Methods: A multi-center descriptive cross-sectional study design was utilized to assess a convenience sample of participants with unilateral and bilateral CMC as well as asymptomatic healthy participants. Participants were recruited from three hand rehabilitation outpatient clinics. A University Institutional Review Board approved the study. Each hand of eligible participants was assigned to either the CMC OA group or the control group following review of past medical history and physical inspection for clinical signs of CMC OA. JPS test methods and goniometer placement were practiced by all three examiners prior to formal data collection to promote consistent and accurate methods. During the test participants were asked to keep their eyes closed while actively repositioning their thumb to a passively presented target position. The target position of 30 degrees CMC abduction (palmer abduction) was selected because it was determined through kinematic analysis that the thumb metacarpal undergoes ulnar translation, flexion, and abduction relative to the trapezium during loaded object grasp. Joint angle was measured using a standard clear plastic goniometer with a central 180 degree scale marked in 5 degree increments and two 17cm long arms. The fulcrum of the goniometer was placed directly overtop the intersection of the first and second metacarpals, indicating the CMC joint. The stationary arm of the goniometer was aligned with the midline of the second metacarpal and the moving arm of the goniometer aligned with the midline of the first metacarpal.A standardized protocol was followed for JPS testing. The testing protocol was explained and demonstrated to the participants until they felt comfortable with the process. No practice trials were performed by the participants prior to testing. Each participant was seated with the involved elbow resting on a table in a flexed position, forearm and wrist in neutral position, fingers relaxed and the CMC, MCP, and IP joints of the thumb in 0 degrees of flexion and extension. The examiner asked the participant to close their eyes for the remainder of the test. Next the examiner passively moved the thumb of the participant to the target angle of 30° CMC abduction. The goniometer was removed and the participant was instructed to maintain the target angle for 3 seconds while concentrating on the position of the thumb. After 3 seconds, the participant was instructed to move the thumb into full abduction before attempting to actively reproduce the target angle. A second measurement was taken once the participant verbally confirmed the target angle was attained. The difference between the target angle and the reproduced angle of was used as the JPS deficit criterion value.

A priori power analysis was conducted to determine the study sample size needed to achieve a .80 statistical power with a large effect size at the .05 alpha level. Normal distribution of the sample was analyzed by using the Kolmogorov- Smirnov test. For comparison, participants with unilateral CMC OA were matched against themselves while those with bilateral CMC OA were age matched with a healthy participant. An unpaired t test was used to compare the mean error of the non CMC OA group and the CMC OA group to evaluate statistical significance. Between-group effect sizes were calculated using the Cohen d coefficient interpretation.

Results: A total of 58 thumbs were evaluated in 29 participants.The participants' characteristics are summarized in Table

1. The mean age of the CMC OA group is 70.31 years (±6.9) as compared to 69.96 years (±6.49) for the healthy control group. A one-way unpaired t-test revealed statistically significant differences in joint position sense testing scores within the CMC OA group as compared to the healthy group t=8.67 (P< 0.001). The mean positional error measured from subjects with CMC OA was 9.86 degrees and was 1.22 degrees for the age matched healthy subjects. The effect size for the difference in means was D=2.28. There was not a statistically significant difference between the mean differences for the dominant and non-dominant CMC OA thumbs for joint position sense acuity t=0.07, p=0.47.

Conclusion: The findings of this study revealed subjects with CMC OA demonstrate greater deficits with JPS when compared to their healthy counterparts. Results of this study suggest the JPS test may be clinically useful for evaluating SM function and setting rehabilitative goals among patients with CMC OA for the purpose of restoring optimal function.

2

A Survey of Hand Therapists' Knowledge and Beliefs About Pain Science

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Purpose: Upper extremity musculoskeletal pain is traditionally conceptualized from a biomedical perspective. However, modern pain science supports a mindset shift beyond structural pathology. As knowledge and beliefs influence clinicians' practice patterns, it is important to examine hand therapists' current knowledge and perspectives of pain to identify potential gaps. The purpose of this survey study was to (1) describe hand therapists' knowledge of pain science and its association with demographic and professional characteristics and (2) identify associations between hand therapists' knowledge of pain science and related beliefs.

Methods: The investigators developed a descriptive cross-sectional survey to capture objective knowledge and perceptions of pain science. The survey included 2 sections: (1) the Revised Neurophysiology of Pain Questionnaire (R- NPQ) and 11 Likert-type questions targeting hand therapists' beliefs about pain science and (2) demographic and professional questions. The survey underwent peer review to establish face and content validity and was distributed via Qualtrics in January 2019 to 3,386 members of the American Society of Hand Therapists. The survey was open for 3 weeks, and a reminder email was sent 14 days after the initial invitation.

Results: Three-hundred sixty-six individuals consented to participate (11% response rate). Of these, 300 participants completed the entire survey; and 8 participants completed at minimum the first section. Three participants were excluded from the analysis because of missing R-NPQ items for a total of 305 participants in the final sample. Most participants were occupational therapists (91.8%) and certified hand therapists (83.2%) and identified as female (88.2%).

Participants' education and practice experience are summarized in Table 1. Most participants reported that their patients with upper extremity conditions routinely or often report pain (97.6%). However, 59.5% reported rarely treating chronic pain conditions as the primary diagnosis.

The R-NPQ scores representing objective knowledge of pain science ranged from 5/12 to 12/12 with a mean score of 8.95 ± 1.52 or 74.6%. (See Table 2). A question-by question analysis suggests participants' lack of knowledge of the modern differentiation between nociception and pain. Specifically, 62.3% of participants missed the item of "It is possible to have pain and not know about it," and 87.2% missed the item of "When part of your body is injured, special pain receptors convey the pain message to your brain." Certified hand therapists scored 0.40 points lower on the R-NPQ than their non-certified peers [$t(85.75) = -2.0$, $p = .049$). As per a one-way ANOVA with Bonferroni post hoc test, participants with a doctoral degree scored 0.69 points higher on the R-NPQ than those with a bachelor's ($p = .013$) and 0.56 points higher than those with a master's ($p = .046$). R-NPQ scores did not significantly vary by entry-level education, years since licensure, years identifying as a hand therapist, or primary diagnoses treated.

Self-reported knowledge of pain science ranged from "1 - not knowledgeable at all" to "5 - extremely knowledgeable" with a mean of 2.85 ± 0.74. However, perceived importance of knowledge of pain science for managing both acute (mean 4.20/5 ± 0.73) and chronic (mean 4.52/5 ± 0.60) upper extremity pain was high. The R-NPQ score was significantly associated with self-reported

knowledge ($r = .32$, $p < .001$). Both objective and self-reported knowledge were significantly associated with perceived importance of knowing pain science and perceived confidence in the evaluation and treatment of acute and chronic upper extremity pain and related patient education. However, correlations between knowledge and other beliefs were larger for self-reported knowledge ($r = .29 - .63$) than objective knowledge ($r = .12 - .25$). Perceived frequency for incorporating pain science principles into managing acute pain was significantly associated with self-reported knowledge ($r = .53$, $p < .001$) but not the R-NPQ score.

Conclusion: In the context of the opioid epidemic, it is vital for clinicians to understand pain to promote best practice in rehabilitation. The present survey is the first attempt to quantify the level of knowledge of modern pain science among hand therapists. Our findings indicate that, while therapists recognize the importance of knowing pain science, they have deficits in knowledge as per the R-NPQ and self-report. The role of specialization and education on knowledge should be further explored. In addition, attention to knowledge and beliefs beyond the R-NPQ score is warranted to understand variation in practice patterns. A qualitative component of the present study will further explore perspectives of musculoskeletal pain and related practice patterns for participants with high and low R-NPQ scores.

Table 1
Participants' Education and Practice Experience (N = 305)

n (%)		
	Associate's degree	1 (0.3)
Entry-level	**Bachelor's degree**	**172 (56.6)**
professional degree	Master's degree	125 (41.1)
	Doctoral degree	6 (2.0)
Highest level of education	Bachelor's degree	107 (35.2)
	Master's degree	**135 (44.4)**
	Doctoral degree	62 (20.4)
	≤5	33 (10.9)
	6-10	29 (9.5)
Years licensed as an OT or PT	11-15	18 (5.9)
	16-20	34 (11.2)
	21-25	51 (16.8)
	26-30	52 (17.1)
	>30	**87 (28.6)**
	≤5	**67 (22.1)**
	6-10	33 (10.9)
Years identifying as a hand therapist	11-15	39 (12.9)
	16-20	57 (18.8)
	21-25	40 (13.2)
	26-30	43 (14.2)
	>30	24 (7.9)

Note. Bolded items represent the response with the highest frequency for each question. Demographic information is missing for 1 participant.

Table 2
Distribution of scores on the Revised Neurophysiology of Pain Questionnaire (N = 305)

Score		n (%)	Cumulative %
5/12		7 (2.3)	2.3
6/12	50%	10 (3.3)	5.6
7/12		32 (10.5)	16.1
8/12		62 (20.3)	36.5
9/12	75%	84 (27.5)	63.9
10/12		63 (20.7)	84.6
11/12		35 (11.5)	96.1
12/12	100%	12 (3.9)	100.0

Note. Scores represent the number of correct responses.

3

Psychosocial Influences in the Development of Cumulative Trauma Disorders

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Purpose: The purpose of this study was to explore the lived experiences of individuals diagnosed with cumulative trauma disorders (CTDs), and investigate the psychosocial phenomena influencing CTD development as an impediment to occupational performance. CTDs remain a persistent and in some cases, epidemic problem in many industries today. Significant controversy surrounds CTD causality and the best way to manage these disorders. Research has shown that approaching CTDs from a symptom management model of medical, surgical, and rehabilitation alone yields inconsistent results.

Methods: This study was a single-phase, qualitative study in which the primary investigator (PI) recruited and interviewed individuals with CTDs using Grounded Theory (GT) methodolgy. The study participants consisted of six females and five males with an average age of 42.1 years, and an average symptom duration of 11.4 months. The interviews were aimed at exploring the lived experiences of the participants while investigating the psychosocial phenomenon influencing CTD development. The interviews were semi-structured, and participants had to meet specific inclusion criteria. The PI then analyzed the interactions using a process of constant comparison, up until saturation occurred. Trustworthiness techniques used during the data analysis phase included peer reviews of the transcribed interviews and member checking by two of the participants. The research question was: How do psychosocial demands impact the development, severity, and resolution of symptoms for workers whose primary work environment or personal health place them at risk for cumulative trauma disorders? Coding is essential to the development of a grounded theory and provides the pivotal link between collecting data and developing an emergent theory to explain the data.

Results: Data analysis many psychosocial factors contribute to the development and impact of CTDs, at both onset of symptoms and throughout the duration of the condition. CTDs have an insidious onset and can lack objective symptoms - *confusion, fear*; "I was scared to know what really was wrong because it happened so suddenly and got steadily worse as the months went on." CTD symptoms cause difficulty performing functions at work and home - *frustration, anger*; "I felt very defeated, very frustrated, I felt worthless in a way 'cause I felt like, you know, hey, I should be able to do this." Work provides two very important things: money and self-satisfaction – *anxiety, exasperation*; "I'm the type of person if I'm not working, I am not happy." Symptom progression leads to conflict with internal and external role expectations - *dissatisfaction, disappointment*; "I work hard and it was difficult admitting that I needed help with my wrist." A non- visible CTD problem impacting function diminishes understanding or support from significant others – *seclusion, aggravation*; "When you have a pain that can't be seen, understanding and sympathy can be hard to come by." There are social consequences for withdrawal – *isolation, unhappiness*; "Other employees were not very supportive. If you show even the smallest kind of weakness, they will jump on it." It is difficult for people with CTDs to find solutions – *frustration, helplessness*; "It takes months to figure that stuff out and mostly I remember the first couple of months, I was just overwhelmed by everything." Workers compensation and disability are complex systems; participation can have negative social consequences – *shame, feeling overwhelmed*; "I was treated like a criminal from the beginning." Without support and resolution, CTDs create an uncertain future – *anxiety, concern*; "I never thought that I would get to the point to where I could not do my job."