Adding Numbers to the Conversation of Limited English Proficiency and Chronic Pain

By: Sasha Ronaghi

Video link

Introduction

With 1 in 5 Americans experiencing chronic pain (Yong) and 2 in 5 Americans having Limited English Proficiency (LEP) (US Census Bureau), about 1 in 12.5 Americans or 26 million Americans are both LEP and suffer from chronic pain. The support system for these individuals is the same lackluster system used for all other medical conditions. Since most conditions have physical signs which doctors can use to treat patients, the language barrier proves to be difficult, but does not completely prevent any treatment. But, for chronic pain, a language barrier can have even worse impacts because there is no structural biomedical cause of it so patients must rely on their communication abilities to receive treatment. This communication barrier can lead to harmful effects on pain management: one study showed that postoperative children with LEP parents had 45% greater pain scores after treatment compared to English speaking patients (Jimenez). Yet, despite the large population affected by this, very little documentation exists on the communication of chronic pain for Limited English Proficient individuals in America. Last quarter, I wrote a paper called "Limited English Proficiency and Chronic Pain Treatment" where I added my own research to this topic by interviewing two pain physicians at Stanford Medicine.

The other missing piece to this equation was the lack of quantitative data surrounding this topic to understand how much the language barrier impacts the communication of pain. Here, I attempt to add to this data with more quantitative data with how a language barrier impacts chronic pain communication. My main question is: what is the minimum proficiency level that a person needs to fully communicate their pain? In other words, at what level of proficiency is there a statistically significant difference between the communication of pain of a non-fluent speaker to a fluent speaker?

The Survey

Survey is in Appendix A. I surveyed 73 participants who spoke another language to any degree. I asked them the following questions:

1. What language do you speak besides English? If you know more than one, pick the one you know best.
2. What is your proficiency in this language selected above?
3. Think back to a time in which you had a body part in pain. Please describe it in your second (non-English) language (1-2 sentences). You can write in English text or your text of your language.

4. Please describe the same event as above in English. (1-2 sentences)
5. What percent better do you think your English description would be if you were speaking to a doctor? (Eg. my English version was 50% better than my Spanish version or my English version was 25% worse than my Spanish version)

There were some limitations to my resources so that I could not interact with LEP chronic pain patients. In order to simulate similar conditions, I did the following:

1. I asked participants to rate their proficiency from Novice, Intermediate, Advanced, and Completely Fluent. While a true LEP patient would be Novice, I wanted to understand what the true proficiency barrier is to communicating pain, so I asked for respondents of all proficiency levels.
2. I asked participants to describe a time in which they experienced physical pain. Many don't experience chronic pain, but almost everyone has at least stubbed their toe or hands some type of physically painful experience and I wanted as large of a sample size as possible. While this does not capture the complexity or difficulty of experiencing chronic pain, it does provide some indication of how people explain pain.
3. I asked participants to describe painful experiences in another language that they may or may not be fluent in. In this scenario, I could compare people of sub-fluent proficiencies to fluent proficiencies to how they communicated their pain. I measured how well they communicated their pain based on how good they believed their non-English description was to their English description (everyone spoke fluent English). I use this metric because how well one communicates their pain is subjective, so I can't determine its quality on my own. However, from my interviews from physicians, they stressed the importance of how well the patient feels their pain is communicated. Assuming, one can describe their pain the best in English, I wanted to compare how well they thought their pain was communicated in relation to their best.
4. I asked participants to describe their pain before rating how well they did to English because it asks them to come up with the language and make a more evidence-based decision as to how well their pain was communicated.

Survey Demographics

There were 73 responses. The four most represented languages were Spanish (37%), Farsi (24.7%), Mandarin (5.5%), and Hindi (4.1%). Here is the proficiency breakdown: Novice (9.6%), Intermediate (37%), Advanced (19.2%), and Completely Fluent (34.2%).

Test #1: Comparing Communication Ability Based on Proficiency

In this test, I calculate the mean reported difference in non-English versus English of the different proficiency levels. Then, I calculated the difference between each sub-fluent proficiency level to the fluent level and used bootstrapping (appendix A) to show if there was a significant difference. Here are the differences and their p-values.

	Mean Score	Difference to Fluent	P-value
Novice	87.5	71.5	8e-06
Intermediate	47.22	31.22	.055
Advanced	50.0	34.0	.037
Fluent	16.0	0	N/A

The mean score is the mean percentage points that the participant perceived their English description was to their non-English description.

From this test, I found that there was a significant difference in all proficiency levels. This shows that, if one is not proficient, they will not be able to communicate their pain as they could if they were fluent.

I also used bootstrapping to test the statistical significance of the joint event where the point distribution is: novice > intermediate < advanced > fluent, as shown by my data. The p-value of this is 0.193909. So, then I tested the relationship as I would expect where the mean point distribution is novice > intermediate > advanced > fluent. The p-value is .0333, suggesting the probability in which novice > intermediate > advanced > fluent is statistically significant.

Test #2: Length of response and Proficiency

I wanted to understand the reason for the statistical significance of the difference between each category and the fluency in ability to communicate. In my interview with Dr. Thomas Anderson, he said that "the length at which a patient speaks and emphasis they use affects pain management" (more in paper discussed above). I decided to show the distribution of length of sentences based on proficiency for the Spanish category. I only used the Spanish category because word count is an indicator of detail in Spanish in the same way that it is an indicator in English. In other languages such as Mandarin, individual characters can have many meanings or represent a phrase, so the number of words doesn't indicate detail.

I analyzed the means of each level's average length of sentence and compared it to the fluent's average length.

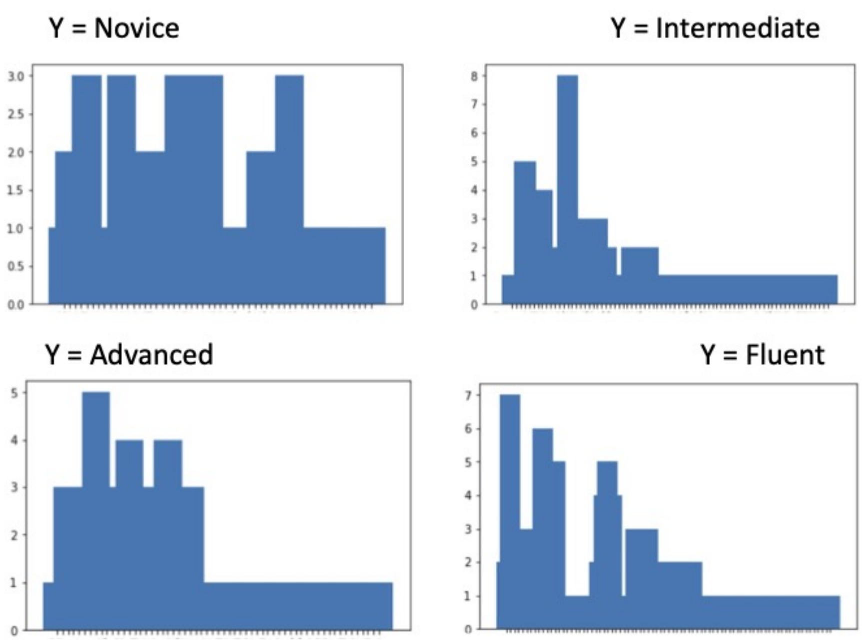
	Mean Length	Difference to Fluent	P-value
Novice	13.8	4.057	.94
Intermediate	11.7	6.143	.82
Advanced	14.42	3.428	.94
Fluent	17.85	0	N/A

This shows that there is an insignificant difference in length of response based on proficiency.

Test #3: Variation in Language and Proficiency

With the length of response not being a factor in the difference of communication strength, I decided to analyze the impact of language variety based on proficiency.

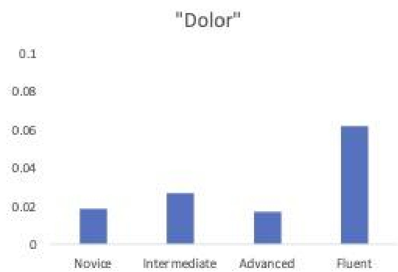
Here is the distribution of length of words for each category, where X is a random variable that represents a word and Y is the proficiency level.

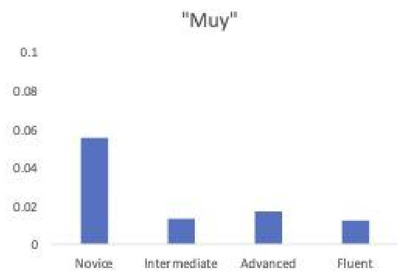


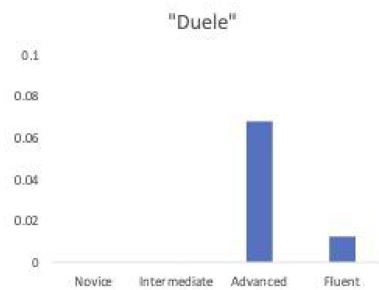
This distribution shows that there is more variation in words used as proficiency increases.

Test #4: Specific Words and Proficiency

I identified non-filler words in the entire Spanish data set that were the most common: “dolor” (appeared 9 times), “muy” (appeared 6 times), and “duele” (appeared 5 times) and created a probability distribution of these words where X = number of times the word appeared and Y = proficiency level.







While this analysis does not directly answer my question, it shows that pain language is tied to fluency, so it is important that patients communicate their pain in their most fluent language.

Conclusion & Future Outlook

Here, I performed data analysis to highlight the numerical significance of issues that LEP chronic pain patients face when trying to communicate their pain and receive treatment. With how little data exists in this topic, this project could be a model for future work to contribute to the topic. A future study could ask these questions and perform similar analyses of a larger sample of patients in the hospital experiencing chronic pain. Ultimately, my work shows that there is a statistically significant difference between non-fluent and fluent speakers in how well they feel they could communicate their pain. Hopefully, this work pushes for more resources for LEP chronic pain patients.

Works Cited

Jimenez, Nathalia, et al. "Postoperative Pain Management in Children, Parental English Proficiency, and Access to Interpretation." Hospital Pediatrics, vol. 4, no. 1, Jan. 2014, pp. 23–30. PubMed, https://doi.org/10.1542/hpeds.2013-0031.

Yong, R. Jason, et al. "Prevalence of Chronic Pain among Adults in the United States." Pain, Apr. 2021. PubMed, https://doi.org/10.1097/j.pain.0000000000002291.

Appendix A

Quiz on Pain and Language

This is completely anonymous. It should only take a few minutes.

1. What language do you speak besides English? If you know more than one, pick the one you know best.

   Mark only one oval.

   - Spanish
   - Mandarin
   - Hindi
   - Farsi
   - Arabic
   - Other: ____________________

2. What is your proficiency in this language selected above?

   Mark only one oval.

   - Novice
   - Intermediate
   - Advanced
   - Completely fluent

3. What is your proficiency in English?

   Mark only one oval.

   - Novice
   - Intermediate
   - Advanced
   - Completely fluent

4. Think back to a time in which you had a body part in pain. Please describe it in your second (non-English) language (1-2 sentences). You can write in English text or your text of your language.

5. Please describe the same event as above in English. (1-2 sentences)

6. What percent better do you think your English description was if you were speaking to a doctor? (Eg. my English version was 50% better than my Spanish version or my English version was 25% worse than my Spanish version)

Mark only one oval per row.

	0%	25%	50%	75%	100%
Better	◯	◯	◯	◯	◯
Worse	◯	◯	◯	◯	◯

Appendix B

Test #1:

```
import pandas as pd
import numpy as np
df = pd.read_csv('Downloads/pain1.csv')
less = []
inter = []
adv = []
more = []
sample = []
for a,b in zip(df.iloc[:, 3], df.iloc[:, 6]):
    b_str = b[0: (len(b) - 1)]
    new_b = int(b_str)
    if (a == "Novice"):
        less.append(new_b)
    if (a == "Intermediate"):
        inter.append(new_b)
    if (a == "Advanced"):
        adv.append(new_b)
    if (a == "Completely fluent"):
        more.append(new_b)
    sample.append(new_b)
less_mean = np.mean(less)
print(less_mean)
inter_mean = np.mean(inter)
print(inter_mean)
adv_mean = np.mean(adv)
print(adv_mean)
more_mean = np.mean(more)
print(more_mean)
lm_diff = abs(more_mean - less_mean)
im_diff = abs(more_mean - inter_mean)
adm_diff = abs(more_mean - adv_mean)
print(lm_diff)
print(im_diff)
print(adm_diff)
count1 = 0
for i in range(1000000):
    sample1 = np.random.choice(sample, 18, replace = True)
    sample2 = np.random.choice(sample, 18, replace = True)
```

```
    mean1 = np.mean(sample1)
    mean2 = np.mean(sample2)
    mean_diff = abs(mean1 - mean2)
    if (mean_diff > lm_diff):
        count1 += 1
print(count1 / 1000000)
count4 = 0
for i in range(1000000):
    sample1 = np.random.choice(sample, 18, replace = True)
    sample2 = np.random.choice(sample, 18, replace = True)
    mean1 = np.mean(sample1)
    mean2 = np.mean(sample2)
    mean_diff = abs(mean1 - mean2)
    if (mean_diff > im_diff):
        count4 += 1
print(count4 / 1000000)
count5 = 0
for i in range(1000000):
    sample1 = np.random.choice(sample, 18, replace = True)
    sample2 = np.random.choice(sample, 18, replace = True)
    mean1 = np.mean(sample1)
    mean2 = np.mean(sample2)
    mean_diff = abs(mean1 - mean2)
    if (mean_diff > adm_diff):
        count5 += 1
print(count5 / 1000000)
count6 = 0
for i in range(1000000):
    samplenov = np.random.choice(sample, 18, replace = True)
    sampleint = np.random.choice(sample, 18, replace = True)
    sampleadv = np.random.choice(sample, 18, replace = True)
    sampleflu = np.random.choice(sample, 18, replace = True)
    mean1 = np.mean(samplenov)
    mean2 = np.mean(sampleint)
    mean3 = np.mean(sampleadv)
    mean4 = np.mean(sampleflu)
    if (mean1 > mean2 and mean2 < mean3 and mean3 > mean4):
        count6 += 1
print(count6 / 1000000)
```

```
count7 = 0
for i in range(1000000):
    samplenov = np.random.choice(sample, 18, replace = True)
    sampleint = np.random.choice(sample, 18, replace = True)
    sampleadv = np.random.choice(sample, 18, replace = True)
    sampleflu = np.random.choice(sample, 18, replace = True)
    mean1 = np.mean(samplenov)
    mean2 = np.mean(sampleint)
    mean3 = np.mean(sampleadv)
    mean4 = np.mean(sampleflu)
    if (mean1 > mean2 and mean2 > mean3 and mean3 > mean4):
        count7 += 1
print(count7 / 1000000)
```

Test #2/3/4

```
def count_words(str):
    word_list = str.split()
    return len(word_list)
df1 = pd.read_csv('Downloads/spanishdata2.csv')
nov = []
inte = []
adva = []
flu = []
nov_len = []
inte_len = []
adva_len = []
flu_len = []
total_words = []
nov_words = []
inte_words = []
adva_words = []
flu_words = []
for a,b in zip(df1.iloc[:, 2], df1.iloc[:, 3]):
    word_list = b.split()
    for i in range (len(word_list)):
        total_words.append(word_list[i])
    print(word_list)
    total_words.append(b.split());
      word_list = b.split
    for word in word_list:
```

```
        total_words.append(word)
    if (a == "Novice"):
        nov.append(b)
        nov_len.append(count_words(b))
        for i in range (len(word_list)):
            nov_words.append(word_list[i])
    if (a == "Intermediate"):
        inte.append(b)
        inte_len.append(count_words(b))
        for i in range (len(word_list)):
            inte_words.append(word_list[i])
    if (a == "Advanced"):
        adva.append(b)
        adva_len.append(count_words(b))
        for i in range (len(word_list)):
            adva_words.append(word_list[i])
    if (a == "Completely fluent"):
        flu.append(b)
        flu_len.append(count_words(b))
        for i in range (len(word_list)):
            flu_words.append(word_list[i])
print(total_words)
plt.hist(total_words)
import matplotlib.pyplot as plt
from collections import Counter
hist = Counter(total_words)
print(hist)
plt.bar(hist.keys() hist.values(), width=5)
hist1 = Counter(nov_words)
print(hist1)
plt.bar(hist1.keys(), hist1.values(), width=5)
hist2 = Counter(adva_words)
print(hist2)
plt.bar(hist2.keys(), hist2.values(), width=5)
hist3 = Counter(inte_words)
print(hist3)
plt.bar(hist3.keys(), hist3.values(), width=5)
hist4 = Counter(flu_words)
print(hist4)
plt.bar(hist4.keys(), hist4.values(), width=5)
```

```
# probabilities of the most common words for the different groups

prob1 = hist1['dolor']/ len(hist1)
prob2 = hist2['dolor']/ len(hist2)
prob3 = hist3['dolor']/ len(hist3)
prob4 = hist4['dolor']/ len(hist4)

print(prob1)
print(prob2)
print(prob3)
print(prob4)

prob9 = hist1['muy']/ len(hist1)
prob10 = hist2['muy']/ len(hist2)
prob11 = hist3['muy']/ len(hist3)
prob12 = hist4['muy']/ len(hist4)

print(prob9)
print(prob10)
print(prob11)
print(prob12)

prob13 = hist1['duele']/ len(hist1)
prob14 = hist2['duele']/ len(hist2)
prob15 = hist3['duele']/ len(hist3)
prob16 = hist4['duele']/ len(hist4)

print(prob13)
print(prob14)
print(prob15)
print(prob16)

nov_mean = np.mean(nov_len)
inte_mean = np.mean(inte_len)
adva_mean = np.mean(adva_len)
flu_mean = np.mean(flu_len)
print(nov_mean)
print(inte_mean)
print(adva_mean)
print(flu_mean)
```

```
nf_diff = abs(flu_mean - nov_mean)
if_diff = abs(flu_mean - inte_mean)
af_diff = abs(flu_mean - adva_mean)
print(nf_diff)
print(if_diff)
print(af_diff)
count1 = 0
for i in range(1000000):
    sample1 = np.random.choice(sample, 6, replace = True)
    sample2 = np.random.choice(sample, 6, replace = True)
    mean1 = np.mean(sample1)
    mean2 = np.mean(sample2)
    mean_diff = abs(mean1 - mean2)
    if (mean_diff > nf_diff):
        count1 += 1
print(count1 / 1000000)
count2 = 0
for i in range(1000000):
    sample1 = np.random.choice(sample, 6, replace = True)
    sample2 = np.random.choice(sample, 6, replace = True)
    mean1 = np.mean(sample1)
    mean2 = np.mean(sample2)
    mean_diff = abs(mean1 - mean2)
    if (mean_diff > if_diff):
        count2 += 1
print(count2 / 1000000)
count3 = 0
for i in range(1000000):
    sample1 = np.random.choice(sample, 6, replace = True)
    sample2 = np.random.choice(sample,6, replace = True)
    mean1 = np.mean(sample1)
    mean2 = np.mean(sample2)
    mean_diff = abs(mean1 - mean2)
    if (mean_diff > af_diff):
        count3 += 1
print(count3 / 1000000)
```