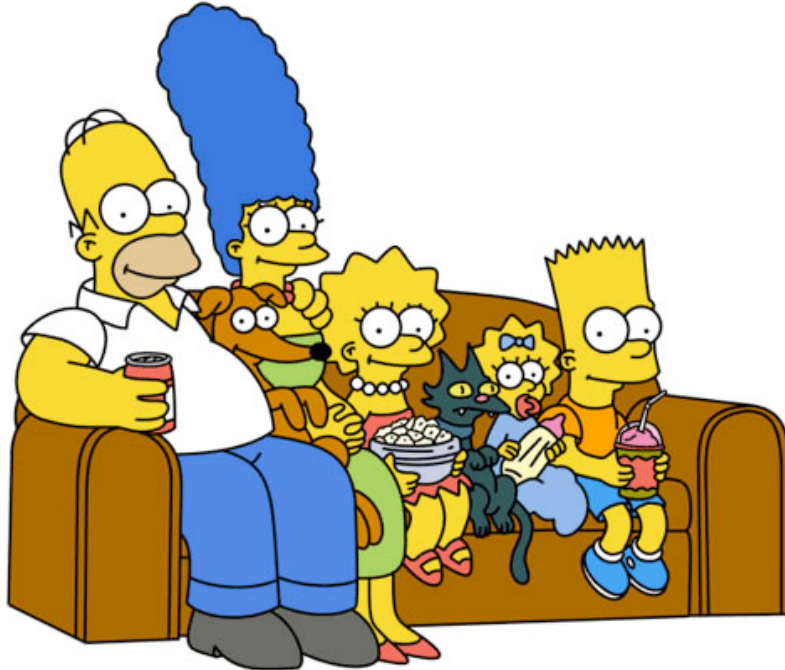


PSYC 562 Measurement of Psychological Processes
Assignment #1: Multi-dimensional scaling - a children's story
Song Hui Chon

Once upon a time, there was a girl named Lisa Simpson in Springfield, Missouri. She lived with her mom Marge and dad Homer. She also had an older brother named Bart and a baby sister named Maggie. Her family also had a cat, "Snowball" and a dog, "Santa's Little Help".



One day during a class, Ms. Hoover, Lisa's teacher, talked about how to make a comparison. She explained that there is usually more than one way to compare things. Lisa asked, "How is that possible? I don't understand, Ms. Hoover."

"Well, let me give you an example." Ms. Hoover said.

"Lisa, how many people are there in your family?" she asked.

"Mom, dad, Bart, Maggie and me - five people, Ms. Hoover." Lisa answered.

"Do you have any pets?" asked Ms. Hoover.

"Yes, ma'am. We have a cat named Snowball and a dog named Santa's little help," said Lisa.

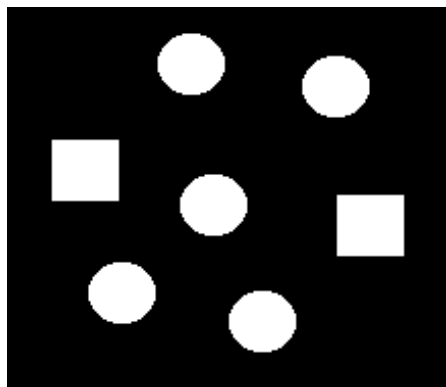
"Very good, Lisa. So can you say there are five people and two animals living in your house?" asked Ms. Hoover.

"Yes, Ms. Hoover."

"Well, then, what kind of *comparison* do you think we just made?" Ms. Hoover asked.

"Ermmm... I don't understand your question, Ms. Hoover." Lisa answered a little embarrassed.

"I guess I need to be more clear. Let's draw a picture on the board."



Ms. Hoover drew five circles and two squares on the black board.

"What do you see, Lisa?"

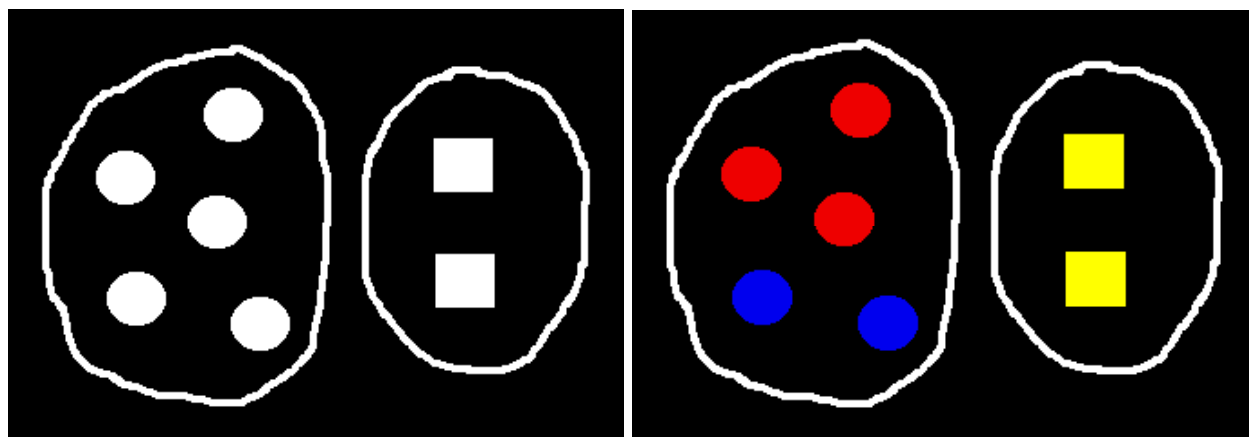
"Two squares and five circles, Ms. Hoover." Lisa answered.

"Very well. If I ask you to distinguish these seven items into different groups, how would you do it?" asked Ms. Hoover.

"I will put the circles in one group and the squares in another group, ma'am." Lisa answered.

"Do you want to draw it on the board?" Ms. Hoover said.

"Okay." Lisa walked to the black board.



"Here, Ms. Hoover." said Lisa after changing the figures on the black board a little bit.

"Excellent. If I tell you this picture is about everyone in your house, what can you tell me?" Ms. Hoover asked.

"Well, I think the circles are the people and the squares are the pets." Lisa replied.

"And how many groups do we have right now?"

"Two, Ms. Hoover." answered Lisa.

"Yes, Lisa. That's correct. Now, let's make another example that looks just like this one but with different colors." said Ms. Hoover.

"Let's put red in three circles, blue in the other two circles and yellow in the squares." Ms. Hoover continued. "Can you tell me what red and blue circles can be if they are about your family?"

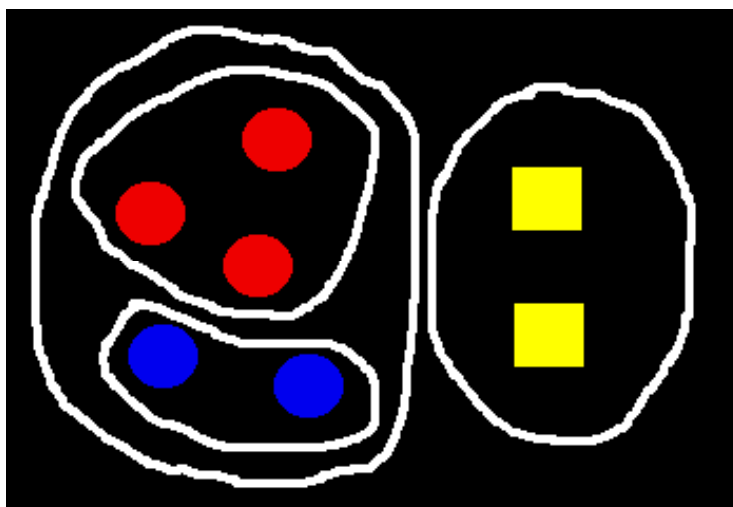
"I think red circles are me, mom and Maggie. And blue circles are dad and Bart, ma'am." said Lisa.

"And what made you think so?" asked Ms. Hoover.

"Because mom, Maggie and I are girls and dad and Bart are boys." Lisa answered.

"Very well, Lisa. Now, what can you change in the picture on the board to show that the red circles are different from the blue circles?" asked Ms. Hoover.

"Erm... put circles like this?" Lisa asked back while drawing a circle around the red circles and another around the blue circles.



"Excellent!" Ms. Hoover said and it made Lisa happy to know her answer was correct.

"So what does this mean? Can you tell me how this new picture has changed from the first one?" Ms. Hoover asked.

"We had two groups in the first picture and now we have three groups?" Lisa answered.

"Great, Lisa! So will you agree with me if I say there are more than one way to group everyone in your family?" asked Ms. Hoover.

"Yes, Ms. Hoover." said Lisa while nodding her head.

"Excellent. Now class, this is related to something called *Multi-dimension scaling*." Said Ms. Hoover looking around the classroom.

"*Multi-WHAT?*" asked Nelson Muntz, clearly not understanding what Ms. Hoover just said.

"*Multi, dimensional, scaling.*" Ms. Hoover repeated while writing them big on the board.

"And what is *THAT?*" asked Nelson again, because those big words did not mean anything to him.

"Well, first, the word *multi* means *more than one*. Sometimes it can mean *many*. Have you heard people saying '*multiple something*' like in '*multiple copies*'?" asked Ms. Hoover. Most students nodded their heads, even though they were still not sure where this was going.



"The second word, *dimensional*, comes from the word *dimension*. Have you heard this word before?" Ms. Hoover asked looking around the classroom. Some students were nodding but some others were shaking their heads.

"Ms. Hoover?" asked Lisa with her right arm stretched in the air.

"Yes, Lisa? What is it?"

"The word *dimension* has something to do with space. One-dimension is just a straight line, two-dimension is a flat surface like a paper, and the space we live has three dimensions, right?" said Lisa, remembering a science book she read a couple of weeks ago.

"Very good, Lisa! I couldn't have given better examples myself." Ms. Hoover said with a delight that in turn made Lisa proud of herself.

"And the last word, *scaling*, has something to do with changing sizes." Ms. Hoover explained. "With all those three big words combined, what does it mean? Can anyone tell me what it means?" asked Ms. Hoover to the entire class.

"I can!" Lisa said excitedly with her arm raised again.

"Sure, Lisa. Go ahead." Ms. Hoover said.

"*Multi-dimensional scaling* means we change the size of *dimensions* or spaces!" said Lisa.

"Great, Lisa. That was correct." Continued Ms. Hoover. "It is usually used to compare *multiple* things and understand in what ways things are similar or different."

"I still don't understand," grunted Nelson. "What does *multi-dimensional scaling* has to do with Lisa's family?"

"A very good question, Nelson! I was wondering who was going to ask that question." Ms. Hoover said with a smile.

"It *IS* a good question?" Nelson mumbled unbelievably, still looking confused.

"Yes, it is, Nelson," replied Ms. Hoover with a smile again.

"We just saw there are at least two ways to group circles and squares in different colors, haven't we?" asked Ms. Hoover to the entire class, most of whom nodded saying yes.

"If we have more shapes, say *triangles*, in the big group, do you think we will use the same number of groups to distinguish the shapes?" Ms. Hoover continued.

"No, Ms. Hoover. We will probably have more groups." Lisa answered.

"Okay. Then what happens if we have only squares and circles but more colors? Will we use the same number of groups or more groups or less groups?" asked Ms. Hoover.

"More groups." Said Nelson, quite confidently this time.

"Good answer, Nelson." Ms. Hoover continued. "Now, imagine that you have one red circle, one blue circle and one yellow square, and you are going to compare two things at once. And this time, you are going to give a number between 1 and 5; 1, if the two things are very similar to each other and 5 if the two things are pretty much the opposite of each other."

		Nelson	Ms. Hoover
●	●	1	2
●	■	5	4
●	■	3	3
●	■	2	3
●	■	4	5
■	■	1	1

"Nelson, how similar do you think the red circle and the blue circle are? What number will you give them?" asked Ms. Hoover.

"Erm... 1?" Nelson answered hesitantly.

"Well, then, how about the blue circle and the yellow rectangle?" Ms. Hoover asked.

"5, I guess." Answered Nelson.

"How about the blue circle and the green rectangle?"

"3." Nelson said.

Nelson gave three more numbers to complete the comparison.

Ms. Hoover turned to look at the entire class and asked, "Can you give them different numbers?"

Many students nodded saying yes.

"Good. I can probably give 2, 4, 3, 3, 5, 1 and you can find many other ways to give numbers to those pairs." Said Ms. Hoover while writing those numbers on the board.

"Now let's go back to Lisa's family members. Let's say that I want to know how people generally group Lisa's family." Ms. Hoover continued.

"I can give the pictures of everyone in Lisa's family to people in Springfield and ask them to organize those pictures in as many groups as they want. Like what I asked Lisa to do first. The way I group the photos is probably different from how other people do it, right?" asked Ms. Hoover and the students nodded.

"But even in those different numbers that different people use, we can find a general way in how most people think. That's basically what is called *Statistics* in a big word." Said Ms. Hoover.

"And *multi-dimensional scaling* is one of many things that are included in the word *Statistics*. It helps us see things in a simpler way," continued Ms. Hoover.

"For example, if we asked 100 people to give numbers to the circles and squares like we just did, we will have a lot of numbers, right?" asked Ms. Hoover looking around the classroom to find out the students nodding.

"And we will have a lot more numbers if we asked 1000 people, will we not?" she asked again.

"Yes, Ms. Hoover." The students replied.

"So the things look very difficult with many numbers, but we can use *multi-dimensional scaling* that will give us a picture that looks like these," Ms. Hoover explained pointing at the two pictures where Lisa drew circles for groups.

"*Multi-dimensional scaling* is great because we can use it for any kind of similar-different test. We can use a big list of numbers and get a picture that we can usually understand. Isn't it easier to understand the groups in the pictures rather than seeing all the numbers?" asked Ms. Hoover.

The students nodded.

"Ms. Hoover? I have a question." Lisa asked.

"What is it, Lisa?" asked Ms. Hoover in turn.

"I can see that *multi-dimensional scaling* is cool to make pictures from numbers. But how does it work?" asked Lisa.

"Well, class, that I don't know. You will have to ask that question to your professor when you go to college." Ms. Hoover said.