



# Contextual influences in decoding pain expressions: effects of patient age, informational priming, and observer characteristics

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## Abstract

We aimed to examine the effects of contextual factors (ie, observers' training background and priming texts) on decoding facial pain expressions of younger and older adults. A total of 165 participants (82 nursing students and 83 nonhealth professionals) were randomly assigned to one of 3 priming conditions: (1) information about the possibility of secondary gain (misuse); (2) information about the frequency and undertreatment of pain in the older adult (undertreatment); or (3) neutral information (control). Subsequently, participants viewed 8 videos of older adults and 8 videos of younger adults undergoing a discomforting physical therapy examination. Participants rated their perception of each patient's pain intensity, unpleasantness, and condition severity. They also rated their willingness to help, sympathy level, patient deservingness of financial compensation, and how negatively/positively they feel towards the patient (ie, valence). Results demonstrated that observers ascribed greater levels of pain and other indicators (eg, sympathy and help) to older compared with younger patients. An interaction between observer type and patient age demonstrated that nursing students endorsed higher ratings of younger adults' pain compared with other students. In addition, observers in the undertreatment priming condition reported more positive valence towards older patients. By contrast, priming observers with the misuse text attenuated their valence ratings towards younger patients. Finally, the undertreatment prime influenced observers' pain estimates indirectly through observers' valence towards patients. In summary, results add specificity to the theoretical formulations of pain by demonstrating the influence of patient and observer characteristics, as well as informational primes, on decoding pain expressions.

**Keywords:** Observer judgements, Priming, Social deception, Aging, Older adults, Elderly, Stereotypes, Social influences

## 1. Introduction

The communications model of pain specifies that various contextual factors, unrelated to the pain experience, influence observers' interpretations of nonverbal pain expressions.<sup>30,31,61</sup> Patient age is one such contextual factor. Observers provide higher pain estimates when assessing pain of older (age 65+ years) compared with younger adults.<sup>33,34,49</sup> Although several other factors have been found to alter observers' assessment of younger adults' pain,<sup>15–17,47</sup>

the study of such influences within the context of the older adult has been limited. Our goal was to examine the impact of observers' training and priming information on observers' perceptions of nonverbal pain expressions of younger and older adults.

Health care professionals tend to provide lower estimates of others' pain compared with lay people.<sup>32,62</sup> As such, we also explored differences in pain judgments of health care trainees compared with students not studying the health professions.

Beliefs in the genuineness of pain expressions modulate observers' judgments of pain. De Ruddere et al.<sup>17</sup> demonstrated that participants who received priming information regarding the misuse of health care services provided significantly lower pain and likability ratings about adults aged 44 to 55 years. Given that younger adults represent the vast majority of the workforce<sup>21,77</sup> and file the majority of financial compensation claims,<sup>2</sup> information about the possible misuse of the health care/compensation system may differentially affect judgments about older vs younger patients.<sup>29</sup> The influence of health system misuse priming on the assessment of older persons' pain, however, has not been investigated. Similarly, the influence of other types of primes (eg, pain undertreatment) has not been studied. As such, we explored the effects of 2 informational primes, in relation to a control prime, on observers' judgments about older vs younger patients. Consistent with De Ruddere et al.,<sup>17</sup> the first prime included information about the possibility of deception due to secondary gain (misuse). The second prime, developed for this investigation, presented information regarding the prevalence and undertreatment of pain in older adults (undertreatment).

Sponsorships or competing interests that may be relevant to content are disclosed at the end of this article.

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Supplemental digital content is available for this article. Direct URL citations appear in the printed text and are provided in the HTML and PDF versions of this article on the journal's Web site ([www.painjournalonline.com](http://www.painjournalonline.com)).

PAIN 159 (2018) 2363–2374

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<http://dx.doi.org/10.1097/j.pain.0000000000001345>

Consistent with previous research, it was hypothesized that: observers would judge older persons' pain higher than younger persons' pain (hypothesis I)<sup>33,34,49</sup>; advanced nursing students would provide lower pain ratings than nonhealth professional students (hypothesis II)<sup>32,62</sup>; the misuse prime would lead to lower valence ratings towards younger adults (hypothesis III)<sup>17</sup>; and the undertreatment prime would result in higher estimates towards older persons' pain (hypothesis IV).

Given past research showing that observers' ratings of deservingness of financial compensation in younger individuals are influenced by contextual factors,<sup>51</sup> we explored whether this also occurs in the context of the older adults who are less likely to apply for injury-related financial compensation.<sup>51</sup> We also explored the influence of patient sex on observers' perceptions given inconsistencies in the past literature.<sup>4,6,34,49,66,70,78</sup> This was the first study to examine the interaction between priming conditions and observers' training on pain estimates. Because the valence of observer attitudes towards patients significantly influences observers' pain judgements,<sup>8,17,80,81</sup> we also explored whether observers' valence ratings mediated the effects of the priming conditions on observers' pain judgements.

## 2. Method

### 2.1. Participants

A power calculation with 1-beta of 0.80, an alpha level ( $\alpha$ ) of 0.05, and an assumed medium effect size<sup>22</sup> was conducted focusing on the analysis requiring the greatest number of participants. It was determined that a sample of 162 would be required. After institutional ethics clearance, participants were recruited through advertisement posters, online postings, and in-class announcements. A total of 165 university students (82 advanced nursing students and 83 nonhealth professional students) were recruited and completed the study. Participants were compensated with \$15.00. Inclusion criteria for nursing students were: (1) 3rd or 4th year university student enrolled in a nursing program, (2) 18 years and older, and (3) speak English fluently. Inclusion criteria for the nonhealth professional students were: (1) a university student not studying the health professions (ie, not in medicine, dentistry, nursing, etc.), (2) at least 20 years of age (this was selected to counterbalance the groups because nursing students were 3rd or 4th year and, therefore, likely to be at least 20 years of age), and (3) speak English fluently.

### 2.2. Apparatus and stimuli

#### 2.2.1. Priming texts

Three priming texts about the pain and the health care system were used. The social deception prime (misuse prime) and neutral prime (control prime) were based on an investigation conducted by De Reddure et al.<sup>17</sup> Minor alterations were made on the scripts (eg, changing "Belgium" to "Canada"). The control prime described the Canadian health care system. The misuse prime indicated that some individuals may deceive health care professionals and take advantage of the health care system. The prime script focusing on the undermanagement of pain in old age was developed for this study. This text also included information about the prevalence of pain in older persons and the availability of effective pain management strategies (see supplementary materials, Appendix A for texts, available at <http://links.lww.com/PAIN/A631>).

#### 2.2.2. Stimulus videos

Videos of 16 different patients (8 adults aged 65 years and older and 8 adults aged 23–39 years) were selected from a larger pool of physiotherapy clinic outpatients' videos that included 48 videos of older adults and 16 videos of younger adults. The selection procedure is described below.

The videos depicted adults undergoing a safe standardized physiotherapy examination designed to identify painful areas.<sup>42,43</sup> This assessment protocol has been used in past research<sup>42,43</sup> and was completed by a licensed physical therapist. Video recordings were taken using a high definition camera, facing the participant directly attached overhead. All videos were edited and cropped so that just the patient's face was shown to reduce additional contextual factors (ie, additional body movements) that could influence ratings.

Because the patient may display several expressions of pain throughout the video, 2 research assistants reviewed the videos and identified the specific time that the peak pain expressions occurred. A total of 42 pain expressions were identified. Cohen's kappa coefficient was calculated because of the dichotomous nature of the rating scale (ie, "pain present" or "pain absent"). Good agreement was found between the 2 research assistants ( $\kappa = 0.78$ , 95%). Consistent with previous research, pain expressions were segmented into 10-second video segments.<sup>15,34</sup>

Subsequently, 2 research assistants coded the facial expressions using the Facial Action Coding System (FACS).<sup>20</sup> The FACS quantifies 44 discrete facial movements, or action units (AUs), based on the functional anatomy of facial muscles.<sup>20</sup> The FACS has been established as a sound method of quantifying pain-related facial activity.<sup>12,26,35,39,48</sup> That is, facial expressions of pain have been differentiated from facial expressions during nonpainful events.<sup>35</sup> Moreover, differences have also been identified between genuine and fake displays of pain.<sup>39</sup> Most facial pain expressions are consistently accounted for in 6 AUs: brow lowering (AU4), cheek raising (AU6), lid tightening (AU7), nose wrinkling (AU9), upper lip raising (AU10), and eyes closed (AU43).<sup>48,60,63,64</sup> Several of these actions consistently co-occur during pain expression; therefore, researchers have combined these AUs to create new actions.<sup>61,63</sup> Cheek raising (AU6) and lid tightening (AU7) have been combined to create "orbit tightening" (AU6/7), and nose wrinkling (AU9) and upper lip raise (AU10) has been combined to create "levator tightening" (AU9/10). Thus, there are 4 facial actions that are most consistently related to pain: brow lowering (AU4), orbit tightening (AU6/7), levator tightening (AU9/10), and closing of the eye (AU43).<sup>64</sup> These 4 facial actions reliably differentiate pain and nonpainful expressions and are significantly related to self-reported pain.<sup>26,59,63</sup>

Using the FACS, the research assistants used a scoring approach described by Prkachin and Solomon.<sup>59</sup> This scoring approach has been validated in previous research involving both younger and older adults<sup>26,63,72</sup> and focuses exclusively on pain-related AUs. This method leads to an overall pain expression score.<sup>59</sup>

All video segments were coded by 2 independent coders in a randomized order. Given the continuous nature of the derived FACS scores, interrater reliability of global pain expressions was assessed through simple correlation.<sup>25,64</sup> Interrater reliability of global pain expression demonstrated good reliability,  $r = 0.94$ . The global pain expression score was then averaged between the 2 coders to result in an average global pain expression score for each video segment.

Once each pain expression was quantified, video segments were balanced by matching average global pain expression

scores. Four videos from each age and sex group were selected, resulting in a total of 16 videos. The mean age of older males was 77 years, SD = 3; younger males was 26 years, SD = 2; older females was 82 years, SD = 4; and of younger females was 30 years, SD = 7. The global pain expressions across age and sex were not significantly different.

The stimulus videos were presented in a random order with 43-second intervals between each segment, which included prompts for participants to complete the rating scales. To reduce order effects, a second stimulus sequence was created using the same procedure but reversing the random order. Thus, 2 video stimuli were created, both approximately 15 minutes in length.

## 2.3. Measures

### 2.3.1. Visual analogue scales

Visual analogue scales (VASs) are widely used self-report measures of subjective experiences and have been demonstrated to be a valid and reliable method of assessing subjective experiences.<sup>7,24,27,44,82</sup> Specifically, test–retest reliability of rating scales ranges from 0.50 to 0.83,<sup>7</sup> and scores have been shown to be highly related to more comprehensive batteries of emotion/affective states.<sup>14</sup> In terms of pain, VASs have been shown to be valid, as they are sensitive to small changes in pain intensity<sup>58</sup> and are highly related with other self-report measures of pain (eg, the Descriptor Differential Scales and Pain Intensity Number Scale).<sup>18,82</sup>

Consistent with similar research designs,<sup>17,49,51</sup> VASs were used to assess 6 variables. That is, participants were asked to rate the patients' *pain intensity* and *pain unpleasantness*. They were also asked to estimate the *severity* of the person's pain condition. Moreover, they were asked to rate their *willingness to help* and how much *sympathy* they felt towards the patient. Finally, participants were asked how deserving the patient was of *financial compensation* for his or her pain. Visual analogue scales' scores were recorded in centimeters.

### 2.3.2. Valence scale

Participants were asked to evaluate the patients in terms of how negative/positive they felt towards the individual. This is consistent with work by De Ruddere et al.,<sup>17</sup> where observers were primed with information about the misuse of the health care system. Like this investigation, valence was evaluated with a 21-point Likert scale, where –10 represented “very negative,” 0 represented “neutral,” and +10 represented “very positive.” Similar rating scales have been used by several other research groups to assess participants' valence towards stimuli.<sup>13,46</sup> This scale has been shown to be valid and reliable indicator of valence and sensitivity to change.<sup>13,17,46</sup>

### 2.3.3. Post-study questionnaire

At the end of the study, observers were asked to respond to one open-ended question regarding what they thought was the purpose of the study. This post-study questionnaire was developed for the purposes of this investigation to better assess whether participants were responding in a particular way as a function of beliefs that the priming scripts were intended to influence responses.

Participants were also asked to respond to 5 open-ended questions regarding what influenced their ratings. More specifically, observers were asked to list factors that influenced their

ratings of pain, willingness to help, sympathy, patient deservingness of financial compensation, and how positively/negatively they felt towards the patient. This exit questionnaire was developed for exploratory purposes to better understand the factors that influenced participants' responses.

## 2.4. Procedure

Before arriving to the laboratory, participants were randomly assigned through block randomization to either the misuse (n = 51), undertreatment (n = 42), or neutral-control (n = 58) priming texts. On arrival, they were screened for eligibility, and informed consent was obtained. Participants were then provided with the prime text to which they were randomized and asked to read the priming text. Once they had read the text, the prime was read again out loud by the experimenter, and all participants were asked whether they had any questions regarding the text. Subsequently, participants viewed the 16 videos. After each video, participants were prompted to complete the VASs and a valence rating.

Once all videos were viewed and measures were completed, participants were asked what they believed the purpose of the study was, to assess demand characteristics. Only 3 participants guessed that the priming scripts were related to the purpose of the study. These participants were not excluded from the study, as the very small sample was not sufficiently powered to alter results. At the end of the study, participants were asked to complete the post-study questionnaire. Participants were then debriefed on the nature of the study and thanked for their participation.

## 2.5. Analyses

### 2.5.1. Quantitative data analyses

Demographic differences across priming conditions (control vs misuse vs undertreatment) with respect to age and level of education were tested using 1-way analyses of variance (ANOVAs). Independent samples *t* tests were conducted to compare the groups for differences in age and years of education (nursing students vs nonhealth professional students). Sex differences between observer type (nursing vs nonhealth professional students) and priming conditions (control vs misuse vs undertreatment) were tested using chi-square tests to ensure equal groups.

We first examined the correlation matrix among our dependent measures. High intercorrelations among these measures would lead us to conduct factor analytic data reduction procedures. After the data reduction, we conducted 3 (control vs misuse vs undertreatment) × 2 (nonhealth professional vs nursing students) × 2 (older vs younger patients) mixed-model ANOVAs to test for main and interaction effects related to observer professional background, patient age, and experimental condition on observers' ratings (eg, pain, sympathy, etc.). Significant univariate effects were followed with simple effects tests. For exploratory analyses, to examine the influence on patient sex (and associated interaction effects) on observers' ratings (eg, pain, sympathy, etc.), we planned additional 3 (control vs misuse vs undertreatment) × 2 (nonhealth professional vs nursing students) × 2 (male vs female patients) mixed-model ANOVAs. Significant univariate effects were followed with simple effect analyses.

Consistent with De Ruddere et al.,<sup>17</sup> mediation analyses were conducted to examine the indirect role of valence ratings between priming conditions and observers' pain, sympathy,

and help estimates. Indicator coding was used to transform the multicategorical predictor variable.<sup>36</sup> Because there were 3 priming conditions (misuse, undertreatment, and control), 2 indicator variables were created ( $3 - 1 = 2$ ; **Fig. 1**). To test the indirect effect of valence, a bootstrapping method (with 5000 resamples and 95% confidence intervals) was used.<sup>36</sup> The bootstrapping method was selected because it is a nonparametric resample procedure that is more appropriate than the normal test (ie, the Sobel test) for investigations with smaller sample sizes.<sup>17,50,57,75</sup>

**Figure 1** illustrates the coefficients that must be identified to conduct a mediation analysis. The relative direct effects of priming conditions have the weights  $c'_1$  and  $c'_2$ . Relative indirect effects (through the mediator “valence ratings”) are represented by weights  $a_1b$  and  $a_2b$ . The effects of priming conditions on patient valence are represented by weights  $a_1$  and  $a_2$ . The effect of valence scores on the outcome variable (eg, observed pain) is represented by weight  $b$ .<sup>36</sup> The total effect (represented by weights  $c_1$  and  $c_2$ ) consists of both the relative direct ( $c'_1$  and  $c'_2$ ) and relative indirect ( $a_1b$  and  $a_2b$ ) effects.

Consistent with bootstrap analyses, the relative indirect effects are significant if the bootstrap confidence interval excludes zero.<sup>36</sup> Mediation is assumed if: (1) the total effects “ $c_1$ ” and/or “ $c_2$ ” and the relative indirect effects “ $a_1b$ ” and/or “ $a_2b$ ” are significant and (2) the relative direct effects “ $c'_1$ ” and/or “ $c'_2$ ” reduce significantly when controlling for the relative indirect effects “ $a_1b$ ” and “ $a_2b$ .” Overemphasizing the relative direct effects “ $c'_1$ ” and/or “ $c'_2$ ,” however, can lead to inaccurate conclusions.<sup>73</sup> Indirect effects “ $a_1b$ ” and/or “ $a_2b$ ” in the absence of total effects “ $c_1$ ” and/or “ $c_2$ ” can occur for several reasons including lack of power, measurement precision, and suppression effects of another variable.<sup>73</sup> Therefore, a significant indirect effect is assumed if the total effects “ $c_1$ ” and/or “ $c_2$ ” are not significant, but the relative indirect effects “ $a_1b$ ” and/or “ $a_2b$ ” are significant.<sup>17,53</sup>

**2.5.2. Narrative data analyses**

Analyses of the post-study questionnaire were conducted using NVivo Software, version 10.<sup>67</sup> Two complimentary narrative analyses’ approaches, thematic analysis and quantitative content analysis, were used to analyze the data.<sup>74</sup> Two researchers collaborated on the analyses to enhance trustworthiness and rigor of the results. To develop a coding framework, Braun and Clarke’s<sup>5</sup> stepwise method of thematic analysis was followed. The first stage involved both coders familiarising themselves with the data by reading all responses. Coders also generated initial ideas regarding observers’ responses. After this phase, coders collaboratively established categories and detailed categorical descriptions to systematically code the data. The categorical framework was used to code the data using meaning units as the basis of analysis. Meaning units are the smallest amount of text that still contains meaning.<sup>55</sup>

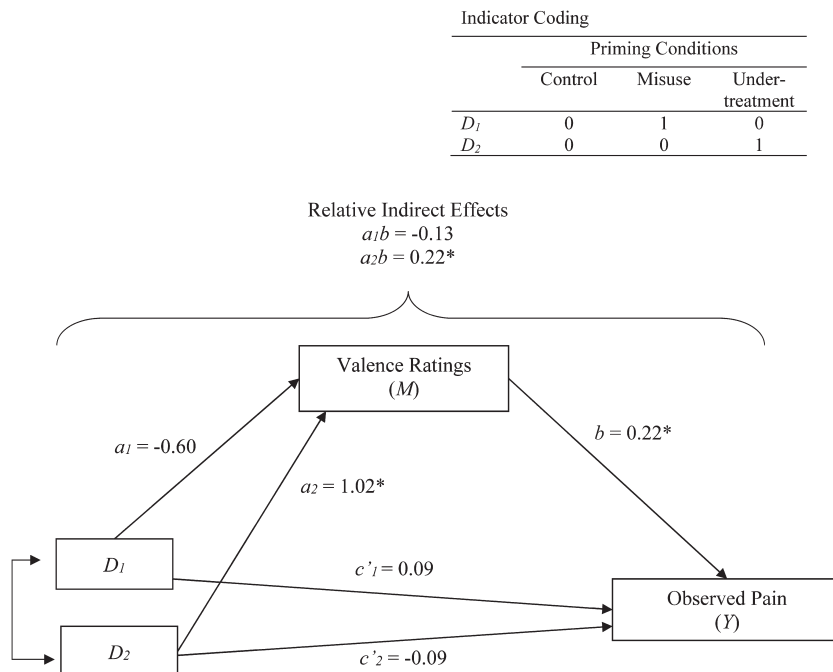
With the established categorical framework, both researchers independently coded all participants’ responses. Subsequently, the 2 researchers compared their data. Consistent with quantitative content analysis,<sup>41</sup> percentage agreement and Cohen’s kappa were calculated to assess interrater reliability.<sup>9,54</sup> After comparisons were conducted, discrepancies were discussed. No changes to the framework were deemed necessary.

Consistent with Braun and Clarke’s<sup>5</sup> final stage, the 2 coders discussed their impressions of the themes that emerged across the categories. After discussions, the total frequencies for each theme were calculated.<sup>41</sup> The frequency score represents the total number of times the observers reported the specified theme.

**3. Results**

**3.1. Demographic characteristics**

A total of 83 nursing students,  $M_{age} = 23$ ,  $SD = 3$ , and 82 nonhealth professional students,  $M_{age} = 24$ ,  $SD = 5$ , completed the study. Of the 165 observers, 23 of them were male, 13



**Figure 1.** Multicategorical mediation model for observed pain estimates.  $D_1$  and  $D_2$  = indicator coded priming conditions (control vs misuse vs undertreatment);  $M$  = mediator variable (valence ratings);  $Y$  = outcome variable (observed pain). \* $p < 0.001$ .



**Table 1****Correlation matrix.**

Outcome*	Pain intensity	Pain unpleasantness	Pain condition severity	Willingness to help	Sympathy	Financial compensation
Pain unpleasantness	0.90					
Pain condition severity	0.92	0.86				
Willingness to help	0.68	0.70	0.71			
Sympathy	0.74	0.76	0.77	0.85		
Financial compensation	0.64	0.62	0.72	0.79	0.76	
Valence	0.40	0.37	0.37	0.56	0.51	0.38

All correlations are significant,  $P < 0.01$ .

\* All outcomes were assessed on a 10-cm visual analogue scale with the exception of valence, which was measured on a 21-point numeric scale.

nonhealth professional students, and 10 nursing students. No significant differences were found across priming conditions or observer type with respect to participants' age and sex.

### 3.2. Data reduction

A correlational matrix was constructed for all observer ratings (Table 1). Given the conceptual relationships and high inter-correlations among the 3 pain estimates (pain intensity, pain unpleasantness, and condition pain severity) and the 3 sympathy and help ratings (willingness to help, financial compensation, and sympathy), we proceeded with a data reduction approach using factor analysis with oblique rotation and forcing a 2-factor solution. This rotation was appropriate because the correlation between our 2 factors exceeded 0.32.<sup>79</sup> Valence was excluded from the factor analysis because we proposed to examine it as a possible mediator between the sympathy/help variables and the pain variables. The Kaiser–Meyer–Olkin measure verified sample size adequacy (Kaiser–Meyer–Olkin = 0.87), and the Bartlett test of sphericity indicated sufficiently large correlations between items for factor analysis,  $\chi^2_{15} = 1136.33$ ,  $P < 0.001$ . The resulting 2-factor solution explained 90.10% of the variance (Table 2) and was stable, given that factor loadings were greater than 0.50 and cross loadings were 0.32 or lower.<sup>11</sup> Moreover, at least half of the items on each factor had loadings that were greater than 0.60.<sup>28</sup> We labelled the first factor that included pain intensity, pain unpleasantness, and pain condition severity “Observed Pain.” The second factor, which included, willingness to help, financial compensation and sympathy ratings, was labelled “Sympathy and Help.” In line with the clearly defined 2-factor solution, we computed 2 new variables based on the average observer scores under each factor. To clarify, to use data reduction techniques to conduct mixed-model ANOVAs, or ANOVAs that include both between-subject factors (ie, priming conditions and observer type) and within-subject factors (ie, patient age and patient sex), observers' ratings of pain intensity, pain unpleasantness, and pain condition severity were averaged to create the “Observed Pain” factor score. Observers' ratings of sympathy, help, and patient deservingness for financial compensation were averaged to create the “Sympathy and Help” factor score. Internally generated factor scores do not differentiate scores for within-subject factor variables (ie, patient age and patient sex). As such, internally generated scores were not used because they would not allow for mixed-model analyses.

### 3.3. Observed pain estimates

Mean values and SDs are presented in Table 3. Consistent with hypothesis I, the 3 (control vs misuse vs undertreatment) × 2

(nursing vs nonhealth professional students) × 2 (older vs younger patients) mixed-model ANOVA demonstrated that observers endorsed significantly higher observed pain estimates towards older patients compared with younger patients,  $F_{1,159} = 384.13$ ,  $P < 0.001$ , partial  $\eta^2 = 0.71$ . There was also a significant interaction between patient age (younger vs older patients) and observer type (nursing vs nonhealth professional students),  $F_{1,159} = 7.40$ ,  $P = 0.007$ , partial  $\eta^2 = 0.04$ . No other significant effects were found.

Simple effect tests were conducted to clarify the identified 2-way interaction (patient age × observer type). Nonhealth professional students' ratings were significantly higher when evaluating pain expressions of older adults,  $M = 4.79$ ,  $SD = 1.45$ , as compared to younger adults,  $M = 3.29$ ,  $SD = 1.20$ ,  $F_{1,159} = 250.64$ ,  $P < 0.001$ , partial  $\eta^2 = 0.61$ . Similarly, nursing students' ratings were significantly higher when evaluating pain expressions of older adults,  $M = 4.76$ ,  $SD = 1.24$ , as compared to younger adults,  $M = 3.62$ ,  $SD = 1.29$ ,  $F_{1,159} = 141.53$ ,  $P < 0.001$ , partial  $\eta^2 = 0.47$ . In general, this interaction effect demonstrates that, although both nursing students and nonhealth care professional students rated observed pain higher in older adults as compared to younger adults, nursing students trended towards higher ratings towards younger adults than nonhealth care professionals.

### 3.4. Sympathy and help estimates

Mean values and SDs are presented in Table 3. Consistent with hypothesis I, the 3 (control vs misuse vs undertreatment) × 2 (nursing vs nonhealth professional students) × 2 (older vs younger patients) mixed-model ANOVA demonstrated that observers reported significantly higher sympathy and help estimates towards older patients compared with younger patients,  $F_{1,159} = 415.17$ ,  $P < 0.001$ , partial  $\eta^2 = 0.72$ . There was also a significant interaction between patient age (younger vs older patients) and observer type (nursing vs nonhealth professional students),  $F_{1,159} = 15.91$ ,  $P < 0.001$ , partial  $\eta^2 = 0.09$ . No other significant effects were found. Simple effects tests were conducted to clarify the identified 2-way interaction (patient age × observer type).

Simple effects tests were conducted to clarify the identified 2-way interaction (patient age × observer type). Nonhealth professional students' ratings were significantly higher when evaluating pain expressions of older adults,  $M = 5.44$ ,  $SD = 1.64$ , as compared to younger adults,  $M = 3.58$ ,  $SD = 1.57$ ,  $F_{1,159} = 299.07$ ,  $P < 0.001$ , partial  $\eta^2 = 0.65$ . Nursing students' ratings were also significantly higher when evaluating pain expressions of older adults,  $M = 5.63$ ,  $SD = 1.57$ , as compared to younger adults,  $M = 4.83$ ,  $SD = 1.74$ ,  $F_{1,159} = 133.11$ ,  $P < 0.001$ , partial

**Table 2**  
**Factor extraction coefficients.**

Outcome*	Factor loadings	
	Factor 1: observed pain	Factor 2: sympathy and help
Pain intensity	<b>1.02</b>	−0.06
Pain unpleasantness	<b>0.95</b>	>0.01
Pain condition severity	<b>0.85</b>	0.14
Willingness to help	0.02	<b>0.93</b>
Sympathy	0.25	<b>0.73</b>
Financial compensation	−0.08	<b>0.98</b>

\* All outcomes were assessed using a 10-cm visual analogue scale. Bold entries under each factor show the items that formed that factor.

$\eta^2 = 0.46$ . Moreover, nursing students provided significantly higher ratings when judging younger adults than nonhealth professional students,  $F_{1,159} = 9.64, P = 0.002$ , partial  $\eta^2 = 0.06$ .

**3.5. Valence ratings**

Results demonstrated significant main effects for each independent variable (priming condition, observer type, and patient age). That is, participants rated videos of older adults significantly more positive than videos of younger adults,  $F_{1,159} = 55.69, P < 0.001$ , partial  $\eta^2 = 0.26$ ; nursing students reported significantly greater positive valence than nonhealth professional students,  $F_{1,159} = 7.20, P = 0.008$ , partial  $\eta^2 = 0.04$ ; and, valence ratings significantly differed depending on which priming text observers received,  $F_{2,159} = 7.61, P = 0.001$ , partial  $\eta^2 = 0.09$ . In addition to these main effects, a 3-way interaction across priming conditions, observer type, and patient age was also observed,  $F_{2,159} = 3.43, P = 0.035$ , partial  $\eta^2 = 0.04$ . Simple effects tests were conducted to clarify this 3-way interaction (patient age  $\times$  observer type  $\times$  priming condition).

Nonhealth professional students in the misuse condition reported significantly higher valence towards older adults,  $M =$

2.41,  $SD = 1.86$ , than younger adults,  $M = 1.53, SD = 1.86, F_{1,159} = 10.06, P = 0.002$ , partial  $\eta^2 = 0.06$ . Also consistent with hypotheses, both nursing students and nonhealth professional students reported significantly higher valence towards older adults,  $M_{\text{nonhealth professional}} = 3.80, SD = 2.62, M_{\text{nursing}} = 4.85, SD = 2.68$ , than younger adults in the undertreatment prime,  $M_{\text{nonhealth professional}} = 1.91, SD = 2.70, M_{\text{nursing}} = 4.17, SD = 2.84; F_{1,159, \text{nursing}} = 5.75, P = 0.018$ , partial  $\eta^2 = 0.04; F_{1,159, \text{nonhealth professional}} = 44.07, P < 0.001$ , partial  $\eta^2 = 0.22$ . Moreover, nursing students in the undertreatment priming condition reported higher valence towards older adults,  $F_{1,159} = 7.53, P = 0.001$ , partial  $\eta^2 = 0.09$ , and younger adults,  $F_{1,159} = 6.78, P = 0.001$ , partial  $\eta^2 = 0.08$ , than nursing students in the misuse condition,  $M_{\text{older}} = 2.39, SD = 2.22, M_{\text{younger}} = 1.90, SD = 1.73$ . Also, nursing students in the control condition reported significantly more positive valence to older adults,  $M = 3.49, SD = 2.21$ , than younger adults,  $M = 2.75, SD = 2.18, F_{1,159} = 7.16, P = 0.008$ , partial  $\eta^2 = 0.04$ . Finally, nonhealth professional students in the undertreatment priming condition reported significantly lower valence towards younger adults than nursing students in the undertreatment priming condition,  $F_{1,159} = 13.16, P = 0.008$ , partial  $\eta^2 = 0.08$ .

**3.6. Mediation analysis: indirect effect of valence**

Following the procedure described by Hayes and Preacher,<sup>36</sup> a bootstrapping method (with 5000 resamples and 95% confidence intervals) was used to test valence ratings as a mediating variable in the relationships between the priming conditions and outcomes. Given that no main effects of observer type (nursing vs nonhealth professional students) were found on these outcomes, observer type was combined for analyses (ie, all responses were analyzed together). Before analyses were conducted, the multicategorical predictor variable (ie, priming condition) was coded using indicator coding procedures.<sup>36</sup> Subsequently, 2 mediation analyses were conducted, one for observed pain estimates and one for sympathy and help estimates.

As displayed in **Figure 1** and **Table 4**, results were in line with findings by De Ruddere et al.<sup>17</sup> Bootstrapped analyses for

**Table 3**  
**Mean values and SDs of observer ratings.**

Outcome*	Between-subject effects					Within-subject effect		Summary of significant effects
	Observer type		Priming conditions			Stimulus persons' age		
	Non-nursing, n = 83	Nursing, n = 82	Control, n = 56	Misuse, n = 55	Undertreatment, n = 54	Older adults	Younger adults	
	M (SD)	M (SD)	M (SD)	M (SD)	M (SD)	M (SD)		
Observed pain†‡	4.04 (1.24)	4.19 (1.21)	4.08 (1.16)	4.04 (1.24)	4.21 (1.28)	4.77 (1.35)	3.45 (1.25)	Age, and age $\times$ observer type interaction
Sympathy and help†‡	4.51 (1.51)	5.01 (1.60)	4.73 (1.40)	4.63 (1.68)	4.91 (1.63)	5.53 (1.60)	3.97 (1.70)	Age, and age $\times$ observer type interaction
Valence†§  ¶	2.33 (2.15)	3.26 (2.32)	2.66 (2.16)	2.06 (1.78)	3.68 (2.68)	4.75 (1.33)	3.44 (1.23)	Age, observer type, priming condition, and age $\times$ observer type interaction $\times$ priming condition

\* Observed pain was calculated by averaging pain intensity, pain unpleasantness, and pain condition severity ratings, which were all assessed on a 10-cm visual analogue scale; sympathy and help was calculated by averaging sympathy, willingness to attribute help, and deservingness of financial compensation ratings, which were all assessed on a 10-cm visual analogue scale; and valence was assessed through a 1-item 21-point numeric scale.  
 † Significant main within-subject effect of patient age (older vs younger adults).  
 ‡ Significant interaction between the within-subject effect of patient age (older adults vs younger adults)  $\times$  the between-subject effect of observer type (nonhealth professional vs nursing students).  
 § Significant main between-subject effect of observer type (nonhealth professional students vs nursing students).  
 || Significant main between-subject effect of priming condition (control vs misuse vs undertreatment).  
 ¶ Significant 3 (priming condition)  $\times$  2 (observer type)  $\times$  2 (patient age) interaction.  
 M, mean.

valence as a mediator in the relationship between priming conditions and observed pain estimates did not demonstrate a total effect,  $c_1 = -0.04$ ,  $SE = 0.23$ , NS;  $c_2 = 0.13$ ,  $SE = 0.23$ , non-significant (NS). That is, relative to the control condition, neither the misuse condition nor the undertreatment condition was a significant predictor of observed pain estimates. A relative direct effect of undertreatment priming condition and valence ratings was identified,  $a_2 = 1.02$ ,  $SE = 0.43$ ,  $P = 0.02$ , indicating that participants in the undertreatment condition reported more positive valence towards the individual in the video than those in the control condition. By contrast, a relative direct effect of the misuse priming condition on valence ratings was not found,  $a_1 = -0.60$ ,  $SE = 0.42$ , NS.

A relative direct effect of the priming condition on observed pain estimates was not found,  $c'_1 = 0.09$ ,  $SE = 0.22$ , NS;  $c'_2 = -0.09$ ,  $SE = 0.22$ , NS. Nonetheless, a direct effect of patient valence on observed pain estimates was found,  $b = 0.22$ ,  $SE = 0.04$ ,  $P < 0.01$ , showing that more positive valence was related with greater pain estimates. The relative indirect effect of the undertreatment priming condition on observed pain estimates through valence ratings was significant, as the bootstrapped confidence interval excluded zero,  $a_2b = 0.22$ ,  $SE = 0.12$ , 95% CI = 0.03 to 0.48. Yet, the relative indirect effect of the misuse priming condition on observed pain estimates through valence ratings was not significant, as the bootstrapped confidence interval did not exclude zero,  $a_1b = -0.123$ ,  $SE = 0.08$ , 95% CI =  $-0.31$  to 0.03.

This same pattern of results was demonstrated with regards to sympathy and help estimates. More specifically, bootstrapped analyses for valence as a mediator in the relationship between priming conditions and sympathy and help estimates did not demonstrate a total effect,  $c_1 = -0.10$ ,  $SE = 0.30$ , NS;  $c_2 = 0.18$ ,  $SE = 0.30$ , NS. That is, relative to the control condition, neither the misuse condition nor the undertreatment condition was a significant predictor of sympathy and help estimates. A relative direct effect of undertreatment priming condition and valence ratings was identified,  $a_2 = 1.02$ ,  $SE = 0.43$ ,  $P = 0.02$ , indicating that participants in the undertreatment condition reported more positive valence towards the individual in the

video than those in the control condition. By contrast, a relative direct effect of the misuse priming condition on valence ratings was not found,  $a_1 = -0.60$ ,  $SE = 0.42$ , NS.

A relative direct effect of the priming condition on sympathy and help estimates was not found,  $c'_1 = 0.12$ ,  $SE = 0.26$ , NS;  $c'_2 = -0.19$ ,  $SE = 0.26$ , NS. Nonetheless, a direct effect of patient valence on sympathy and help estimates was found,  $b = 0.37$ ,  $SE = 0.05$ ,  $P < 0.01$ , showing that higher positive valence was related with greater sympathy and help estimates. The relative indirect effect of the undertreatment priming condition on sympathy and help estimates through valence ratings was significant, as the bootstrapped confidence interval excluded zero,  $a_2b = 0.37$ ,  $SE = 0.18$ , 95% CI = 0.05 to 0.73. Yet, the relative indirect effect of the misuse priming condition on sympathy and help estimates through valence ratings was not significant, as the bootstrapped confidence interval did not exclude zero,  $a_1b = -0.22$ ,  $SE = 0.14$ , 95% CI =  $-0.51$  to 0.05.

These results demonstrate that valence ratings significantly and indirectly affected the relationship between the undertreatment priming condition and observed pain as well as sympathy and help estimates. That is, relative to the control condition, participants in the undertreatment priming condition reported feeling more positively towards patients, which led to higher ratings of observed pain, sympathy, and help. Valence was not found to indirectly influence the relationship between the misuse priming condition and observers' pain or sympathy and help estimates.

### 3.7. Exploratory analyses: patient sex

#### 3.7.1. Observed pain

The 3 (control vs misuse vs undertreatment)  $\times$  2 (nursing vs nonhealth professional students)  $\times$  2 (female vs male patients) mixed-model ANOVA demonstrated a significant univariate within-subject effect (female vs male patients),  $F_{1,159} = 123.10$ ,  $P < 0.001$ , partial  $\eta^2 = 0.44$ . That is, observers' pain estimates were higher towards male patients,  $M = 4.43$ ,  $SD = 1.23$ , compared with female patients,  $M = 3.80$ ,  $SD = 1.32$ . No other main effects or interactions were significant.

**Table 4**  
**Indirect effect of valence.**

			Relative direct effect		P				
			Coefficient (SE)						
D <sub>1</sub>									
a <sub>1</sub>			-0.60 (0.42)		0.16				
D <sub>2</sub>									
a <sub>2</sub>			1.02* (0.43)		0.02				
	Relative direct effects		Total effects		Relative indirect effects				
	Coefficient (SE)	P	Coefficient (SE)	P	Coefficient (SE)	95% LLCI	95% ULCI		
Observed pain†									
c' <sub>1</sub>	0.09 (0.22)	0.67	c <sub>1</sub>	-0.04 (0.23)	0.87	a <sub>1</sub> b	-0.13 (0.08)	-0.31	0.03
c' <sub>2</sub>	-0.09 (0.22)	0.98	c <sub>2</sub>	0.13 (0.23)	0.58	a <sub>2</sub> b	0.22‡ (0.12)	0.03	0.48
b	0.22* (0.04)	<0.01							
Sympathy and help§									
c' <sub>1</sub>	0.12 (0.26)	0.65	c <sub>1</sub>	-0.10 (0.30)	0.74	a <sub>1</sub> b	-0.22 (0.14)	-0.51	0.05
c' <sub>2</sub>	-0.19 (0.26)	0.47	c <sub>2</sub>	0.18 (0.30)	0.54	a <sub>2</sub> b	0.37‡ (0.18)	0.05	0.73
b	0.37* (0.05)	<0.01							

\*  $P < 0.05$ .

† Observed pain was calculated by averaging pain intensity, pain unpleasantness, and pain condition severity ratings, which were all assessed on a 10-cm visual analogue scale.

‡ 95% confidence intervals excluded zero.

§ Sympathy and help was calculated by averaging sympathy, willingness to attribute help, and deservingness of financial compensation ratings, which were all assessed on a 10-cm visual analogue scale.

D<sub>1</sub>, first indicator variable; D<sub>2</sub>, second indicator variable; LLCI, lower-level confidence interval; ULCI, upper-level confidence interval.

### 3.7.2. Sympathy and help

The 3 (control vs misuse vs undertreatment)  $\times$  2 (nursing vs nonhealth professional students)  $\times$  2 (female vs male patients) mixed-model ANOVA demonstrated a significant univariate within-subjects effect (female vs male patients),  $F_{1,159} = 67.37$ ,  $P < 0.001$ , partial  $\eta^2 = 0.30$ . That is, observers' sympathy and help estimates were higher towards male patients,  $M = 5.00$ ,  $SD = 1.50$ , compared with female patients,  $M = 4.51$ ,  $SD = 1.72$ . No other main effects or interactions were significant.

### 3.7.3. Valence ratings

Based on the ANOVA test, observers' valence ratings were not found to differ as a function of patient sex,  $M_{\text{male}} = 2.74$ ,  $SD = 2.31$ ;  $M_{\text{female}} = 2.85$ ,  $SD = 2.45$ . The 2-way interaction between patient sex (male vs female) and observer type (nursing vs nonhealth professional students),  $F_{1,159} = 8.03$ ,  $P = 0.005$ , partial  $\eta^2 = 0.05$ , was found. No other interactions were found. Simple effects tests were conducted to clarify the 2-way interaction (patient sex  $\times$  observer type). Nursing students rated male patients more positively,  $M = 3.01$ ,  $SD = 2.40$ , than nonhealth professional students,  $M = 2.40$ ,  $SD = 2.18$ ,  $F_{1,159} = 4.03$ ,  $P = 0.046$ , partial  $\eta^2 = 0.03$ . In addition, nursing students rated female patients more positively,  $M = 3.43$ ,  $SD = 2.52$ , than nonhealth professional students,  $M = 2.28$ ,  $SD = 2.25$ ,  $F_{1,159} = 10.31$ ,  $P = 0.002$ , partial  $\eta^2 = 0.06$ . Nursing students rated females more positively than videos of males,  $F_{1,159} = 8.83$ ,  $P = 0.003$ , partial  $\eta^2 = 0.05$ , whereas nonhealth professional students' valence ratings did not significantly differ as a function of the patient sex,  $F_{1,159} = 1.06$ , NS.

### 3.8. Overview of narrative analysis results

A coding framework was developed following Braun and Clarke's<sup>5</sup> stepwise methods and 2 researchers coded the data independently. Percentage agreement and Cohen's kappa demonstrated good to excellent reliability (percentage agreement = 97%,  $\kappa = 0.57$ ).<sup>9,54</sup>

Results from thematic and content analyses are displayed in **Figure 2**. Overall, observers indicated that their ratings varied as a function of several factors. Observers did not specify whether these factors increased or decreased their ratings. As such, the purpose of these analyses was to develop a list of factors that observers indicated influenced their ratings. Grounded in observers' responses, results were divided into 2 categories: (1) observable pain-related changes and (2) non-pain-related factors. Distinct themes emerged within each category (see supplementary materials, Appendix B for examples of quotations, available at <http://links.lww.com/PAIN/A631>).

#### 3.8.1. Observable pain-related changes

Based on the results of the quantitative content analysis, observers indicated that their ratings varied as a function of numerous pain-related changes. The most frequently identified observable changes were "general pain expressed" and "facial movements." Observers frequently identified "pain intensity" and "general changes in patient's facial expression" as variables that influenced their ratings. Participants also specified that their ratings were influenced by other observable changes including, but not limited to, eye and mouth movements, laughing or smiling, bodily movements, and changes in breathing.

#### 3.8.2. Non-pain-related characteristics

Based on the results of the content analysis, we identified 3 categories of potential influence: (1) patient-level personal characteristics; (2) observers' general impressions of patients; and (3) additional contextual characteristics (see supplementary materials, Appendix B for examples of quotations, available at <http://links.lww.com/PAIN/A631>).

#### 3.8.3. Patient-level personal characteristics

According to quantitative analyses, observers frequently noted that their ratings varied as a function of non-pain-related characteristics of the patients. They often reported, for instance, that the patient's sex and age moderated their ratings. Observers also noted that their ratings differed as a function of the patient's general physical characteristics, such as being "well groomed."

#### 3.8.4. Observers' general impressions of patients

Observers reported that their ratings varied as a function of general inferences they made about the patient. In other words, they made general judgements about the patient, which then influenced their specific ratings. The most frequently identified theme was observers' general impressions of how helpless patients were in coping with their pain. Observers also inferred, as potential influences on their ratings, the extent to which patients appeared willing to receive help, how sympathetic observers felt towards patients, and their overall impression (ie, positive or negative valence) of patients. Although less frequently identified, observers noted that their ratings were influenced by the extent to which they perceived the patient as faking or exaggerating their pain experience. Finally, observers indicated that perceiving patients as withholding pain expressions or suppressing the experience also affected their ratings.

#### 3.8.5. Additional contextual characteristics

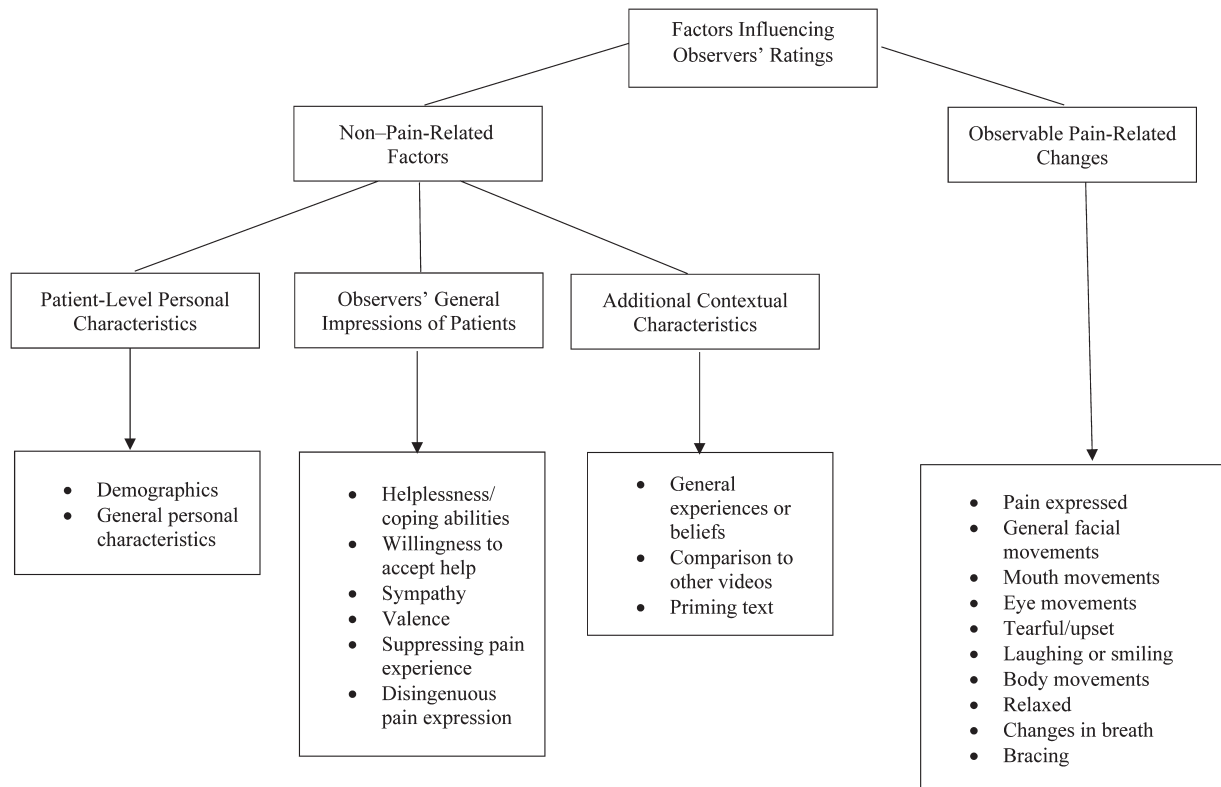
Observers indicated that their ratings varied as a function of supplementary information as well as beliefs and attitudes. That is, additional information that extended beyond the information presented in each distinct stimulus video (eg, previous life experiences/beliefs, comparisons with others' pain, informational primes). The most frequently identified theme was observers' own personal experiences and beliefs. For example, observers noted that their previous experiences influenced their ratings of the videos (eg, whether the individual reminded them of a friend/grandparent). Although less frequently noted, participants also stated that their ratings were affected when they compared the patient's experience with previous patients' expressions. Finally, the informational priming texts were noted to influence ratings by a small number of observers.

## 4. Discussion

### 4.1. Overview of findings

We examined the influence of contextual features on pain judgements. An important contribution of this research was the evaluation of the effect of informational primes on observers' evaluation of older persons' pain. Another novel feature was the exploration of observers' judgements of others' pain as a function of interactions across multiple contextual variables. Considering the role of several contextual factors (eg, priming information, patient age, and observer type) provides a more precise





**Figure 2.** Thematic analysis summary of factors identified by participants that influenced their ratings of pain, sympathy, willingness to help, deservingness of financial compensation ratings, and how positively/negatively they felt towards the patient. General personal characteristics comprised general statements about the patient's general physical characteristics, such as being "well groomed."

characterization of the influence of such variables on the interpretation of pain expressions.

**Table 5** summarizes central findings. Observers rated older persons as experiencing greater pain than younger adults, emphasizing the importance of examining judgements from a lifespan perspective. An unexpected relationship between observer type and patient age was also identified; nursing students ascribed greater sympathy and help to younger adults than nonhealth professional students. As hypothesized, priming observers with information about the misuse of the health care system attenuated their valence ratings of younger patients, whereas priming observers about the undertreatment of pain in older persons increased their valence ratings of older patients. Consistent with previous research,<sup>8,17,80,81</sup> observers' valence towards patients significantly influenced their estimations of pain as well as sympathy and help. In addition, observers rated male patients' pain higher. Results of narrative data supported quantitative findings, suggesting that observers' judgements are influenced by a variety of non-pain-related factors. In general, findings enhance the specificity of theoretical understandings of pain and demonstrate that patient and observer characteristics, as well as informational primes, significantly moderate observers' judgements of pain expressions.

#### 4.2. The role of patient age and observer type

As hypothesized,<sup>33,34,49,52</sup> observers ascribed higher observed pain, sympathy, and help to older patients compared with younger patients. One contributing factor to this finding may be commonly held stereotypes about older individuals, such as the belief that older persons are less healthy than younger

persons.<sup>37,38,40,52</sup> These common stereotypes may increase observers' sensitivity towards older persons' nonverbal pain cues.<sup>52</sup> Future research should aim to clarify the mechanisms that influence observers' estimates of older persons' pain.

An unexpected interaction between observer type and patient age was identified. Nursing students provided greater sympathy and help ratings to younger patients compared with nonhealth professional students. These findings conflict with results from previous investigations where practicing health care professionals provided lower estimates of others' pain compared with lay people.<sup>32,62</sup> Several studies, however, have failed to replicate this underestimation bias.<sup>1,49,56</sup> Prkachin et al.<sup>65</sup> proposed that the underestimation effect was a result of health care professionals' increased exposure to high amounts of pain that, subsequently, biases them against identifying pain in others. Consequently, the limited clinical experience in the present sample may have contributed to the unexpected finding.

#### 4.3. The role of informational primes

Ratings of valence varied as a function of a 3-way interaction across priming condition, patient age, and observer type. As expected, results demonstrated that both nursing and nonhealth professional students in the undertreatment prime condition rated older patients more positively than younger patients. In addition, nursing students in the undertreatment priming condition reported more positive valence towards older adults than nursing students in the misuse condition. These results highlight the positive influence of priming about undertreatment on observers' valence towards older patients. Moreover, findings demonstrate that, compared with nonhealth professional

**Table 5****Summary of main findings.**

Observers provided higher ratings for older vs younger patients on the following outcomes: Observed pain Sympathy and help Valence
Patient age (younger vs older patients) × observer type (nursing vs nonhealth professional students) interaction that demonstrated: Nursing students provided higher ratings for younger adults vs nonhealth professional students on sympathy and help
Valence ratings significantly indirectly influenced the relationship between the undertreatment priming condition and ratings of: Observed pain Sympathy and help
Observers provided higher ratings for male vs female patients on the following outcomes: Observed pain Sympathy and help
Participants indicated that their ratings were most frequently influenced by the patient's demographics (a non-pain-related characteristic), followed by the pain expressed by the patient (an observable pain-related change).

students, nursing students' valence was more greatly influenced by the undertreatment prime. A potential explanation is that nursing students are more sensitive to information about the undertreatment of health conditions in vulnerable populations, given that nursing students' years in training is positively related to favourable attitudes towards older persons.<sup>76</sup>

Consistent with hypotheses, nursing students in the misuse priming condition reported less positive valence towards younger adults than nursing students in the undertreatment condition. In addition, nonhealth professional students in the misuse condition reported significantly less positive valence towards younger compared with older patients. These findings are consistent with previous research, where inferring that patients' pain expressions are insincere, reduced judges' willingness to attribute pain, and offer assistance.<sup>17,47,56</sup> Results from this study contribute to the literature by demonstrating that priming observers about the misuse of the health care system exclusively reduced positive valence towards younger patients. This is not surprising because younger adults compose most of the active work force and, therefore, are more likely to require vocational financial compensation due to missed work.<sup>77</sup>

#### 4.4. The indirect effect of valence

Priming with information about the undertreatment of pain in older adults was associated with more positive valence towards patients. In turn, greater positive valence was correlated with higher pain, sympathy, and help judgements to all patients. This indirect relationship is in line with results from several researchers who have demonstrated the significant role of valence in pain estimates.<sup>8,17,80,81</sup> These investigations have revealed that observers attribute higher pain, distress, and disability scores to more likable patients.<sup>8,80</sup> Interestingly, the undertreatment prime positively influenced observers' ratings of all persons, despite this prime's specific focus on older persons' pain. Consistent with the spreading-activation theory,<sup>10,23,45</sup> it is speculated that information about the undertreatment of older persons' pain may have activated semantically related concepts (eg, undertreatment of younger person's pain), which prompted observers to display a heightened sensitivity to all persons' pain. More research is needed to explore the indirect influence of valence on pain estimates.

#### 4.5. The influence of patient sex

Observers rated males higher than females on pain, sympathy, and help. This sex effect was strong across all indicators, except for valence ratings. In general, these results contribute to the mixed body of literature regarding the impact of patient sex on observers' interpretations of their pain.<sup>4,34,66,68,71,78</sup> The discrepancies in the literature are currently not well understood and could be due to methodological differences across studies, including study-specific features. For instance, observers in the present investigation were primarily young women, which was not the case in other studies. More research is needed to clarify patient sex effects.

#### 4.6. Findings based on narrative data

Analysis of narrative data supported quantitative findings and the influence of contextual features on observers' interpretations of pain. Observers most frequently indicated that patients' demographic characteristics influenced their ratings. This is consistent with findings of the quantitative analyses, showing that observers' ratings differed as a function of patients' sex and age. In addition, observers documented various other contextual features that influenced their ratings, including their own beliefs. General trends suggest that some influences had a more widespread impact than others. For instance, observers reported that "pain expressed" and "patient demographics" influenced their observed pain, sympathy, and help ratings. By contrast, other characteristics (eg, "bracing") were mentioned less frequently and more exclusively in the context of pain ratings. This may suggest that some contextual factors (eg, patient age) have a more pervasive influence on observers' judgement than other factors.

#### 4.7. Theoretical contributions

Findings from this study add specificity to the communications model of pain by clarifying the influence of specific contextual factors on decoding nonverbal pain expressions. The consideration of multiple variables and interactions across variables allows for a more comprehensive description of the factors that influence pain communication. For instance, the combination of observer type and patient age moderated observers' ratings of sympathy and help. These results emphasize the intricate relationships

across contextual factors and the influence of combinations of variables on pain decoding.

Moreover, results identified unique factors that impact the decoding of older and younger persons' pain experience. Observers primed with information about the misuse of the health care system attributed lower pain to younger patients, whereas priming information about the undertreatment of pain in older persons had a positive influence on observers' ratings of older persons' pain. In general, these findings suggest that specific contextual variables influence pain decoding differently depending on the age of the person expressing pain.

#### 4.8. Limitations

Because our observers were predominantly young females in university, future research should test the impact of these contextual factors in a more diverse sample of observers. This is particularly relevant, as observer and patient characteristics are known to influence pain decoding.<sup>19,25</sup> Researchers may also evaluate the influence of additional contextual features, such as observers' ethnicity and sex.<sup>3,69</sup> There would also be value in using manipulation checks in future research to ensure that experimental primes are perceived as intended. An additional limitation was the lack of information yielded regarding the relationship between pain judgements and clinical decisions. Clinical research evaluating health care professionals' behaviour is needed to examine the ecological validity of the present findings.

#### 5. Conclusions

This investigation expanded our current understanding of the influence of contextual factors in decoding pain. Unique conceptual and methodological features of this study provide greater meaning to the results and allow for increased specificity in the communications model of pain.<sup>31,61</sup> Results suggest that informational primes, observer-level factors, and patient characteristics all interact to influence observers' interpretations of pain expressions. Moreover, likeability of patients was found to indirectly influence observers' willingness to attribute pain, sympathy, and help. These results highlight the complexity of pain decoding and identify unique combinations of variables that influence perceptions of others' pain.

#### Conflict of interest statement

The authors have no conflicts of interest to declare.

This research was supported through grants from the AGE WELL Network of National Centres of Excellence (#WVP6.3), the Canadian Institutes of Health Research (#201403), and the Saskatchewan Health Research Foundation (#2908). Amy Hampton was supported by a Health Professional Student Research Award and a Graduate Scholarship awarded by the University of Regina Faculty of Graduate Studies and Research.

#### Acknowledgements

The authors thank Reihaneh Ahmadi, Delaine Ammaturo-Shackleton, Erin Browne, and Natasha Gallant for her help with the coding of facial expressions.

#### Appendix A. Supplemental digital content

Supplemental digital content associated with this article can be found online at <http://links.lww.com/PAIN/A631>.

#### Supplemental video content

Video content associated with this article can be found online at <http://links.lww.com/PAIN/A632>.

#### Article history:

Received 17 February 2018

Received in revised form 26 June 2018

Accepted 27 June 2018

Available online 12 July 2018

#### References

- [1] Ammaturo DA, Hadjistavropoulos T, Williams J. Pain in dementia: use of observational pain assessment tools by people who are not health professionals. *Pain Med* 2017;18:1895–907.
- [2] Association of Workers' Compensation Boards of Canada (AWCBC). National work injury, disease and fatality statistics. Toronto, ON: Association of Worker's Compensation Boards of Canada, 2016.
- [3] Bartley EJ, Fillingim RB. Sex differences in pain: a brief review of clinical and experimental findings. *Br J Anaesth* 2013;111:52–8.
- [4] Beaupre P, Keefe FJ, Lester N, Affleck G, Fredrickson B, Caldwell DS. A computer-assisted observational method for assessing spouses' ratings of osteoarthritis patients' pain. *Psychol Health Med* 1997;2:99–108.
- [5] Braun V, Clarke V. Using thematic analysis in psychology. *Qual Res Psychol* 2006;3:77–101.
- [6] Cano A, Johansen AB, Geisser M. Spousal congruence on disability, pain, and spouse responses to pain. *PAIN* 2004;109:258–65.
- [7] Cella DF, Perry SW. Reliability and concurrent validity of three visual analogue mood scales. *Psychol Rep* 1986;59:827–33.
- [8] Chibnall JT, Tait RC. Observer perceptions of low back pain: effects of pain report and other contextual factors. *J Appl Soc Psychol* 1995;25:418–39.
- [9] Cohen J. A coefficient of agreement for nominal scales. *Educ Psychol Meas* 1960;20:37–46.
- [10] Collins AM, Loftus EF. A spreading-activation theory of semantic processing. *Psychol Rev* 1975;82:407–28.
- [11] Costello AB, Osborne JW. Best practices in exploratory factor analysis: four recommendations for getting the most from your analysis. *PARE* 2005;10:1–9.
- [12] Craig KD, Patrick CJ. Facial expression during induced pain. *J Pers Soc Psychol* 1985;48:1080–91.
- [13] Crawford JR, Henry JD. The Depression Anxiety Stress Scales (DASS): normative data and latent structure in a large non-clinical sample. *Br J Clin Psychol* 2003;42:111–31.
- [14] Davies B, Burrows G, Poynton C. A comparative study of four depression rating scales. *Aust N Z J Psychiatry* 1975;9:21–4.
- [15] De Ruddere L, Goubert L, Stevens M, de C Williams AC, Crombez G. Discounting pain in the absence of medical evidence is explained by negative evaluation of the patient. *PAIN* 2013;154:669–76.
- [16] De Ruddere L, Goubert L, Stevens MA, Deveugele M, Craig KD, Crombez G. Health care professionals' reactions to patient pain: impact of knowledge about medical evidence and psychosocial influences. *J Pain* 2014;15:262–70.
- [17] De Ruddere L, Goubert L, Vervoort T, Kappesser J, Crombez G. Impact of being primed with social deception upon observer responses to others' pain. *PAIN* 2013;154:221–6.
- [18] Doctor JN, Slater MA, Atkinson JH. The descriptor differential scale of pain intensity: an evaluation of item and scale properties. *PAIN* 1995;61:251–60.
- [19] Edwards R, Eccleston C, Keogh E. Observer influences on pain: an experimental series examining same-sex and opposite-sex friends, strangers, and romantic partners. *PAIN* 2017;158:846–55.
- [20] Ekman P, Friesen WV. Measuring facial movement. *J Nonverbal Behav* 1976;1:56–75.
- [21] Employment Projections Program, U.S. Bureau of Labor Statistics. Civilian labor force, by age, sex, race, and ethnicity; Washington, DC: U.S. Bureau of Labor Statistics, 2017. April 2018.
- [22] Erdfelder E, Faul F, Buchner A. GPOWER: a general power analysis program. *Behav Res Methods Instr Comput* 1996;28:1–11.
- [23] Ferrand L, New B. Semantic and associative priming in the mental lexicon. In: Anonymous mental lexicon: some words to talk about words. Hauppauge, NY: Nova Science Publishers, 2003. p. 25–43.

- [24] Folstein MF, Luria R. Reliability, validity, and clinical application of the visual analogue mood scale. *Psychol Med* 1973;3:479–86.
- [25] Gagnon MM, Hadjistavropoulos T, MacNab YC. Contextual influences on pain communication in couples with and without a partner with chronic pain. *PAIN* 2017;158:1960–70.
- [26] Gallant NL, Hadjistavropoulos T. Experiencing pain in the presence of others: a structured experimental investigation of older adults. *J Pain* 2017;18:456–67.
- [27] Gift AG. Visual analogue scales: measurement of subjective phenomena. *Nurs Res* 1989;38:286–8.
- [28] Guadagnoli E, Velicer WF. Relation of sample size to the stability of component patterns. *Psychol Bull* 1988;103:265–75.
- [29] Hadjistavropoulos T. “Stop the fraud!”: what is the effect of social deception priming on health professionals? *PAIN* 2013;154:185–6.
- [30] Hadjistavropoulos T, Craig KD. A theoretical framework for understanding self-report and observational measures of pain: a communication model. *Behav Res Ther* 2002;40:551–70.
- [31] Hadjistavropoulos T, Craig KD, Duck S, Cano A, Goubert L, Jackson PL, Mogil JS, Rainville P, Sullivan MJ, de C Williams AC, Vervoort T, Fitzgerald TD. A biopsychosocial formulation of pain communication. *Psychol Bull* 2011;137:910–39.
- [32] Hadjistavropoulos T, LaChapelle D, MacLeod F, Hale C, O’Rourke N, Craig KD. Cognitive functioning and pain reactions in hospitalized elders. *Pain Res Manag* 1998;3:145–51.
- [33] Hadjistavropoulos T, LaChapelle DL, MacLeod FK, Snider B, Craig KD. Measuring movement-exacerbated pain in cognitively impaired frail elders. *Clin J Pain* 2000;16:54–63.
- [34] Hadjistavropoulos T, McMurtry B, Craig KD. Beautiful faces in pain: biases and accuracy in the perception of pain. *Psychol Health* 1996;11:411–20.
- [35] Hale CJ, Hadjistavropoulos T. Emotional components of pain. *Pain Res Manag* 1997;2:217–16.
- [36] Hayes AF, Preacher KJ. Statistical mediation analysis with a multicategorical independent variable. *Br J Math Stat Psychol* 2014;67:451–70.
- [37] Herr KA, Garand L. Assessment and measurement of pain in older adults. *Clin Geriatr Med* 2001;17:457–78, vi.
- [38] Herr KA, Mobily PR. Complexities of pain assessment in the elderly. *Clinical considerations. J Gerontol Nurs* 1991;17:12–19.
- [39] Hill ML, Craig KD. Detecting deception in pain expressions: the structure of genuine and deceptive facial displays. *PAIN* 2002;98:135–44.
- [40] Hoffland SL. Elder beliefs: blocks to pain management. *J Gerontol Nurs* 1992;18:19–23.
- [41] Hsieh HF, Shannon SE. Three approaches to qualitative content analysis. *Qual Health Res* 2005;15:1277–88.
- [42] Husebo BS, Strand LI, Moe-Nilssen R, Husebo SB, Ljunggren AE. Pain behaviour and pain intensity in older persons with severe dementia: reliability of the MOBID Pain Scale by video uptake. *Scand J Caring Sci* 2009;23:180–9.
- [43] Husebo BS, Strand LI, Moe-Nilssen R, Husebo SB, Ljunggren AE. Pain in older persons with severe dementia. Psychometric properties of the Mobilization-Observation-Behaviour-Intensity-Dementia (MOBID-2) Pain Scale in a clinical setting. *Scand J Caring Sci* 2010;24:380–91.
- [44] Huskisson EC. Visual analogue scales. In: Melzack R. *Pain measurement and assessment*. New York: Raven Press, 1983. p. 33–7.
- [45] Hutchison KA, Balota DA, Neely JH, Cortese MJ, Cohen-Shikora ER, Tse CS, Yap MJ, Bengson JJ, Niemeyer D, Buchanan E. The semantic priming project. *Behav Res Methods* 2013;45:1099–114.
- [46] Kanske P, Kotz SA. Auditory affective norms for German: testing the influence of depression and anxiety on valence and arousal ratings. *PLoS One* 2012;7:e30086.
- [47] Kappesser J, Williams AC, Prkachin KM. Testing two accounts of pain underestimation. *PAIN* 2006;124:109–16.
- [48] Kunz M, Mylius V, Schepelmann K, Lautenbacher S. Impact of age on the facial expression of pain. *J Psychosom Res* 2008;64:311–18.
- [49] 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.
- [50] MacKinnon DP, Lockwood CM, Hoffman JM, West SG, Sheets V. A comparison of methods to test mediation and other intervening variable effects. *Psychol Methods* 2002;7:83–104.
- [51] MacLeod F, LaChapelle D, Hadjistavropoulos T, Pfeifer J. The effect of disability claimants’ coping styles on judgments of pain, disability and compensation. *Rehabil Psychol* 2001;46:417–35.
- [52] Matheson DH. The painful truth: interpretation of facial expressions of pain in older adults. *J Nonverbal Behav* 1997;2:223–38.
- [53] Mathieu JE, Taylor SR. Clarifying conditions and decision points for mediational type inferences in organizational behavior. *J Organ Behav* 2006;27:1031–56.
- [54] McHugh ML. Interrater reliability: the kappa statistic. *Biochemia Med* 2012;33:267–82.
- [55] Miles MB, Huberman AM. *Qualitative data analysis*. Thousand Oaks: Sage Publications, 1994.
- [56] Poole GD, Craig KD. Judgments of genuine, suppressed, and faked facial expressions of pain. *J Pers Soc Psychol* 1992;63:797–805.
- [57] Preacher KJ, Hayes AF. SPSS and SAS procedures for estimating indirect effects in simple mediation models. *Behav Res Methods Instrum Comput* 2004;36:717–31.
- [58] Price DD, McGrath PA, Rafii A, Buckingham B. The validation of visual analogue scales as ratio scale measures for chronic and experimental pain. *PAIN* 1983;17:45–56.
- [59] Prkachin KM. The consistency of facial expressions of pain: a comparison across modalities. *PAIN* 1992;51:297–306.
- [60] Prkachin KM. Effects of deliberate control on verbal and facial expressions of pain. *PAIN* 2005;114:328–38.
- [61] Prkachin KM, Craig KD. Expressing pain: the communication and interpretation of facial pain signals. *J Nonverbal Behav* 1995;19:191–205.
- [62] Prkachin KM, Solomon P, Hwang T, Mercer SR. Does experience influence judgments of pain behaviour? Evidence from relatives of pain patients and therapists. *Pain Res Manag* 2001;6:105–12.
- [63] Prkachin KM, Solomon PE. The structure, reliability and validity of pain expression: evidence from patients with shoulder pain. *PAIN* 2008;139:267–74.
- [64] Prkachin KM, Solomon PE. The structure, reliability and validity of pain expression: evidence from patients with shoulder pain. *PAIN* 2009;139:267–74.
- [65] Prkachin KM, Solomon PE, Ross J. Underestimation of pain by health-care providers: towards a model of the process of inferring pain in others. *Can J Nurs Res* 2007;39:88–106.
- [66] Pronina I, Rule NO. Inducing bias modulates sensitivity to nonverbal cues of others’ pain. *Eur J Pain* 2014;18:1452–7.
- [67] QSR International Pty Ltd. NVivo qualitative data analysis software. Version 10. Doncaster, VIC: QSR International Ltd., 2012.
- [68] Riva P, Sacchi S, Montali L, Frigerio A. Gender effects in pain detection: speed and accuracy in decoding female and male pain expressions. *Eur J Pain* 2011;15:985.e1–985.e11.
- [69] Robinson ME, Gagnon CM, Riley JL III, Price DD. Altering gender role expectations: effects on pain tolerance, pain threshold, and pain ratings. *J Pain* 2003;4:284–8.
- [70] Robinson ME, Riley JL III, Myers CD, Papas RK, Wise EA, Waxenberg LB, Fillingim RB. Gender role expectations of pain: relationship to sex differences in pain. *J Pain* 2001;2:251–7.
- [71] Robinson ME, Wise EA. Prior pain experience: influence on the observation of experimental pain in men and women. *J Pain* 2004;5:264–9.
- [72] Rocha EM, Prkachin KM, Beaumont SL, Hardy CL, Zumbo BD. Pain reactivity and somatization in kindergarten-age children. *J Pediatr Psychol* 2003;28:47–57.
- [73] Rucker DD, Preacher KJ, Tormala ZL, Petty RE. Mediation analysis in social psychology: current practices and new recommendations. *Soc Personal Psychol Compass* 2011;5:359–71.
- [74] Schneider LH, Hadjistavropoulos HD, Faller YN. Internet-delivered cognitive behaviour therapy for depressive symptoms: an exploratory examination of therapist behaviours and their relationship to outcome and therapeutic alliance. *Behav Cogn Psychother* 2016;44:625–39.
- [75] Shrout PE, Bolger N. Mediation in experimental and nonexperimental studies: new procedures and recommendations. *Psychol Methods* 2002;7:422–45.
- [76] Soderhamn O, Lindencrona C, Gustavsson SM. Attitudes toward older people among nursing students and registered nurses in Sweden. *Nurse Educ Today* 2001;21:225–9.
- [77] Statistics Canada. *Labour force survey*. Ottawa, ON: Statistics Canada, 2017.
- [78] Stutts LA, Hirsh AT, George SZ, Robinson ME. Investigating patient characteristics on pain assessment using virtual human technology. *Eur J Pain* 2010;14:1040–5.
- [79] Tabachnick BG, Fidell LS. *Using multivariate statistics*. Boston, MA: Pearson Education, Inc, 2007.
- [80] Tait RC, Chibnall JT. Physician judgments of chronic pain patients. *Soc Sci Med* 1997;45:1199–205.
- [81] Tait RC, Chibnall JT, Kalaoukalani D. Provider judgments of patients in pain: seeking symptom certainty. *Pain Med* 2009;10:11–34.
- [82] Wilkie D, Lovejoy N, Dodd M, Tesler M. Cancer pain intensity measurement: concurrent validity of three tools—finger dynamometer, pain intensity number scale, visual analogue scale. *Hosp J* 1990;6:1–13.