Pain Medicine Advance Access published January 30, 2016

Pain Medicine 2015; 0: 1–7
doi: 10.1111/pme.12927

OXFORD

Original Research Article

Age Differences in Decoding Pain from the Facial Expression of Healthy Individuals and Patients with Dementia

Stefan Lautenbacher, PhD,* Wiebke Hofer, MD,* and Miriam Kunz, PhD*,†

*Physiological Psychology, Otto-Friedrich University Bamberg, Germany; †Department of Family Medicine, Geriatrics Section, University Medical Center Groningen, The Netherlands

Correspondence to: Stefan Lautenbacher, Physiological Psychology, University of Bamberg, Markuspl. 3, Bamberg 96045, Germany. Tel: +49-951-8631851; Fax: +49-951-8631976; E-mail: stefan.-lautenbacher@uni-bamberg.de.

Funding sources: This study was supported by grants of the Bamberg University (FNK) and of the European program COST (TD 1005).

Conflict of interest: There are no conflicts of interest.

Abstract

Objective. Patients with dementia, whose ability to provide self-report of pain is often impaired, are in crucial need of observers who can detect the patients' pain-indicative behaviors appropriately, to initiate treatment. The facial display of pain promises to be especially informative for that purpose. The age of the observer has been shown to have a critical influence on observational emotion recognition (with age-related decrements in facial emotion recognition) but has not yet been studied as such for pain recognition.

Methods. For that purpose, 24 young (mean age: 24 years) and 22 older (mean age: 70 years) observers watched 120 video clips, showing facial expressions of young and old individuals with and without dementia during slight and moderate noxious stimulation. After each clip, observers were asked to rate how much pain the observed individual might have experienced.

Results. Young observers were superior in grading different levels of pain in the observed individuals; furthermore, their ratings corresponded better with the self-ratings of the observed individuals. However, the performance of the older observers was still sufficient as regards the differentiation of different pain levels and prediction of self-report in others.

Conclusions. Age does not only lead to a decline in recognition of facial expressions of emotions but age also affects the quality of observational pain recognition in others. However, given that older observers' performance was only slightly reduced, clearly suggests that older caregivers are surely not at risk of becoming visual agnostic for the pain in others.

Key Words. Pain; Dementia; Decoding; Facial Expressions; Ago of the Observer

Introduction

It is known that patients with cognitive impairment, especially those suffering from dementia, report less about pain compared with unimpaired individuals of the same age [1,2]. In line with this, patients with dementia are also often prescribed less analgesics [3,4]. Given that painful conditions are likely to be equally prevalent in people with and without dementia [5], this reduced pain report and reduced prescription of pain medication is concerning and suggests an undertreatment of pain in patients with dementia. The reason for this seems to be that pain is difficult to assess in patients with dementia; mainly due to the dementia-related decline in verbal communication [6]. Given that verbal communication serves as the gold standard in pain assessment and also guides the management and treatment of pain, there is a crucial need for alternative ways to assess pain when the verbal report starts to fail or becomes invalid. The facial expression of pain promises to be the most informative nonverbal form of communication, which might help caregivers and healthcare professionals to infer correctly whether an individual suffers from pain [7,8].

For two reasons, the question arises whether the age of the observer affects the correct decoding of pain from facial expressions. First, there is a literature showing that emotion recognition based on the observation of facial expressions is affected by the age of the observer, with the majority of the studies showing slight to moderate age-related deteriorations, especially for the recognition of negative affective states [9–11]. This effect is supposed to be due (among others) to a neuropsychological decline, with age affecting predominantly anterior parts of the brain. Second, caregivers and nurses for older adults are often decades younger than the individuals they are taking care of. Any "own-age bias" (better face recognition for persons of the same age and worse recognition when the ages differ [12]) might have deleterious consequences for the patients with dementia because young caregivers might be biased against recognizing pain in older individuals and thus, in exactly those patients they are responsible for.

With this study, we wanted to investigate the competence of observers of different ages to decode pain from the facial expression of patients with dementia compared with that of young and older individuals without cognitive impairment. Two competing hypotheses formed the basis of our investigation:

1. The "age-related neuropsychological decline" hypothesis would expect older observers to be less competent in the facial recognition and grading of pain in others, thus, making young observers the better professional choice for being caregivers.
2. The "own-age bias" hypothesis suggests that each age group performs best when inferring pain in individuals of their own corresponding age group. Accordingly, young observers would not be the better choice for being caregivers of older patients with dementia.

As stimulus material for pain decoding, we used videotapes of patients and control individuals from our former facial encoding studies [13,14].

Methods

Participants (Observers)

Twenty-four young observers between the ages of 19 and 33 years (♀ = 12; ♂ = 12; mean age: 23.6 ± 4.4 years) and 22 older observers between the ages of 65 and 84 years (♀= 12; ♂ = 10; mean age: 69.6 ± 4.3 years) participated in the present study. The sample size calculation for this study was based on previous studies that investigated the effect of age on decoding of facial expression of several affective states (e.g., [10,15,16]). Young observers were recruited via advertisements posted in the buildings of the University of Bamberg, whereas the older observers were recruited via advertisements posted in the local newspaper (Bamberg) and advertisements posted at local adult education centers (Volkshochschule). Exclusion criteria for both groups were acute or chronic pain, mental disorders in the last 10 years, somatic diseases with likely affection of the pain system, self-reported impaired vision, disorder of attention, and prosopagnosia (impaired ability to recognize faces). These criteria were recorded by use of an anamnestic questionnaire. The study protocol was approved by the ethics committee of the Otto-Friedrich University of Bamberg. All participants gave written informed consent and either received course credit (young observers) or monetary compensation (older observers, 20 €) for their participation.

Material

The video segments, which were presented to the observers of this study, were recorded in earlier studies on facial expressions of pain (for more detail see description in Kunz et al. [12,13]). Three groups of individuals were shown in these videos, namely young individuals (20–38 years), older individuals without cognitive impairments (above 65 years), and older individuals with mild to moderate forms of dementia {above 65 years (MMSE [17] score 17.0, SD: 4.9) for more information see [18]}. The face of these individuals was videotaped while they received phasic pressure stimulation induced by a Fisher pressure algometer. All subjects from the earlier studies had agreed on a later presentation of these video tapes (we only presented videos of patients with dementia who 1) provided a self-report rating to all painful stimuli applied; and 2) who still had legal capacity and thus, were able to provide written informed consent). The videos showed two stimulation conditions, one in which individuals received a slightly painful stimuli (2 kg) and one in which they received a moderately to strongly painful stimuli (5 kg). The pressure increased steadily at an application rate of 1 kg per second until the target intensity was reached and then continued at that level for another 5 seconds. Observers were shown the facial expression that occurred during these 5 seconds at the target intensity level (either 2 or 5 kg). For each of the three videotaped groups (young, old without dementia, old with dementia), the video material of 20 individuals (♀ = 10; ♂ = 10) were randomly selected out of the much greater samples studied [13,14]. Given that each videotaped individual received two stimulation intensities (2 and 5 kg), we presented 120 video segments [2 intensities x (20 young + 20 old + 20 patients with dementia)] to each observer in the present study in a randomized order.

Only frontal views without other facial displays, for example, due to vocalization or yawning were used. Moreover, all 5 second video clips started off with a "neutral expression." Another inclusion criterion of a video segment was the availability of a concurrent six-point verbal rating (VRS) of the observed individual ("no pain," "slight pain," "moderate pain," "strong pain," "very strong pain," "extremely strong pain") for later comparison with the rating of the observers. Therefore, only videos of those patients with dementia were selected who were still able to provide self-report of pain. All video clips were also analyzed using the Facial Action Coding System [13,14,19].

Experimental Protocol

The presentation of the video segments and the assessment of the observer ratings were made possible by the use of a laptop (screen width of 15.4 inches). Testing took place in a quiet room in our laboratory at the University of Bamberg and light conditions could be adjusted to guarantee good visibility. The sessions lasted for approximately 90 minutes and were divided into three blocks. In each block observers watched and rated 40 video segments (120 video segments in total). By dividing the video presentation into three blocks, we tried to prevent fatigue effects that can be expected when having to rate 120 video clips in a row. There were 5 minutes breaks between blocks.

Observers were told that the individuals in the videos were recorded while they were experiencing different levels of pain intensities as well as during nonpainful sensations. After each video, observers were asked to rate the intensity of the pain, which the person in the video appears to experience, on the basis of the observable facial display using a 10-point numerical rating scales (NRS). The pain scale was presented for 7.5 seconds. For later comparison with the self-report ratings of the videotaped individuals, the pain scale was labeled with the same anchors that were used for the videotaped individuals [13,14], namely "no pain"—"extremely strong pain." Observers rated by mouse click. Following the pain scale, observers were also asked to provide additional ratings (e.g., rating the attractiveness of the observed individual); however, these ratings were not considered any further in this report.

Statistics

Observers' history of observing others in pain: To exclude the possibility that potential group differences between young and older observers might simply be due to young individuals having no or little history of observing pain in others, we asked the observers 1) whether; and 2) how often they had contact with an individual who was suffering pain; and 3) how long this individual had been suffering from pain. Answers were compared between young and older observers using Mann–Whitney Tests.

Competence to decode facial expressions of pain: To investigate the competence of the two age groups of observers to decode facial expressions of pain, we used two parameters for further computations:

1. *level*: on the one hand, we were interested on how much pain the observers saw in the facial expressions presented to them. Therefore, we simply used the NRS pain ratings as provided by the observers and entered them into a mixed model analysis with 1 between-subject factor *observer group* (young vs older individuals); and 2 within-subject (repeated measure) factors; namely: *age and cognitive status of the observed* (young vs old and cognitively unimpaired vs old and patients with dementia) and *stimulus intensity* (2 kg vs 5 kg pressure). The within-subjects factors all refer to variations in the videotaped individuals and experimental conditions shown in the video segments; only the between-subject factor reflects the age variation in the observer. Only in case of significance, single comparisons (*t*-tests) were computed for posthoc testing.
2. *concordance*: on the other hand, we were interested in the agreement between observers' pain judgments and the self-report ratings as provided by the videotaped individuals. Therefore, we calculated for each observer the Pearson correlation between his/her own pain ratings (NRS) and the self-report pain ratings of those having been observed (VRS). These individual correlations were calculated separately for the three groups of videotaped individuals but across the two pain intensity levels; thus resulting into three correlation coefficients per observer (indicating the competence of each observer to match the self-report of: 1) young individuals; 2) cognitively unimpaired older individuals; 3) patients with dementia). These individual correlations, which were Fisher-z transformed for better comparisons between subject groups, were then entered into a mixed model analysis with 1 between-subject factor *observer group* (young vs older individuals) and 1 within-subject (repeated measure) factor; namely: *age and cognitive status of the observed* (young vs old and cognitively unimpaired vs old and patients with dementia). Again, the within-subject factor refers to variations in the videotaped individuals and experimental conditions shown in the video segments; only the between-subject factor reflects age variations in the observer. Only in case of significance, single comparisons (*t*-tests) were computed for posthoc testing.

As the correlations between observer ratings (NRS) and self-report ratings (VRS) were supposed to reflect the competence of the observer of matching the self-report of the observed subject (concordance), these correlations should be positive and significantly greater than zero if such a competence can be assumed to exist at all. For that purpose, one sample *t*-tests were computed to test whether the correlations were significantly greater than zero.

The α-level was set to 0.05 throughout and analyses were conducted using SPSS 22.

Results

Observers' History of Observing Others in Pain

As Mann–Whitney Tests revealed, the number of observers who had contact with an individual who was suffering from pain did not differ between young (67%) and older (50%) observers ($P = 0.257$). The same applied to the frequency of contacts with an individual suffering from pain (29% of the young observers and 31% of the older observers had more than once a week contact; $P = 0.637$). When asked about how long the individual they were in contact with, had been suffering from pain, all young and older observers stated that the individual was suffering from chronic pain (more than 6 months).

(i) Level (Differentiating Between Facial Responses to Slight vs Moderate Pain Intensities)

Descriptive statistics of the NRS ratings for the observed intensity of pain are given in Table 1 separately for the young and the older observers.

Age Effects

Analysis of variance showed a non-significant result for the between-subject factor *"observer group"* ($F_{1/44} = 0.02$, $P = 0.878$), thus young and older observers did not differ in general as regards the level of perceived pain in others. There was, however, a significant interaction between the between-subject factor *"observer group"* and the within-subject factor *"intensity"* ($F_{1/44} = 10.80$, $P = 0.002$). This significant interaction was due to the fact that young observers' pain judgment increased more from low to high stimulus intensities compared with old observers (see Figure 1), thus young observers were more sensitive in differentiating between facial responses to slight versus moderate pain intensities.

Other Effects

Both young and older observers saw more pain in the facial display of the observed subjects when the *stimulus intensity* was higher. Accordingly, the main effect of the within-subject factor *stimulus intensity* was significant ($F_{1/44} = 212.27$, $P < 0.001$). However, there was also a significant interaction between *stimulus intensity* and the within-subject factor *age and cognitive status of the observed* ($F_{2/88} = 148.68$, $P < 0.001$). As can be seen in Table 1, observers only saw an increase in facial pain display from low to high stimulus intensities in old individuals with ($t = -16.077$, $P < 0.001$) and without ($t = -8.746$, $P < 0.001$) dementia; whereas observers saw no differences between intensities in young individuals ($t = -1.937$, $P = 0.059$).

Moreover, the level of displayed pain appeared to differ between the three groups of observed individuals ($F_{2,88} = 146.63$, $P < 0.001$). As can be seen in Table 1, all observers saw least pain in the facial display of young individuals (young vs old and cognitively unimpaired: $t = -8.803$, $P < 0.001$; young vs old and cognitively impaired: $t = -13.060$, $P < 0.001$). Highest levels of pain were perceived in patients with dementia (vs old and cognitively unimpaired: $t = -15.270$, $P < 0.001$).

Table 1 Observers' pain estimate (mean, SD) (NRS; 1–10) of young and older observers when inferring pain in young and old individuals with and without dementia under two stimulation conditions (2 kg vs 5 kg)

Video Attributes		Young Observers		Older Observers	
		Mean	SD	Mean	SD
Young	2 kg	2.40	1.08	2.30	1.10
	5 kg	2.55	0.98	2.31	1.18
Old	2 kg	2.97	1.26	3.37	1.82
	5 kg	3.78	1225	3.78	1.73
Demented	2 kg	3.45	1.35	3.87	2.06
	5 kg	5.23	1.23	5.15	2.00

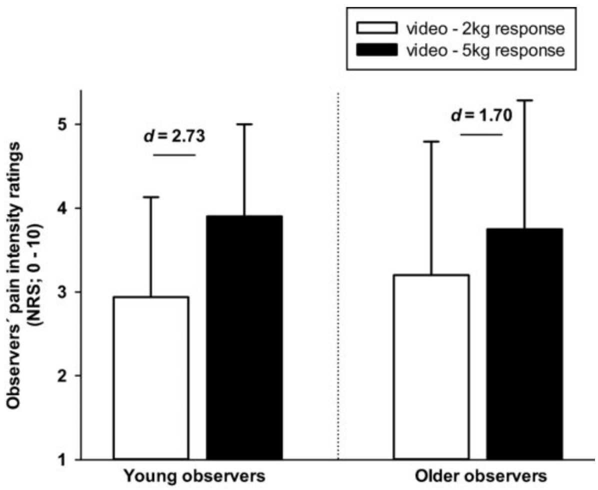

Figure 1 Observers' pain estimate (mean, SD) when inferring pain in others based on their facial expression. Ratings are given separately for *observer group* (young vs old) and *stimulus intensity* (2 kg vs 5 kg). As can be seen, young observerś pain judgment increased slightly more between the two intensities compared with the older observers.

(ii) Concordance (Correlation Between Observer Ratings and Self-Report Ratings of the Observed Individuals)

Our concordance parameter was derived from the pain intensity estimates of each single observer compared with the self-report of the observed individuals, by computing individual correlations between the two rating parameters. Accordingly, such concordance parameters were available for each observer under each observational condition and could be subjected to the calculation of descriptive statistics, which are displayed in Figure 2 (the *y*-axis indicates the strength of the agreement).

Age Effects

Analysis of variance showed a significant result for the between-subject factor *"observer group"* ($F_{1/44} = 4.72$, $P = 0.035$). As can be seen in Figure 2, young observers had higher concordance rates compared with older

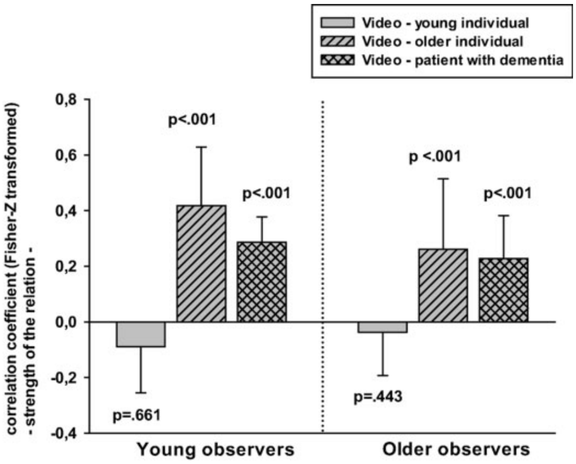

Figure 2 Pearson correlation coefficients (mean and SD) between observers' judgment (young and older observers) and self-report ratings (of the observed young and old individuals with and without dementia). *P* values displayed, indicate wether concordance values differ from zero (one-sample *t*-test).

observers and, thus, showed a better ability to estimate pain intensities in others. Furthermore, we found a significant interaction between *"observer group"* and *"age and cognitive status of the observed"* of the observed individuals ($F_{2/88} = 3.56$, $P = 0.033$). Surprisingly, this interaction was due to younger observers showing a higher concordance rates compared with older observers when evaluating pain in older individuals ($t = 2.49$, $P = 0.017$; see also Figure 2; all other P values >0.05).

Other Effects

Concordance rates were significantly affected by "*age and cognitive status of the observed*" ($F_{2/88} = 124.45$, $P < 0.001$). On average, the concordance scores for the three groups of observed individuals were: young $= -0.02$ (indicating no relationship); old and cognitively unimpaired $= 0.35$ (moderate relationship); old and cognitively impaired $= 0.28$ (weak relationship) (see also Figure 2). Interestingly, the concordance of the observer ratings were clearly highest when older cognitively unimpaired individuals were judged, which can also be seen in significant group differences between this group and the other two groups (young vs old and cognitively unimpaired: $t = -10.05$, $P < 0.001$; old and cognitively unimpaired vs old and cognitively impaired: $t = 2.57$, $P = 0.014$). And the concordance was lowest when judging facial pain displays of young individuals, given that correlation coefficients were also significantly reduced compared with judging old and cognitively impaired individuals ($t = -11.19$, $P < 0.001$).

The findings as presented above inform about whether concordance parameters differed between observers and between groups of observed individuals but they do not inform about whether the concordance values significantly differed from zero or, in other words, whether the observers were better than chance in inferring the pain intensity in others by observing their facial display. To test this, one-sample *t*-tests were computed. This was done for each combination of "*observer group*" and "*age and cognitive status of the observed*," resulting into a total of six tests. As can be seen in Figure 2, four out of these six tests showed that concordance values were significantly different from zero. Interestingly, we found no significant concordance values when the observed individuals were young. In contrast, the concordance between observers' ratings and self-ratings of the observed individuals proved to be significant in 100% of the tests when older individuals (with or without cognitive impairments) were observed (see Figure 2).

Discussion

To test the competing hypotheses that facial recognition and grading of pain either 1) decreased with age ("age-related neuropsychological decline" hypothesis); or 2) is always best when judging one's own age group ("own-age bias" hypothesis), healthy young (mean age: 24 years) and older observers (mean age: 70 years) rated pain in young and older individuals without and with dementia. The observer ratings were based on short video clips that showed facial responses to noxious stimulation of slight and moderate pain intensities. The main findings were in favor of the "age-related neuropsychological decline" hypothesis. Young observers were better in differentiating facial expressions elicited by slight compared with moderate pain intensities. Furthermore, the correlations between observer ratings and self-ratings of the observed—called concordance in the present study—were higher in the young observers. This was especially true, when the observed were older individuals. This finding speaks strongly against the hypothesis of an "own-age bias." Thus, the present data are consistent with existing literature on age-related changes in emotion recognition of facial expressions, which shows in the majority of the studies slight to moderate deteriorations in older observers, especially when judging facial expressions of negative affective states [9–11].

Besides the "age-related neuropsychological decline" and the "own-age bias" hypothesis, there are other hypotheses that might be relevant when trying to explain age differences in decoding pain in others. Halfens et al. [20], for example, hypothesized that accuracy can only be learned by experience. Based on this hypothesis, older observers should be better in decoding pain in others. Our findings do not fit very well with this hypothesis. Other hypotheses, namely the "adaptation-level-hypothesis" or ideas of habituation or adaptation or desensitization due to repeated exposure to pain in others [21,22] would suggest that older individuals underestimate the level of pain in others more than younger observers. Again, our findings do not fit very well with these hypotheses. Older observers did not rate the pain of others as being less intense, they were only less sensitive in differentiating between different pain intensity levels.

As stated above, our results also do not support the concern that an “own-age bias” [12] may prevent young nurses and caregivers from being experts in the identification and grading of pain in older adults, which would hamper proper pain management. In contrast, young observers appeared to be especially sensitive to facial pain expressions in older adults. However, as the recognition and grading performance of older observers, whose age was higher than that of formal caregivers in nursing homes, was far from being poor, concerns about the observational qualification of caregivers at the end of their professional life also seem completely unnecessary.

All observers saw more pain in individuals with dementia than in those without and the least amount of pain in young individuals. This partially matches the order of objectively assessed facial pain expression in earlier studies [13,14,23]. According to fine-grained analyses using the Facial Action Coding System (FACS) in these studies, the patients with dementia showed the strongest facial display of pain, however, no differences were found between young and older individuals without cognitive impairment [13,14,23]. Therefore, seeing more pain in facial expressions of demented patients is supported by fine grained FACS analyses of facial expressiveness in this patient group. The tendency to see more pain in older compared with young individuals (although FACS analyses did not reveal different degrees of facial expressiveness between age groups [13]) was also reported by other authors [24,25]. It has been suggested that seeing more pain in older individuals is based on a stereotype that older individuals are frailer and thus, more likely to suffer from painful experiences [24]. Interestingly, however, the accuracy of the observer ratings was also best for older individuals, considering the match with the self-report ratings. Thus, in spite of potential judgment biases due to such stereotypes of ageing, the ability to accurately infer pain from facial expressions of older individuals was even increased.

Overall, the concordance values between observer ratings and self-report ratings of the videotaped individuals were small to moderate at most. However, this is not surprising when considering 1) that observers solely based their pain judgements on the facial responses; and 2) that facial responses often do not correlate strongly with self-report ratings. Indeed, most studies only found weak associations between self-report and facial responses [26,27] because individuals differ in their tendency to display overtly their pain via their facial expression. In “real life” situations where the observer can base their pain judgement on multiple pain behaviors (e.g., facial expressions, body posture, breathing) it can be expected that concordance values are considerably higher [27].

Limitations of the study are as follows: 1) both age samples were not especially experienced in the evaluation of pain in others. Eritz and Hadjistavropoulos [28] showed that informal caregivers become more sensitive to behavioral indicators of pain only when they had intense contact with patients with dementia. Thus, informal and formal caregivers might, independent of their age, perform better when having intense contact with patients in pain. 2) We did not assess the cognitive performance level of our participants. Thus, we cannot exclude that the age differences we found in decoding facial expressions of pain might be partially due to age differences in overall cognitive performance levels. 3) Moreover, given that we used a cross-sectional design, we cannot exclude that our age effects are confounded with cohort differences. 4) The observed individuals were videotaped subjects from earlier experimental studies [13,14] and thus, showed facial responses to acute, experimentally induced pain that might differ from facial responses occurring during chronic pain conditions. Given that facial expressions tend to quickly habituate, chronic pain patients often only show facial expressions of pain during an acute exacerbation of their pain (e.g., during movements). This is why observational pain tools often advise the observer to observe patients not only during rest but also during movement [29]. Moreover, we only included videos of patients with dementia who were still able to provide self-report ratings and thus, our findings might not be transferrable to patients with more sever forms of dementia. 5) Last, the random selection of video tapes from a previous study might have produced a suboptimal sample, especially with regard to the young individuals, because all observers had difficulties to see differences in pain intensity when observing the young individuals. Furthermore, the concordance between observer ratings and self-reports of the observed was only poor when the observed individuals were young.

Taken together, the competence of inferring pain in others on the basis of observing their facial display appeared to decline moderately with the age of the observer. Age changes were studied from young to older adults, thus fully capturing the age range of formal and informal caregivers of patients with dementia. The findings speak clearly against the assumption that young caregivers might not qualify for pain care of patients with dementia because of an “own age bias” in the observations of facial signals of pain. Moreover, given that older observers’ performance was only slightly reduced, clearly suggests that older caregivers are surely not at risk of becoming visual agnostic for the pain in others.

References

1 Mantyselka P, Hartikainen S, Louhivuori-Laako K, Sulkava R. Effects of dementia on perceived daily pain in home-dwelling elderly people: A population-based study. Age Ageing 2004;33:496–9.

2 Parmelee PA, Smith B, Katz IR. Pain complaints and cognitive status among elderly institution residents. J Amer Geriatr Soc 1993;41:517–22.

3 Sieber FE, Mears S, Lee H, Gottschalk A. Postoperative opioid consumption and its relationship to cognitive function in older adults with hip fracture. J Am Geriatr Soc 2011;59:2256–62.

4 Pickering G, Jourdan D, Dubray C. Acute versus chronic pain treatment in Alzheimer's disease. Eur J Pain 2006;10:379–84.

5 Haasum Y, Fastbom J, Fratiglioni L, Kåreholt I, Johnell K. Pain treatment in elderly persons with and without dementia: A population-based study of institutionalized and home-dwelling elderly. Drugs Aging 2011;28:283–93.

6 Scherder E, Herr K, Pickering G, et al. Pain in dementia. Pain 2009;145:276–8.

7 Hadjistavropoulos T, Craig KD, Duck S, et al. A biopsychosocial formulation of pain communication. Psychol Bull 2011;137:910–39.

8 Hadjistavropoulos T, Herr K, Prkachin KM, et al. Pain assessment in elderly adults with dementia. Lancet Neurol 2014;13:1216–27.

9 Orgeta V, Phillips LH. Effects of age and emotional intensity on the recognition of facial emotion. Exp Aging Res 2008;34:63–79.

10 Sullivan S, Ruffman T. Emotion recognition deficits in the elderly. Int J Neurosci 2004;114:403–32.

11 Ruffman T, Henry JD, Livingstone V, Phillips LH. A meta-analytic review of emotion recognition and aging: implications for neuropsychological models of aging. Neurosci Biobehav Rev 2008;32:863–81.

12 Ebner NC, He Y, Johnson MK. Age and emotion affect how we look at a face: Visual scan patterns differ for own-age versus other-age emotional faces. Cogn Emot 2011;25:983–97.

13 Kunz M, Mylius V, Schepelmann K, Lautenbacher S. Impact of age on the facial expression of pain. J Psychosom Res 2008;64:311–8.

14 Kunz M, Scharmann S, Hemmeter U, Schepelmann K, Lautenbacher S. The facial expression of pain in patients with dementia. Pain 2007;133:221–8.

15 Calder AJ, Keane J, Manly T, et al. Facial expression recognition across the adult life span. Neuropsychologia 2003;41:195–202.

16 Malatesta CZ, Izard CE, Culver C, Nicolich M. Emotion communication skills in young, middle-aged, and older women. Psychol Aging 1987;2:193–203.

17 Folstein MF, Folstein SE, McHugh PR. Mini-mental State: A practical method for grading the state of patients for the clinician. J Psychiatr Res 1975;12:189–98.

18 Lautenbacher S, Niewelt BG, Kunz M. Decoding pain from the facial display of patients with dementia: A comparison of professional and nonprofessional observers. Pain Med 2013;14:469–77.

19 Ekman PE, Friesen WV. Facial Action Coding System. Palo Alto, CA: Consulting Psychologists Press; 1978.

20 Halfens R, Evers G, Abu-Saad H. Determinants of pain assessment by nurses. Int J Nurs Stud 1990;27:43–9.

21 Prkachin KM, Rocha EM. High levels of vicarious exposure bias pain judgments. J Pain 2010;11:904–9.

22 Mason DJ. An investigation of the influences of selected factors on nurses' inferences of patient suffering. Int J Nurs Stud 1981;18:251–9.

23 Kunz M, Mylius V, Scharmann S, Schepelman K, Lautenbacher S. Influence of dementia on multiple components of pain. Eur J Pain 2009;13:317–25.

24 Hadjistavropoulos T, LaChapelle D, Hale C, MacLeod F. Age- and appearance-based stereotypes about patients undergoing a painful medical procedure. Pain Clin 2000;12:25–33.

25 Matheson DH. The painful truth: Interpretation of facial expressions of pain in older adults. J Nonv Behav 1997;21:223–38.

26 Kunz M, Mylius V, Schepelmann K, Lautenbacher S. On the relationship between self-report and facial expression of pain. J Pain 2004;5:368–76.

27 Labus JS, Keefe FJ, Jensen MP. Self-reports of pain intensity and direct observations of pain behavior: When are they correlated? Pain 2003;102:109–24.

28 Eritz H, Hadjistavropoulos T. Do informal caregivers consider nonverbal behavior when they assess pain in people with severe dementia? J Pain 2011;12:331–9.

29 Husebo BS, Kunz M, Achterberg WP, et al. Pain assessment and treatment challenges in patients with dementia. Z Neuropsychol 2012;23:237–46.