

## The need for diversity in research on facial expressions of pain

### Letter to Editor:

Facial expressions of pain facilitate social communication and are often incorporated in clinical pain assessments, including in patients with acute and chronic pain,<sup>4,23</sup> infants,<sup>25</sup> critically ill nonverbal patients,<sup>20</sup> and cognitively impaired patients.<sup>19</sup> Researchers have begun using criteria such as the Facial Action Coding System<sup>8</sup> to systematically measure facial responses to pain in the laboratory and clinic. Kunz et al.<sup>15</sup> recently performed a much-needed systematic review of this field, which highlights a promising consistency across published data sets. The authors comprehensively reviewed facial movements based on Facial Action Coding System and identified 4 main clusters of action units that occur most frequently and move more in pain conditions compared with baseline in acute and chronic pain: AU4 (brow lower), AU6\_7 (cheek raise/lid tighten), AU9\_10 (nose wrinkle/lip raise), and AU25\_26\_27 (opening of the mouth). This provides key regions of interest for medical providers and future studies to analyze when assessing pain. Importantly, the authors also acknowledge variability in the coactivation of these units across studies, and ultimately advise that doctors evaluate pain expression on an individual basis.

The systematic review also highlights a more unfortunate area of consistency within the field of facial expression research, which is potential sample homogeneity and omission of important demographic information. Eighty-seven percent of the articles in the review were conducted in either Canada or Germany. Although most articles reported the age and sex of their samples, nearly all articles omitted information on race and ethnicity, leaving open the question of whether the findings reflect facial expressions of pain in White males and females from Canada and Germany, or people in general. Only 3 articles mentioned anything pertaining to ethnic or cultural background<sup>5,21,22</sup> or socioeconomic status<sup>21</sup> and none evaluated the potential influence of these factors or intersectional identity in statistical analyses. It is particularly important to consider the role of ethnicity in clinical and basic research because ethnic minorities experience increased pain in laboratory<sup>14</sup> and clinical settings,<sup>1,3</sup> increased postoperative pain,<sup>18</sup> and receive decreased care.<sup>17,24</sup> For example, Black American patients experience increased pain and receive less opioid treatment compared with White Americans after motor vehicle collisions.<sup>2</sup> If pain researchers do not include sample demographics in publications, we run the risk of perpetuating disparities and building a science of pain based on homogeneous samples.

Although researchers have begun to look for mechanisms underlying health inequities in pain,<sup>6,12,16</sup> a lack of diverse samples and over-reliance on White stimulus sets has limited researchers' ability to evaluate whether facial expressions or

their assessment contribute to disparities in pain. One recent study found that White participants require more evidence to recognize pain in Black American faces compared with White American faces.<sup>16</sup> This in-group bias parallels a large literature on biased emotion perception in the United States<sup>9</sup> and directly links with the pain disparities mentioned above. Furthermore, it is still unknown if there are cultural or ethnic differences in the expression of pain. Recent evidence indicates cultural differences in the association between facial responses and basic emotions,<sup>13</sup> despite long-held assumptions that emotional expressions are universal.<sup>7</sup> Pain researchers should increase efforts to include ethnically and culturally diverse samples to evaluate whether similar variations are seen in pain expressions.

We feel that the review by Kunz et al.<sup>15</sup> highlights the need for pain researchers to (1) collect diverse samples in studies of facial responses and other pain assessments, (2) report sample demographics, and (3) formally consider ethnic and cultural influences on pain and pain-related responses. If we continue to use homogeneous samples, we are likely to introduce further biases in pain assessments, particularly as we become more dependent on automated technology and algorithms.<sup>11</sup> Such biases have already been documented in image-based assessments in other fields,<sup>26</sup> including medical decision-making,<sup>10</sup> and we fear it is only a matter of time before they are identified in automated tools for pain. However, if we train these new algorithms with diverse samples, then we have the opportunity to create machines that exhibit less bias than humans. This is a critical period and we urge the research community to note these gaps, report sample demographics, and avoid homogeneous studies that may further the crisis of health disparities in pain.

### Conflict of interest statement

The authors have no conflict of interest to declare.

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### References

- [1] Anderson KO, Green CR, Payne R. Racial and ethnic disparities in pain: causes and consequences of unequal care. *J Pain* 2009;10: 1187–204.
- [2] Beaudoin FL, Gutman R, Zhai W, Merchant RC, Clark MA, Bollen KA, Hendry P, Kurz MC, Lewandowski C, Pearson C, O'Neil B, Datner E, Mitchell P, Domeier R, McLean SA. Racial differences in presentations and predictors of acute pain after motor vehicle collision. *PAIN* 2018;159: 1056–63.
- [3] Campbell CM, Edwards RR. Ethnic differences in pain and pain management. *Pain Manag* 2012;2:219–30.
- [4] Chapman CR, Casey KL, Dubner R, Foley KM, Gracely RH, Reading AE. Pain measurement: an overview. *PAIN* 1985;22:1–31.
- [5] Craig KD, Hyde SA, Patrick CJ. Genuine, suppressed and faked facial behavior during exacerbation of chronic low back pain. *PAIN* 1991;46: 161–71.
- [6] Drwecki BB, Moore CF, Ward SE, Prkachin KM. Reducing racial disparities in pain treatment: the role of empathy and perspective-taking. *PAIN* 2011;152:1001–6.

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- [7] Ekman P, Friesen WV. Constants across cultures in the face and emotion. *J Pers Soc Psychol* 1971;17:124–9.
- [8] Ekman PE, Friesen WV. Facial action coding system. Palo Alto: Consulting Psychologists Press, 1987.
- [9] Efenbein HA, Ambady N. Is there an in-group advantage in emotion recognition? *Psychol Bull* 2002;128:243–9.
- [10] Esteva A, Kuprel B, Novoa RA, Ko J, Swetter SM, Blau HM, Thrun A. Dermatologist-level classification of skin cancer with deep neural networks. *Nature* 2017;542:115–18.
- [11] Hammal Z, Cohn JF. Automatic, objective and efficient measurement of pain using automated face analysis. In: Vervoort T, Karos K, Trust Z, Prkachin K, editors. Social and interpersonal dynamics in pain. Cham: Springer, 2018. pp. 121–46.
- [12] Hoffman KM, Trawalter S, Axt JR, Oliver MN. Racial bias in pain assessment and treatment recommendations, and false beliefs about biological differences between blacks and whites. *Proc Natl Acad Sci USA* 2016;113:4296–301.
- [13] Jack RE, Garrod OG, Yu H, Caldara R, Schyns PG. Facial expressions of emotion are not culturally universal. *Proc Natl Acad Sci USA* 2012;19:7241–4.
- [14] Kim HJ, Yang GS, Greenspan JD, Downton KD, Griffith KA, Renn CL, Johantgen M, Dorsey SG. Racial and ethnic differences in experimental pain sensitivity: systematic review and meta-analysis. *PAIN* 2017;158:194–211.
- [15] Kunz M, Meixner D, Lautenbacher S. Facial muscle movements encoding pain—a systematic review. *PAIN* 2019;160:535–49.
- [16] Mende-Siedlecki P, Qu-Lee J, Backer R, Van Bavel JJ. Perceptual contributions to racial bias in pain recognition. *J Exp Psychol Gen*. Available at: <https://psyarxiv.com/xkufm/>. Accessed 21 February 2019.
- [17] Mossey JM. Defining racial and ethnic disparities in pain management. *Clin Orthop Relat Res* 2011;469:1859–70.
- [18] Ng B, Dimsdale JE, Rollnik JD, Shapiro H. The effect of ethnicity on prescriptions for patient-controlled analgesia for post-operative pain. *PAIN* 1996;66:9–12.
- [19] Oosterman JM, Zwakhalen S, Sampson EL, Kunz M. The use of facial expressions for pain assessment purposes in dementia: a narrative review. *Neurodegener Dis Manag* 2016;6:119–31.
- [20] Payen JF, Bru O, Bosson JL, Lagrasta A, Novel E, Deschaux I, Lavagne P, Jacquot C. Assessing pain in critically ill sedated patients by using a behavioral pain scale. *Crit Care Med* 2001;29:2258–63.
- [21] Prkachin KM, Solomon PE. The structure, reliability and validity of pain expression: evidence from patients with shoulder pain. *PAIN* 2008;139:267–74.
- [22] Rahu MA, Grap MJ, Cohn JF, Munro CL, Lyon DE, Sessler CN. Facial expression as an indicator of pain in critically ill intubated adults during endotracheal suctioning. *Am J Crit Care* 2013;22:412–22.
- [23] Teske K, Daut RL, Cleeland CS. Relationships between nurses' observations and patients' self-reports of pain. *PAIN* 1983;16:289–96.
- [24] Todd KH, Samaroo N, Hoffman JR. Ethnicity as a risk factor for inadequate emergency department analgesia. *JAMA* 1993;269:1537–9.
- [25] von Baeyer CL, Spagrud LJ. Systematic review of observational (behavioral) measures of pain for children and adolescents aged 3 to 18 years. *PAIN* 2007;127:140–50.
- [26] Zou J, Schiebinger L. AI can be sexist and racist—it's time to make it fair. *Nature* 2018;559:324–6.

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## Reply to Dildine and Atlas

### Letter to Editor:

We appreciate the response by Dildine and Atlas<sup>3</sup> to our recently published review article on facial muscle movements accompanying the experience of pain.<sup>8</sup> As the 2 authors correctly point out, most of the evidence on facial expressions of pain stems from research conducted either in Canada or in Germany. And although attempts for diversity were made in these studies, by including participants of varying age groups,<sup>9</sup> of varying degrees of cognitive functioning,<sup>1,4,10</sup> both men and women<sup>7</sup> as well as pain patients and pain-free individuals,<sup>12</sup> the participants were mainly Caucasian. Consequently, as the authors correctly state, our knowledge on facial expressions of pain is mostly based on “facial expressions of pain in White males and females from Canada and Germany.”<sup>3</sup> This is indeed a shortcoming that might limit the generalizability of the findings on facial expressions of pain.

Based on previous evidence, it seems less likely that the type of facial muscle movements occurring during pain will vary across ethnic and cultural groups. Given that a similar subset of pain-indicative facial muscle movements can be found in newborns<sup>2,13</sup> and in genuinely blind individuals<sup>6</sup> suggests that this subset of muscle movements—composed of contraction of the eyebrows, contraction of the muscles surrounding the eyes, nose wrinkle/lip raise, and opening of the mouth<sup>8</sup>—is largely hardwired. However, the intensity to which these pain-indicative facial responses are displayed can be expected to vary substantially among different ethnic and cultural groups. The intensity of facial expressions of pain is governed by learned social display rules that determine when, where, and how we should facially express or not express our pain.<sup>5</sup> Thus, ethnic and cultural differences in social display rules will result in variations in facial expressiveness.

It is crucial to investigate ethnic and cultural differences in facial expressions of pain, given that facial expressions are of great clinical relevance in pain diagnostic and pain treatment. Especially for nonverbal individuals (eg, individuals with dementia), facial expression is one of the key indicators of pain.<sup>11</sup> Not knowing how ethnic and cultural aspects might impact the facial expression of pain could lead to an overtreatment or undertreatment of pain. Thus, we echo the authors' call for more diversity in facial expression of pain research. This diversity should not only include the encoding side (the person expressing pain) but also the decoding side (the observer) of the facial communication of pain process.

### Conflict of interest statement

The authors have no conflict of interest to declare.

### References

- Beach PA, Huck JT, Miranda MM, Foley KT, Bozoki AC. Effects of Alzheimer disease on the facial expression of pain. *Clin J Pain* 2016;32:478–87.
- Craig KD, Prkachin KM, Gruneau RE. In: Turk DC, Melzack R, editors. Handbook of pain assessment. New York: Guilford Publications 2011, pp. 117–133.
- Dildine TC, Atlas LY. The need for diversity in research on facial expressions of pain. *PAIN* 2019;160:1901.
- Hadjistavropoulos T, Browne ME, Prkachin KM, Taati B, Ashraf A, Mihailidis A. Pain in severe dementia: a comparison of a fine-grained assessment approach to an observational checklist designed for clinical settings. *Eur J Pain* 2018;22:915–25.
- Karmann AJ, Lautenbacher S, Bauer F, Kunz M. The influence of communicative relations on facial responses to pain: does it matter who is watching? *Pain Res Manag* 2014;19:15–22.
- Kunz M, Faltermeier N, Lautenbacher S. Impact of visual learning on facial expressions of physical distress: a study on voluntary and evoked expressions of pain in congenitally blind and sighted individuals. *Biol Psychol* 2012;89:467–76.