

# Exploring the sensory space of American ciders from the Northeast and Mid-Atlantic United States using classical descriptive analysis

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# Introduction

American cider is growing in popularity<sup>1, 18</sup>

- Led by on-premise sales, small- and medium-size orchards/producers<sup>3</sup>
- New York, Virginia, and Vermont are ranked 1<sup>st</sup>, 8<sup>th</sup>, and 12<sup>th</sup> with the most cideries<sup>23</sup>

American Cider Association urges the development of a common descriptive language<sup>14</sup>

- To share among consumers and producers
- To clarify cider sensory attributes and potential
- Segment ciders based on styles: modern vs. traditional

# Introduction

Descriptive Analysis (DA) is the gold-standard for descriptive sensory research<sup>11, 22</sup>

- Utilizes a trained panel (8-12 panelists)
- Highlights the sensory potential of a product space, and reliable terms that can discriminate a product space
- Common for alcoholic beverages, many other foods and beverages<sup>10, 13, 16, 21</sup>

# Objectives

- Explore the what sensory attributes can be used to describe a large representative sample of American ciders from Virginia, Vermont, New York (Northeast and Mid-Atlantic US)
- Determine if *and* how a trained panel can distinguish samples based on extrinsic product factors
  - Cider style
  - Packaging
  - Apple Varieties

# Methods

## Sample Selection

- 42 samples total
  - 12 Vermont
  - 16 Virginia
  - 16 New York
- Unbalanced with styles, packaging, apple varieties

## Panel Training

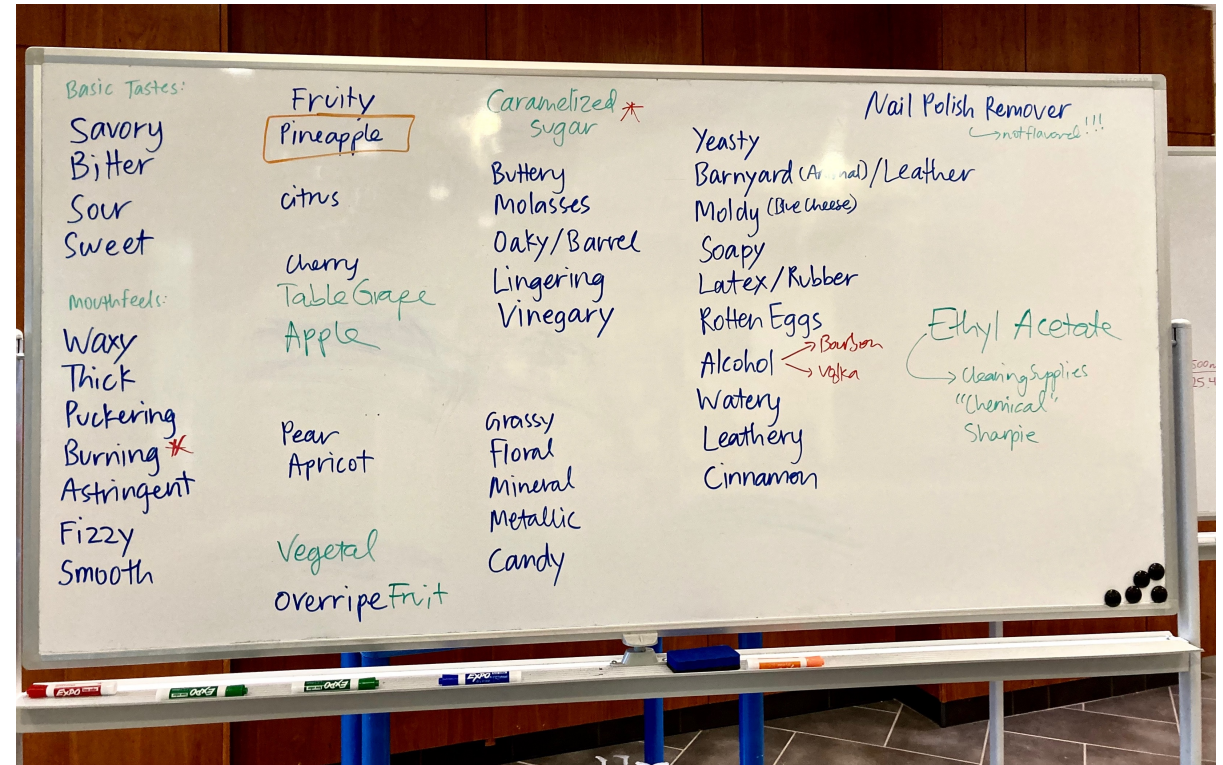
- 8 panelists
- 13 hours
- Reference standards with verbal definitions

## Sample Evaluation

- 14 evaluations
- Duplicate
- Standard procedures, adapted to minimize waste<sup>24</sup>

Data Analysis: multiple 3-way MANOVAs  
pseudomixed 3-way ANOVAs for significant attributes  
Rstudio ver. 4.1.2 (R Core Team, 2018)

# Methods



# Results

Significant differences across all 4 factors:

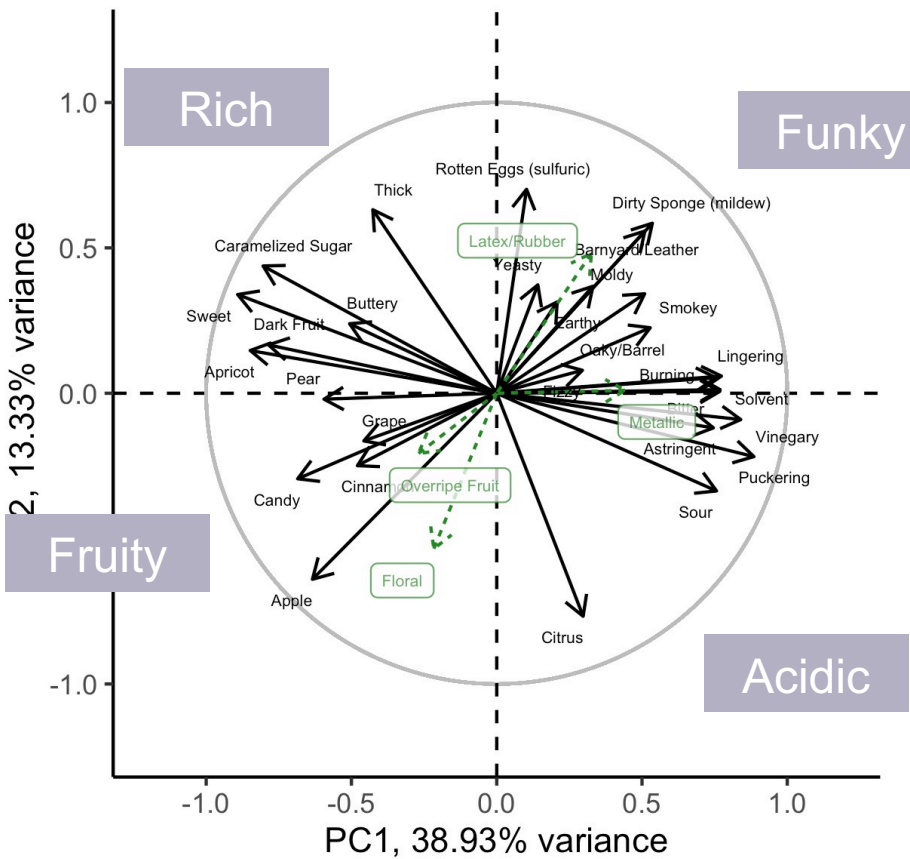
- samples (Wilk's  $\Lambda = 0.0002$ ,  $p < 0.05$ )
- states (Wilk's  $\Lambda = 0.82884$ ,  $p < 0.05$ )
- styles (Wilk's  $\Lambda = 0.59820$ ,  $p < 0.05$ )
- packaging (Wilk's  $\Lambda = 0.76098$ ,  $p < 0.05$ )

33 descriptive attributes

- 29 attributes significantly discriminated samples
- 11 attributes significantly discriminated by State
- 17 attributes significantly discriminated by packaging, style (modern vs. traditional)

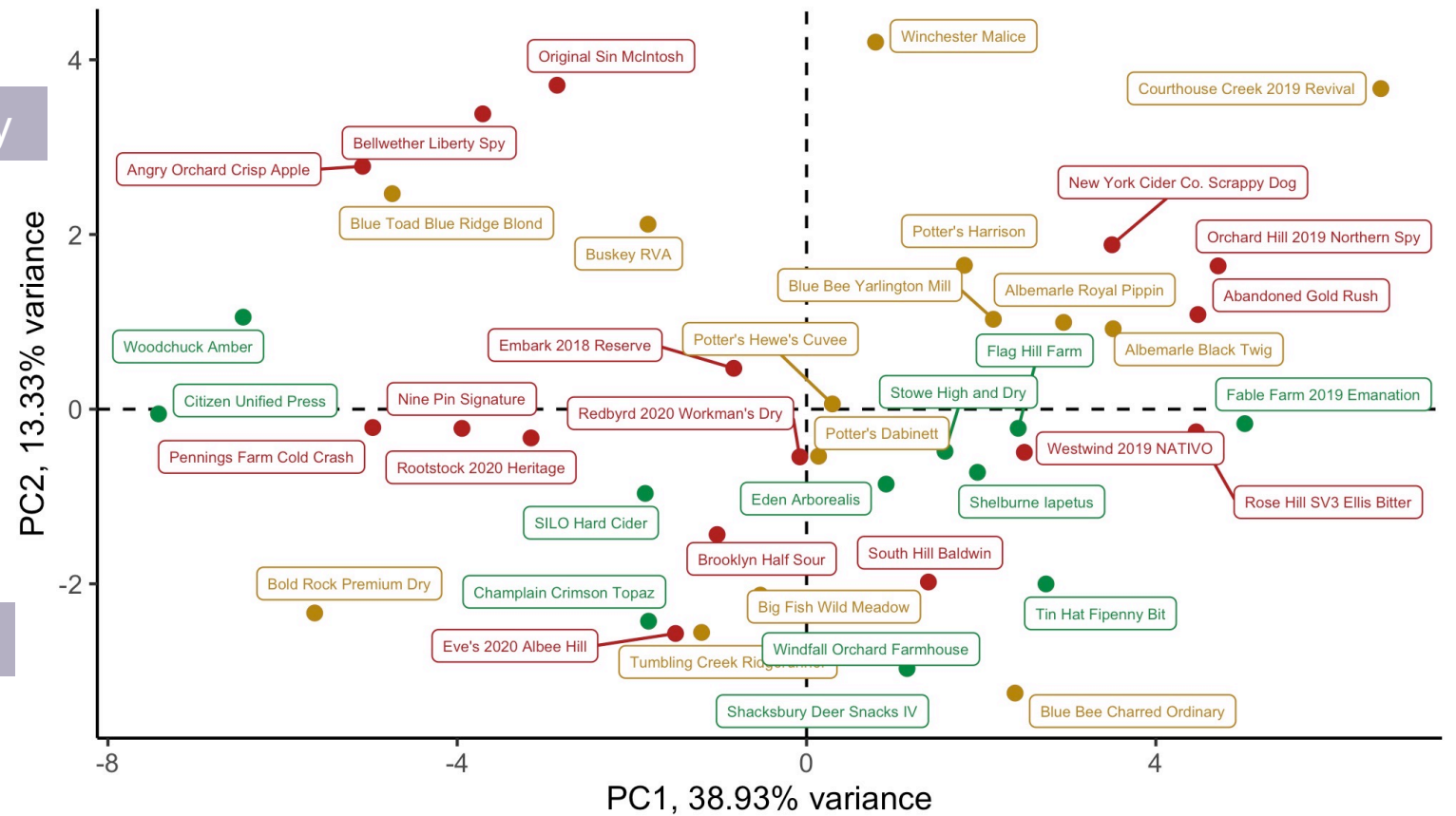
# Results

(a) PCA plot of Descriptive Attributes



Type of Attribute   a   significant   a   supplementary

(b) PCA plot of Samples



State   ●   New York   ●   Vermont   ●   Virginia



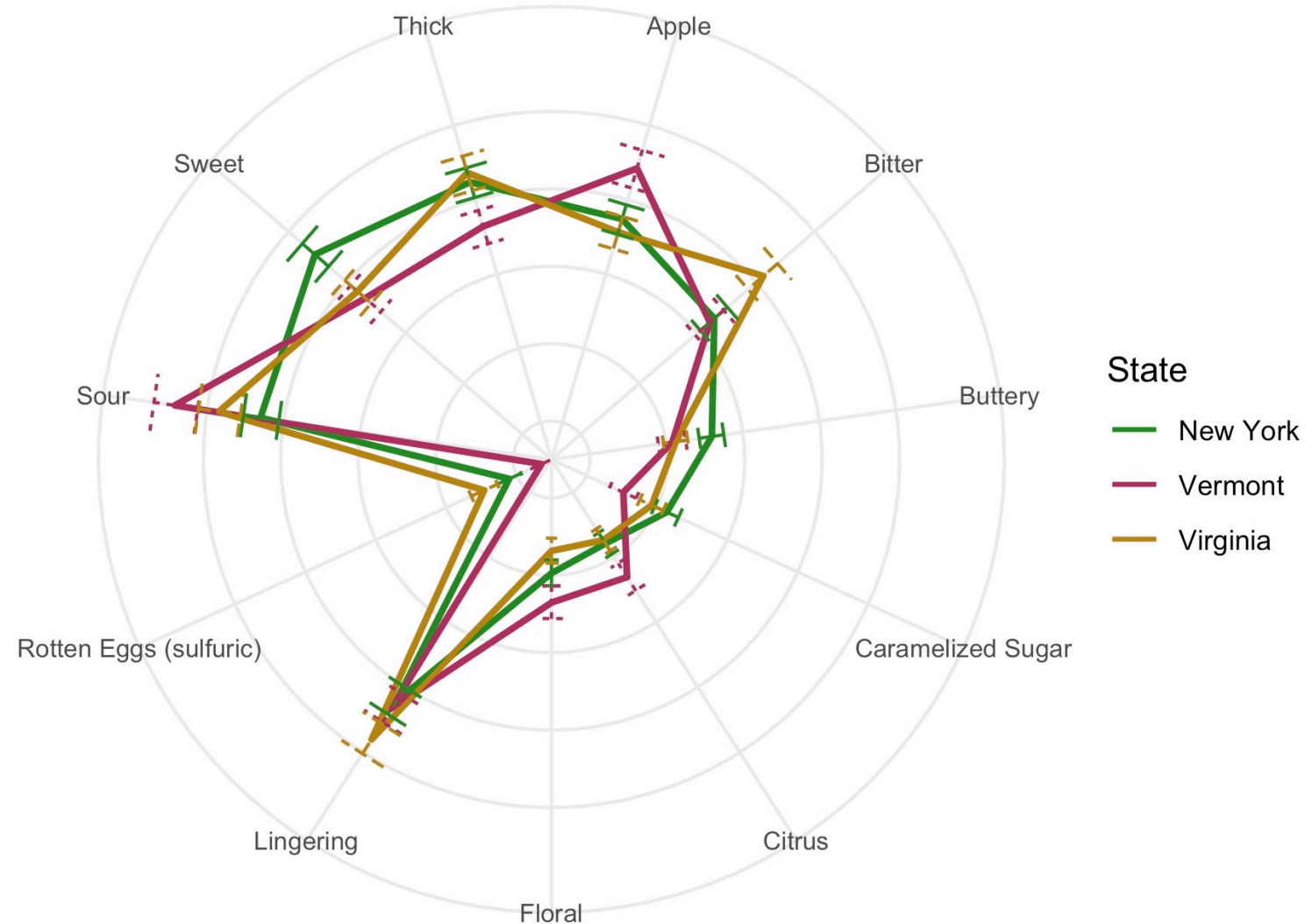
# Results

## 11 significant descriptors

- Subtle yet significant differences across location

Large variation in production processes within states<sup>2, 10, 13, 18</sup>

- Need for more research on styles of production, effects to sensory quality



# Results

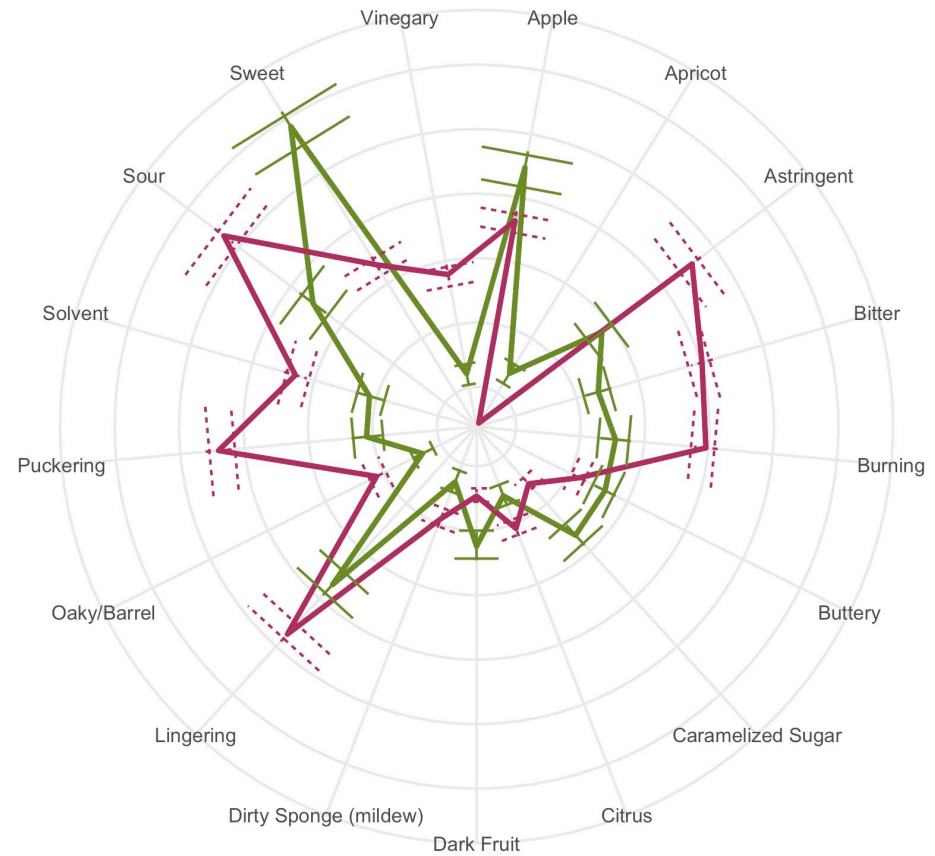
(a) Cider Styles



The large difference in mean intensity ratings for “sweet” across modern and traditional ciders highlights how 1 dryness-sweetness scale is ineffective<sup>5</sup>

Cider Style — modern — traditional

(b) Packaging Formats



Packaging — can — glass bottle

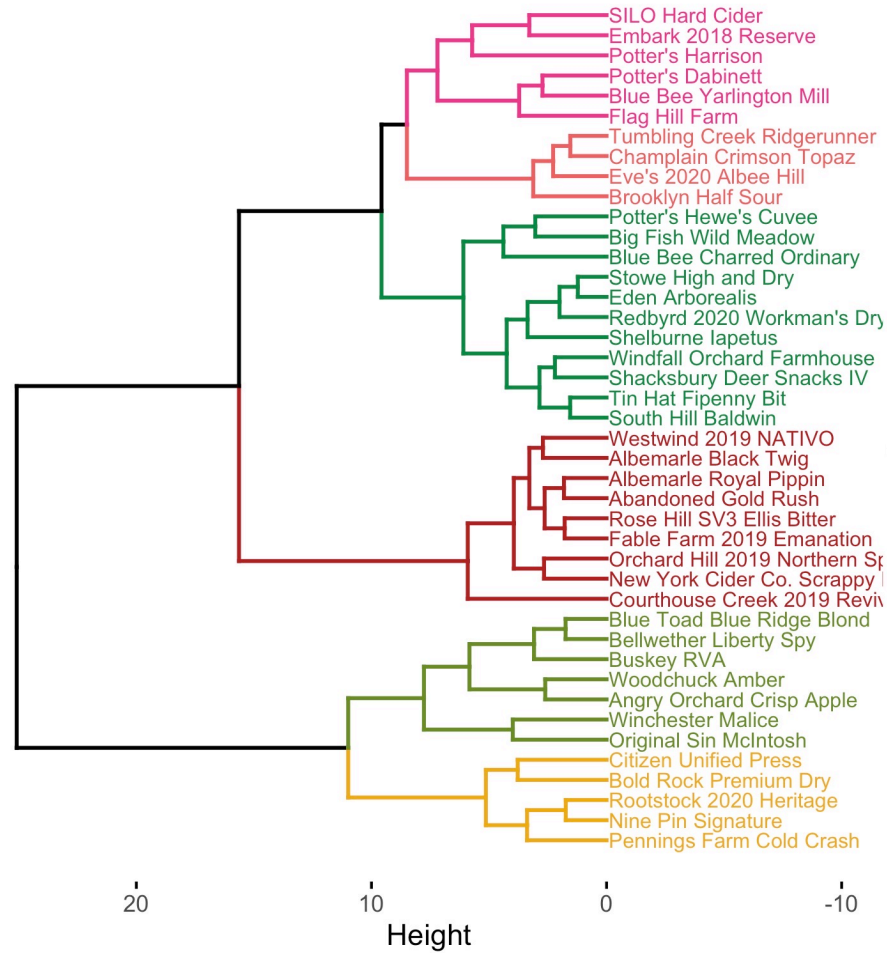
# Discussion

29 significant descriptors across the samples:

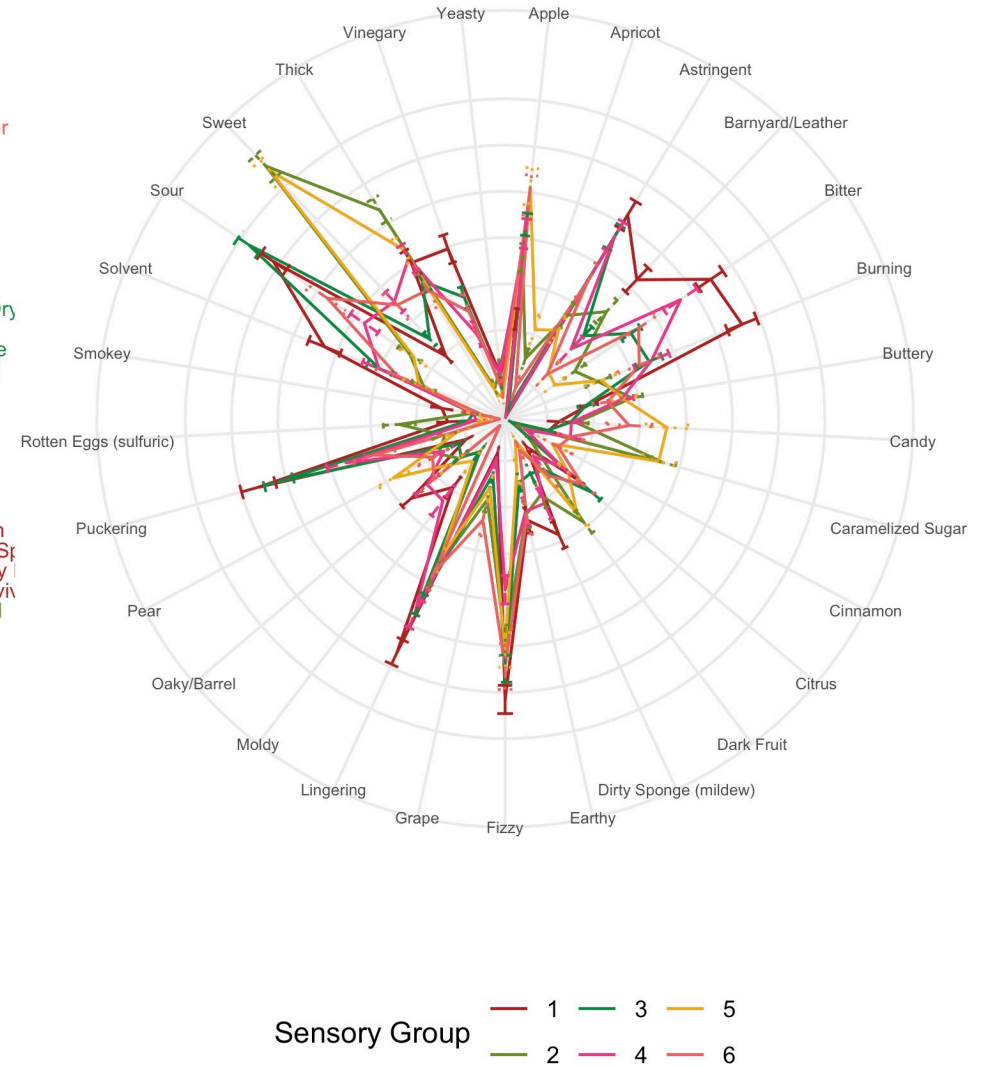
- Similar terms compared to other research on Virginia ciders, ciders made using natural fermentation methods<sup>7, 11, 17</sup>
- Closely overlapping terms indicate that broader descriptive terms can also be useful (e.g., “Barnyard/Leather” + “Dirty Sponge (mildew)” + “Moldy” = funky
  - Broad terms → clear and quick to motivate immediate purchase decisions
  - Descriptive terms → detailed for intentional, reflective tasting
- Valuable for generating a sensory lexicon for American hard cider
- Dissemination through marketing materials, application in cidery settings

# Results

(a) Hierarchical Cluster of the Cider Samples according to Sensory Similarity



(b) Radar Plot of Mean Intensities across Sample Clusters



# Future/Other Research

- Interest in combining different yeasts with different apples to create different flavors
- Further research is *needed to identify how production processes contribute to sensory differences across cider styles, cider origin*<sup>11</sup>
- Discussion of off-flavors (sulfuric, metallic) from cans<sup>6</sup>
- Need to explore the boundaries of complex and funky<sup>6</sup>



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# Resources

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