

Research Objectives

Methodological objective:

• Merge IRT model and logistic regression to estimate the effect of distances in latent space on outcomes of interest in conjoint survey experiments

Substantive problem:

• Do individuals feel closer to more local organizations and do feelings of closeness make individuals more likely to want to interact with an organization?

Motivation

- Recent work on conjoints has underlined the need to reconsider how we analyze them [2], with one proposal to use an IRT framework [1].
- I adapt this framework to focus on the actual distance between profiles and respondent and its effect.

Two Part Model

1) IRT component to estimate positions in latent space:

$$\Pr(Y_{ik} = 1 | \mathbf{x}_{ik1}, \mathbf{x}_{ik2}) = \Phi(b(\mathbf{x}_{ik1}, \mathbf{x}_{ik2}) \theta_i - g(\mathbf{x}_{ik1}, \mathbf{x}_{ik2}))$$

where $b(\mathbf{x}_{ik1}, \mathbf{x}_{ik2}) = 2(x_{ik1} - x_{ik2})^{\top} \boldsymbol{\beta} / \sigma$ and $g(\mathbf{x}_{ik1}, \mathbf{x}_{ik2}) = \boldsymbol{\beta}^{\top} (\mathbf{x}_{ik1} \mathbf{x}_{ik1}^{\top} - \mathbf{x}_{ik2} \mathbf{x}_{ik2}^{\top}) \boldsymbol{\beta} / \sigma.$

2) Logistic regression to estimate effect of distances:

$$Pr(W_{ij} = 1 | \mathbf{x}_{ij1}, \mathbf{x}_{ij2}) =$$

$$(W_{ij} = 1 | \mathbf{x}_{ij1}, \mathbf{x}_{ij2}) = \log i t^{-1} (\gamma_0 + \gamma_1 * (2\theta_i (\mathbf{x}_{ij1} - \mathbf{x}_{ij2})^\top \boldsymbol{\beta} + \boldsymbol{\beta}^\top (\mathbf{x}_{ij2} \mathbf{x}_{ij2}^\top - \mathbf{x}_{ij1} \mathbf{x}_{ij1}^\top) \boldsymbol{\beta})$$

where Y_{ik} , W_{ij} are 1 if profile 1 in pairs k and j (different pairs used for each outcome) for respondent iis chosen, and 0 if not, and $\mathbf{x}_{ik1}, \mathbf{x}_{ik2}$ and $\mathbf{x}_{ij1}, \mathbf{x}_{ij2}$ represent the attributes of profiles 1 and 2 in pairs k and j, respectively, for respondent i.

Note that the term with the γ_1 coefficient is equal to $\theta_i - \mathbf{x}_{ij2}^{\top} \boldsymbol{\beta}^{2} - (\theta_i - \mathbf{x}_{ij1}^{\top} \boldsymbol{\beta})^2$: the difference in the distance between ideal points and profile lo*cations*: positive = i closer to profile 1 than profile

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Empirical Application:	Localr
 676 students at UNC - Chapel Hill completed conjoint survey experiment Attributes made organizations more or less student-like (demographically local) or geographically local Each saw 15 randomly created pairs of hypothetical vote registration organizations 	 Str V





Fig 3: Effect of Diff. in Dist. Between Ideal Points and Profiles on Probability of Wanting to Attend Meeting



Diff. in Dist. Between Profiles 2 and 1 and Ideal Point

Distances in Latent Space: A Novel Approach to Analyzing Conjoints

ness and Organizations

udents were asked two outcome questions:

W: Would you be more likely to attend a meeting held by organization 1 or organization 2?

Y: With which organization would you say you feel more of a personal connection?

sed profiles 2-15 for IRT portion; profile 1 for gistic regression component

odels were estimated using Stan's R interface stan

Results





• Local organizational traits moved organizations closer to positive pole of latent space (Fig. 1)

• 59.3% of students had estimated positions with credible intervals entirely to the right of the most student/local organization (Fig. 2) • As difference in distances

increases—respondent is closer to org. 1 than org. 2—the probability of wanting to attend a meeting held by org. 1 increases (for reference, within data distances were normally distributed around 0, with standard deviation 1) (Fig. 3)

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- example)

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Assessing Model Fit

• Use Area Under the ROC Curve (because Bernoulli distributed outcomes)

• Use profiles 2-15 to assess fit of logistic regression portion and profile 1 to assess fit of IRT portion

AUCs (Posterior Medians with 95% Credible Intervals)

	$0.868 \ [0.858, \ 0.878]$
tic Regression:	$0.765 \ [0.762, \ 0.769]$

• Logistic regression part of model does not fit as well; it is possible that students took other factors into account besides distance, or that the form of the distance is different (absolute difference, for

Conclusion

• **Substantively**, students were more likely to want to attend a meeting of the organization to which they were closer in the latent space—this shows that closeness matters for engagement • Methodologically, this project demonstrates the value of thinking of conjoint profiles and individuals as being located in a latent space

Next Steps

• Restructure experiment so that second question (W) is not forced-choice but asked about each profile in turn; this can get a better estimate of the effect of distance; requires modification of logistic regression portion of model

• Simulation study to investigate approach more

Email: hoellers@unc.edu Full presentation slides available **here**.

References

[1] Devin Caughey, Hiroto Katsumata, and Teppei Yamamoto. Item response theory for conjoint survey experiments. Working Paper, 2019.

[2] Scott Abramson, Korhan Koçak, and Asya Magazinnik. What do we learn about voter preferences from conjoint experiments? Working Paper, 2019.