DISCOVERY!

Using Virtual Human Technology to Capture Dentists' Decision Policies about Pain

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ABSTRACT

Healthcare professionals use race, gender, and age cues when making pain management decisions. Use of these demographic cues, therefore, is an important topic in the study of healthcare disparities. This study used virtual human (VH) technology to investigate the effects of VH patients' demographic cues on dentists' pain management decisions. Eighty-nine dentists viewed patients with different demographic cues. Analyses revealed that dentists rated pain intensity higher and were more willing to prescribe opioids to female, African-American, and younger patients than to their demographic counterparts. Results also found significant 2-way interactions between race and age for both pain assessment and treatment decisions. The interaction results suggest that the race difference (Caucasian < African American) was more pronounced for younger than for older patients. This is the first study to examine demographic cue use in dentists' decision-making for pain. The study found that dentists used demographic cues when making pain management decisions. Currently, there are no guidelines for decision-making practices for gender-, race-, or age-related pain. Since dentists see thousands of patients during their careers, the use of demographic cues could affect a substantial portion of the population. The findings could improve future training programs for dentists and dental students.

KEY WORDS: gender, race, age, pain management, dentists, education.

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INTRODUCTION

Patient gender, race, and age have been found to influence pain-related care (Faherty and Grier, 1984; Cleeland *et al*., 1994; Anderson *et al.*, 2000). Although 2 studies have found that dentist-patient communication is affected by the patient's race, few studies have examined whether dentists' pain management decisions are influenced by patients' demographic characteristics (Koerber *et al*., 2004; Cabral *et al*., 2005). There is also limited research that identifies the cause of inequalities in accessibility to dental treatment by demographic group (Slater, 2001; Pau *et al*., 2007).

We have developed a novel, valid, and reliable approach to investigate the influence of patient demographic cues on providers' pain management decisions (Hirsh *et al.*, 2009a,b; Stutts *et al*., 2010). This approach utilizes virtual human (VH) technology that has high visual fidelity and expressive facial animation (Hirsh *et al.*, 2009a,b; Stutts *et al.*, 2010; Wandner *et al*., 2010). Since the patient is not present, there is a greater likelihood that a participant will report his/her perceptions and treatment opinions with less social desirability bias (Chang and Krosnick, 2010). Hirsh *et al.* (2009b) previously found that nurses rated the VHs' facial expressions as realistic depictions of pain. The nurses also reported that their decisions about the VHs' pain were similar to those they would make for real patients. The visual appearance of each VH is experimenter-controlled, thus facilitating the modification of one independent variable (*e.g.*, race) while controlling all other demographic variables and pain expressions. This level of inter-participant standardization and experimenter control of stimuli is an important advantage in the study of demographic cue use. We have successfully used this technology in research on laypersons, healthcare trainees, and nurses (Hirsh *et al.*, 2009a,b; Stutts *et al.*, 2010; Wandner *et al*., 2010). These previous studies found that patient gender, race, age, and pain expression contributed to participants' pain assessment and treatment decisions for patients.

Given the importance of optimal and appropriate dental pain care, the personal and social implications of healthcare disparities, and the limited research on this topic, the current study sought to examine the influence of patient gender, race, age, and pain expression on dentists' pain assessment and treatment decisions.

METHODS

Participants

Eighty-nine dentists (57 men and 32 women) participated in this study. There were 68 Caucasians, eight Asians, five Hispanics, three African Americans,

Figure. Still frame of virtual human (VH) with cues representing female gender, Caucasian race, younger age, and high pain expression.

four "others", and one participant who did not report his/her race. The average age of the dentists was 44 yrs (range, 23 to 84 yrs). A wide geographic range of U.S. states was represented in our sample, although a majority of the dentists lived in Florida (N = 48). The average number of years of professional experience was approximately 19. All participants provided informed consent and were compensated $50 for their participation.

Procedures

This study was approved by the Institutional Review Board (IRB) at the University of Florida. Potential participants were mailed letters asking them to participate in the study. Those who expressed interest were directed to a secure Web site to complete the study. After providing consent, participants completed a demographic questionnaire and then observed 32 patient profiles. For each patient profile, participants read the same clinical vignette, which stated that the patient was seeking treatment for pain that began 2 months previously in his/her lower mandibular left posterior tooth. The patient also reported having had a "large filling" put in the same tooth 1 yr previously. The patient's pain, described as being exacerbated by cold foods and liquids, had previously been relieved by nonsteroidal anti-inflammatory drugs (NSAIDs). However, 2 weeks prior to assessment, warm foods and liquids began to cause persistent pain that was not relieved by NSAIDs. All of the dentists viewed the same 32 patient profiles and clinical vignettes in random order.

In addition to reading the clinical vignette, participants viewed a 20-second looped video of the patient. In each of the 20-second looped videos, the patient image contained 4 cues: gender (male, female), race (Caucasian, African American), age (younger adult, older adult), and pain expression (low, high). The gender, race, and age cues were represented by changes in the VHs' appearance (*e.g.*, skin tone, hair length). The pain expression cue was consistent with the empirically validated facial expressions of pain, which consist of changes to specific facial action units (brow lowering, tightening of the orbital muscles, nose wrinkling/upper lip raising, and eye closure) from the Facial Action Coding System (FACS) (Prkachin, 1992). All possible cue combinations were presented twice, resulting in 32 stimuli. The Fig. presents a still frame image of the high pain expression captured from the VH videos. Appendix Fig. 1 presents a still frame image of a VH expressing low pain.

For each patient, participants made 1 pain assessment (pain intensity) and 1 pain treatment rating (willingness to administer opioids). Pain ratings were recorded on separate 100-point VASs. Endpoints ranged from *no pain sensation* to *most intense pain imaginable* (pain intensity), and from *not at all likely* to *complete certainty* (willingness to administer opioid analgesics).

Statistical Analyses

All data analyses were performed with SPSS for Windows (Version 20). We conducted descriptive statistical analyses to summarize the demographic and background characteristics of the sample. We used paired-samples *t* tests to evaluate whether dentists could reliably distinguish between high- and low-pain-expressing faces. We performed repeated-measures analysis of variance (RANOVA) to examine pain assessment and treatment decisions made by dentists as a function of each VH's personal characteristics (gender, race, and age). Finally, repeated-measures analysis of covariance (RANCOVA) examined whether dentists' gender and age influenced their pain assessment and treatment decisions.

RESULTS

Validating Low- *vs.* High-pain-expressing Faces

The *t* test analyses indicated that dentists rated pain intensity higher and were more willing to administer opioid analgesics to high-pain-expressing faces than to low-pain-expressing faces, regardless of the patients' gender, race, or age. This result is consistent with previous work and serves as validation of the VH stimuli. The Table presents the results of the *t* test analyses. Since the participants were able to distinguish between high- and low-pain-expressing faces, this study used only the high-pain-expressing faces to examine dentists' pain assessment and treatment decisions.

Pain Assessment

The results of pain intensity analyses indicated a main effect for gender [$F(1,88) = 6.45$, $p = .05$, partial $\eta^2 = .07$], race [$F(1,88) = 4.05$, $p = .05$, partial $\eta^2 = .04$], and age [$F(1,66) = 26.12$, $p = .000$, partial $\eta^2 = .28$]. Dentists assessed female, African-American, and younger patients as experiencing greater pain intensity than male, Caucasian, and older patients. There was also a significant race-by-age interaction [$F(1,88) = 8.34$, $p = .05$, partial $\eta^2 = .09$]. The interaction results suggest that the race difference (Caucasian < African American) was more pronounced for younger than for older patients.

A significant 3-way interaction (race by age by gender) was also found [$F(1,88) = 5.24$, $p = .05$, partial $\eta^2 = .06$]. The male patients in the study were rated as having more pronounced race differences (Caucasian < African American) for younger than

Table. Validating the Differences between High and Low Pain-related Body Postures in the Making of Pain Assessment and Treatment Decisions

Decision	Cue	Pain Level	Mean	SD	*t*	Cohen's *d*
Pain Assessment						
Pain Intensity	Female African-American, Younger	Low Pain Expression	37.89	21.43	–9.71***	–1.12
		High Pain Expression	60.92	19.84		
	Female African-American, Older	Low Pain Expression	40.63	21.37	–7.27***	–0.67
		High Pain Expression	55.34	22.46		
	Female Caucasian, Younger	Low Pain Expression	33.73	22.16	–9.37***	–1.13
		High Pain Expression	58.31	21.36		
	Female Caucasian, Older	Low Pain Expression	41.88	22.39	–4.83***	–0.53
		High Pain Expression	53.75	22.26		
	Male African-American, Younger	Low Pain Expression	35.49	23.00	–7.40***	–1.01
		High Pain Expression	59.07	23.49		
	Male African-American, Older	Low Pain Expression	40.73	22.49	–4.68***	–0.52
		High Pain Expression	52.40	22.45		
	Male Caucasian, Younger	Low Pain Expression	33.37	22.00	–7.48*	–0.92
		High Pain Expression	53.40	21.62		
	Male Caucasian, Older	Low Pain Expression	37.86	22.26	–8.33***	–0.75
		High Pain Expression	54.52	22.20		
Pain Treatment						
Administering Opioid Analgesics	Female African-American, Younger	Low Pain Expression	36.91	27.71	–8.50***	–0.76
		High Pain Expression	57.58	26.98		
	Female African-American, Older	Low Pain Expression	38.44	27.25	–4.94***	–0.42
		High Pain Expression	50.16	28.52		
	Female Caucasian, Younger	Low Pain Expression	31.96	27.76	–7.31***	–0.74
		High Pain Expression	52.32	27.20		
	Female Caucasian, Older	Low Pain Expression	38.66	27.31	–4.54***	–0.37
		High Pain Expression	48.84	27.16		
	Male African-American, Younger	Low Pain Expression	33.03	28.25	–7.21***	–0.72
		High Pain Expression	54.06	30.00		
	Male African-American, Older	Low Pain Expression	38.98	28.88	–3.58*	–0.31
		High Pain Expression	47.63	27.80		
	Male Caucasian, Younger	Low Pain Expression	34.49	28.09	–4.88***	–0.48
		High Pain Expression	47.84	28.05		
	Male Caucasian, Older	Low Pain Expression	35.42	27.29	–7.38***	–0.52
		High Pain Expression	50.14	28.79		

*$p < .05$, **$p < .01$, ***$p < .001$.

for older patients. The pain ratings for female patients did not significantly interact with the race or age of the patient. Appendix Fig. 2 displays the pain assessment results.

Medication Treatment

The results of the analyses on willingness to administer opioid analgesics indicated a main effect for gender [$F(1,88) = 4.15$, $p = .05$, partial $\eta 2 = .05$], race [$F(1,88) = 6.66$, $p = .01$, partial $\eta 2 = .07$], and age [$F(1,88) = 15.99$, $p = .000$, partial $\eta 2 = .15$]. Dentists were more willing to administer opioid analgesics to female, African-American, and younger patients than to their demographic counterparts. A significant race-by-age interaction [$F(1,88) = 11.23$, $p = .001$, partial $\eta 2 = .11$] was also identified. The interaction results indicated that the race (Caucasian < African American) difference was more pronounced for younger than for older patients.

Dentist Characteristics

When gender was added as a covariate in the repeated-measures analysis, the pattern of results remained the same, except that the main effect for race was lost. The results indicated that female dentists were more likely to rate pain intensity higher, and were more likely to administer opioid analgesics to patients, than were male dentists, regardless of the gender, race, or age of the patient. Age was also added as a covariate to the repeated-measures analysis; however, age was not a significant covariate.

DISCUSSION

In recent years, the healthcare field has aimed to identify and eliminate barriers to healthcare equality. One area of research has looked at whether patients' gender, race, or age influences

their healthcare assessment and treatment. Previous studies have found that a significant number of laypersons, healthcare trainees, and practicing clinicians are influenced by patient demographic characteristics when making pain assessment and treatment decisions (Hirsh *et al.*, 2009a,b; Stutts *et al*., 2010). However, few studies have investigated this phenomenon among dentists, despite the fact that dental pain is a prominent clinical issue. The current study addressed this gap in the literature; we used VH technology to examine the influence of patients' gender, race, and age on dentists' pain-related decision-making.

Overall, the results of group-level analyses were consistent with those reported in previous studies on non-dental pain (Hirsh *et al.*, 2009a,b; Stutts *et al.*, 2010). As expected, dentists rated pain intensity higher and were more willing to administer opioid analgesics to high-pain-expressing faces than to low-pain-expressing faces, indicating that pain level is a salient cue in their decisions about pain and that the VH stimuli validly represented pain level. Also consistent with previous research, dentists assessed and treated female, African-American, and older patients differently than male, Caucasian, and younger patients. It is particularly important to highlight the main effect for age because it accounts for between 15% and 28% of the variance. The study also found significant race-by-age interactions for pain intensity ratings and willingness to administer opioid analgesics. Previous research has indicated that younger African Americans are more likely to report dental pain than their demographic counterparts (Vargas *et al*., 2000). Our results suggest that dentists assess the pain of younger African Americans higher than that of older African Americans. In turn, it would make sense that dentists would be more willing to prescribe opioids to younger African Americans than to older African Americans. The research also suggests that people living below the poverty line are more likely to experience more dental pain due to their lack of access to care (Vargas *et al.*, 2000). It is possible that race is confounded by high poverty status, and dentists have generalized these results. The study also found a 3-way interaction among race, age, and gender of the patient when rating pain intensity. However, research has yet to examine precisely how, or to what extent, a combination of demographic cues such as gender, race, and age influences dentists' patient pain intensity ratings. This information would make apparent to dental schools and dental associations that dentists, as a group, may assess and treat demographic groups differently.

The study also examined whether the gender of the dentist influenced the pain assessment and treatment ratings. When gender was added as a covariate in the repeated-measures analysis, the pattern of results remained the same, except that there was no longer a main effect of race for pain intensity. The loss of the main effect of race might be due to a loss of statistical power. The study also found that female dentists were more likely to rate the patients' pain intensity higher and were more likely to administer opioid analgesics than were the male dentists.

The public health impact of detecting patient demographic cue use becomes important when one considers that most dentists will see thousands of patients during their careers. Thus, these results are applicable to a large proportion of the population and represent a significant issue to be studied. At present, there are no empirical results supporting a clinical reason or guideline for differential assessment or treatment of pain on the basis of gender, race, or age. The use of these cues in pain decision-making has an unknown effect on patient outcome, but may be related to reported disparities in pain treatment (Faherty and Grier, 1984; Cleeland *et al.*, 1994; Anderson *et al.*, 2000; Cabral *et al*., 2005). There is no clear reference standard for age, race, or gender when it comes to pain treatment. Thus, it is possible that use of these cues could negatively affect the care of a large number of patients before, during, or after dental procedures. Such cue use could have an even greater reach if transmitted, implicitly or explicitly, during dental education activities. These possibilities highlight the importance of evidence-based pain assessment and treatment education in both dental schools and continuing dental education curricula.

This study has several limitations. The dentists who participated may represent a select sample, thus limiting the generalizability of our findings. Also, our study sample was relatively homogenous, composed primarily of Caucasian dentists and those in general dentistry. Their responses might not be representative of the national dentist population. Finally, this is an analogue study, and, despite our VH innovations, which increased the realism of the stimuli and the task, may not be fully representative of a real clinical scenario.

In summary, this study found that dentists assign female and African-American patients higher ratings in most pain assessment and treatment domains compared with their demographic counterparts. While dentists assessed older adult patients as having more pain than younger adult patients, they were more willing to administer opioid analgesics to younger patients than to older patients. These results could inform future research, education, and clinical practice by increasing awareness of potential gender, race, and age cue use in dental pain care.

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