy*, *43*(1), 132–141. https://doi.org/10.1016/J.BETH.2011.04.002

Olatunji, B. O., Ebesutani, C., Sawchuk, C. N., McKay, D., Lohr, J. M., & Kleinknecht, R. A. (2012). Development and Initial Validation of the Medical Fear Survey-Short Version. *Assessment*, *19*(3), 318–336. https://doi.org/10.1177/1073191111415368

Olsen, N., Moore, P. J., Hyde, S., & Fowler, L. A. (2020). Healthcare Treatment Seeking and Avoidance. In *The Wiley Encyclopedia of Health Psychology* (pp. 297–304). John Wiley & Sons, Ltd. https://doi.org/10.1002/9781119057840.ch79

Posit team. (2025). *RStudio: Integrated Development Environment for R*.

R Core Team. (2021). *R: A language and environment for statistical computing*. R Foundation for Statistical Computing. https://www.R-project.org/

Reisenzein, R. (1994). Pleasure-arousal theory and the intensity of emotions. *Journal of Personality and Social Psychology*, *67*(3), 525–539. https://doi.org/10.1037/0022-3514.67.3.525

Robinson, M. D., Klein, R. J., & Irvin, R. L. (2021). Sex differences in threat sensitivity: Evidence from two experimental paradigms. *Journal of Experimental Social Psychology*, *95*, 104136. https://doi.org/10.1016/j.jesp.2021.104136

Rozin, P., Haidt, J., McCauley, C., Dunlop, L., & Ashmore, M. (1999). Individual Differences in Disgust Sensitivity: Comparisons and Evaluations of Paper-and-Pencil versus Behavioral Measures. *Journal of Research in Personality*, *33*(3), 330–351. https://doi.org/10.1006/JRPE.1999.2251

Ruxton, G. D. (2006). The unequal variance t-test is an underused alternative to Student's t-test and the Mann-Whitney U test. *Behavioral Ecology*, *17*(4), 688–690. https://doi.org/10.1093/beheco/ark016

Sawchuk, C. N., Lohr, J. M., Lee, T. C., & Tolin, D. F. (1999). Exposure to disgust-evoking imagery and information processing biases in blood-injection-injury phobia. *Behaviour Research and Therapy*, *37*(3), 249–257. https://doi.org/10.1016/S0005-7967(98)00127-2

Sawchuk, C. N., Lohr, J. M., Westendorf, D. H., Meunier, S. A., & Tolin, D. F. (2002). Emotional responding to fearful and disgusting stimuli in specific phobics. *Behaviour Research and Therapy*, *40*(9), 1031–1046. https://doi.org/10.1016/S0005-7967(01)00093-6

Simon, E., Zsidó, A. N., Birkás, B., & Csathó, Á. (2022). Pain catastrophizing, pain sensitivity and fear of pain are associated with early life environmental unpredictability: A path model approach. *BMC Psychology*, *10*(1), 97. https://doi.org/10.1186/s40359-022-00800-0

Spleen, A. M., Lengerich, E. J., Camacho, F. T., & Vanderpool, R. C. (2014). Health Care Avoidance Among Rural Populations: Results From a Nationally Representative Survey. *The Journal of Rural Health*, *30*(1), 79–88. https://doi.org/10.1111/jrh.12032

Stevens, E. S., Behar, E., & Siev, J. (2021). The roles of disgust sensitivity and anxiety sensitivity in attentional bias in dental anxiety. *Journal of Anxiety Disorders*, *83*, 102450. https://doi.org/10.1016/j.janxdis.2021.102450

Turk, D. C., & Wilson, H. D. (2010). Fear of Pain as a Prognostic Factor in Chronic Pain: Conceptual Models, Assessment, and Treatment Implications. *Current Pain and Headache Reports*, *14*(2), 88–95. https://doi.org/10.1007/s11916-010-0094-x

Wardenaar, K. J., Lim, C. C. W., Al-Hamzawi, A. O., Alonso, J., Andrade, L. H., Benjet, C., Bunting, B., de Girolamo, G., Demyttenaere, K., Florescu, S. E., Gureje, O., Hisateru, T., Hu, C., Huang, Y., Karam, E., Kiejna, A., Lepine, J. P., Navarro-Mateu, F., Oakley Browne, M., … de Jonge, P. (2017). The cross-national epidemiology of specific phobia in the World Mental Health Surveys. *Psychological Medicine*, *47*(10), 1744–1760. https://doi.org/10.1017/S0033291717000174

Wilcox, R. (2012). *Introduction to Robust Estimation and Hypothesis Testing* (3rd ed.). Elsevier.

Wright, S., Yelland, M., Heathcote, K., & Ng, S.-K. (2009). Fear of needles—Nature and prevalence in general practice. *Aust Fam Physician*, *38*(3), 172–176. https://doi.org/10.3316/informit.771566427388173

Yuan, C., & Yang, H. (2019). Research on K-Value Selection Method of K-Means Clustering Algorithm. *J - Multidisciplinary Scientific Journal*, *2*(2), 226–235. https://doi.org/10.3390/j2020016

Zhou, F., Zhao, W., Qi, Z., Geng, Y., Yao, S., Kendrick, K. M., Wager, T. D., & Becker, B. (2021). A distributed fMRI-based signature for the subjective experience of fear. *Nature Communications*, *12*(1), 6643. https://doi.org/10.1038/s41467-021-26977-3

Zsidó, A. N. (2024). The effect of emotional arousal on visual attentional performance: A systematic review. *Psychological Research*, *88*(1), 1–24. https://doi.org/10.1007/s00426-023-01852-6

Zsido, A. N., Bernath, L., Labadi, B., & Deak, A. (2020). Count on arousal: Introducing a new method for investigating the effects of emotional valence and arousal on visual search performance. *Psychological Research*, *84*(1), 1–14. https://doi.org/10.1007/S00426-018-0974-Y

Zsido, A. N., Kiss, B. L., Coelho, C. M., Matuz, A., Rahvard, P. P., & Birkas, B. (2025). A machine learning approach to investigate the role of fear of pain, personal experience, and vicarious learning in dental anxiety. *BMC Oral Health*, *25*(1), Article 1. https://doi.org/10.1186/s12903-025-05973-9

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