

Measuring Music

Ramifications of Reifying
Issues and Music and Sciences

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Outline

- I. We're never directly manipulating or getting at the "Truth"
- II. All models are wrong, some are useful
- III. It's important we think about what we are measuring
- IV. We always lose something when we turn it into a number

Falsifiability and Operationalization

Review from last week

What is falsifiability, who proposed it as a demarcation criteria, and why is it important we are able to differentiate scientific from non-scientific questions?

Falsifiability

- If something can be proven wrong
- Karl Popper
- Public health, pseudoscience, severity testing
- Demarcation criteria

Operationalization / Operationalize

- Rarely do we get to directly study a concept of interest**
- For example, pitch is perceptual approximation for fundamental frequency**
- For example, no one universally agreed upon definition of musicality**
- Need to pick something that approximates**

Operationalizing Musicianship

- There is no universally agreed on metric of who counts as a musician
- In many ways, matters only personally and culturally, maybe with union?
- But clearly there are people who are more of a musician than others
- From scientific point of view, important to find way to agree on this
- Why might it be important to have an agreed upon definition of musicianship?
- What do we gain when we come to agreement about musicianship?
- What do we lose when we come to an agreement about musicianship?

Operationalizing Complexity

- Problems at the individual level are similar when talking about sonic elements?
- What music is the most complex?
- What music is the least complex?
- What (and whose!?) tools are we using to make these assessments?

Operationalizing

- Necessary evil in scientific research
- Goal is to find measure that we believe reflects what we want to study
- Important to consider the values we have when we reduce
 - Musicianship Example
 - Complexity Example
- Operationalizing makes us commit to a specific world view
 - OK if wrong, that is iterative nature of science
 - Keeps us honest about the tools that we use
- Makes our assumptions explicit!
- We have specific language for talking about common errors when operationalizing

Validity and Reliability

Reliability

→ How consistent is your measure?

Validity

→ How well does your measure actually represent what it sets out to do?

Reliability

- What do you expect to happen every time you step on your bathroom scale?
- If you get the same result every time you use a tool, you have a reliable measure
- Reliability is related, but not the same as validity!

Reliability

- **Test-retest reliability**
 - Give same measure twice
- **Internal consistency**
 - Ask same type of questions on a test
- **Inter-rater reliability**
 - Ask two people to score the same thing

Reliability

- Variables that can be directly measured (height, weight, speed) tend to have higher reliability
- But just because you can't measure something directly doesn't mean you can't measure it: what constructs do you believe exist but need to be *indirectly* measured?

Reliability

- Variables that can be directly measured (height, weight, speed) tend to have higher reliability
- But just because you can't measure something directly doesn't mean you can't measure it: what constructs do you believe exist but need to be *indirectly* measured?
- Personality, musicality, working memory capacity, tonality?

Check for Understanding

If I wanted to create a new tool to measure absolute pitch (the ability to name a musical pitch without using an external reference), what would be an reliable way to do this?

Validity

- **Are we measuring what we think we are!?**
- **Depends on the definition of the construct**
- **You can come up with a measure for anything you want, but still might not measure something “real”**

Validity

- **Personality**
- **Why use the Big Five (OCEAN)?**
 - Openness to New Experiences
 - Conscientiousness
 - Extraversion
 - Agreeableness
 - Neuroticism
- **Why not Meyers Briggs, Astrology?**

Check for Understanding

Come up with a new psychometric* measure that would be very reliable, but not valid. Explain why.

***psycho (mind) metric (measuring)**

BREAK

Check for Understanding

Why is it important to be able to measure something that we are interested in studying?

Small World and Big World

Working with models



Models

- Almost everything in the world is too complex to study and account for everything
 - Weather patterns, human brain, the musculoskeletal system, migration of whales, musical improvisation, the early universe
- Scientists get around this cumbersome task by making models
- “All models are wrong, some are useful” -- George Box
- Models are only meant to approximate part of a process
- Statistical models are extremely important in modern science

Example: Regression

- Statistical model that answers question: How much?
- Formulate as mathematical model of a line

$$Y = 2.3x_1 + 1.05x_2 + 7$$

- Y : Number of measures a piano player can memorize
- x_1 : number of hours they have practiced a piece of music
- x_2 : number of years they have played piano

How many measures could a piano player who has practiced 10 hours with 3 years of experience memorize?

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$$Y = (2.3 * 10) + (1.05 * 3) + 7$$

$$= 23 + 3.15 + 7$$

$$Y = 33.15 \text{ measures of music}$$

Discussion Questions

- What are some of the advantages of using a model to discuss something you wish to study scientifically?
 - What are some of the disadvantages of using a model to discuss something you wish to study scientifically?
- Break out rooms!

Discussion Points

Advantages

- Have common language to discuss assumptions
- Clear ways in which the model can be wrong to different extent
- Ability to incorporate uncertainty in measurements
- Removes what is special about each individual case

Disadvantages

- Reductionist approach
- Will never capture all of the nuances involved in the task at hand
- Models can be deceiving in how they represent what is important about the world
- Removes what is special about each individual case

Measuring Sounds

+

Measuring People

Measuring

(Moved to week 4)

Check for Understanding

Based on what you have learned thus far, what would you say to a scientist who wanted to create a psychometric tool that will measure if a child is a musical genius?