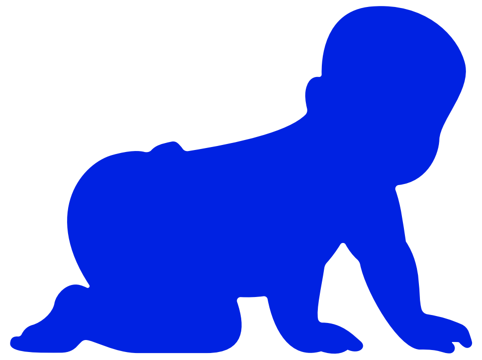
ORDINAL REGRESSION MODELS

What is an ordinal variable?

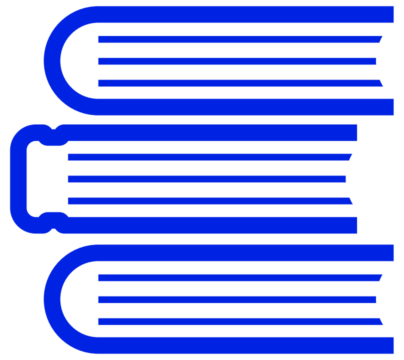
Quantitative variables

Quantitative variables

Discrete



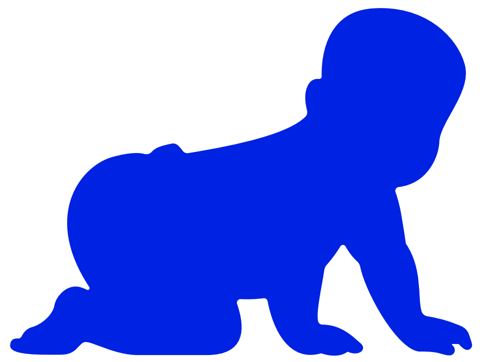
Number of children



Books read

Quantitative variables

Discrete



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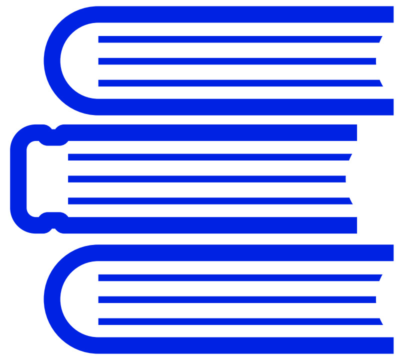
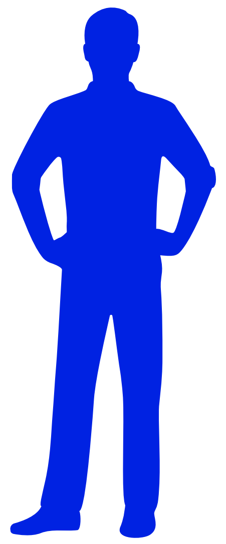


Books read

Continuous

Time

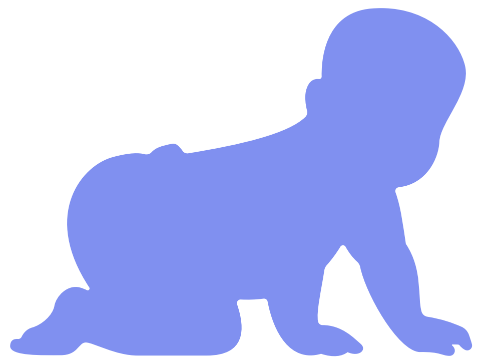


Age

Quantitative variables

Categorical variables

Discrete



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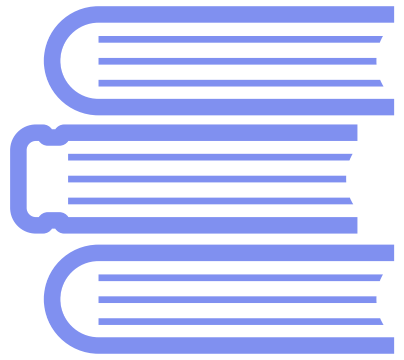
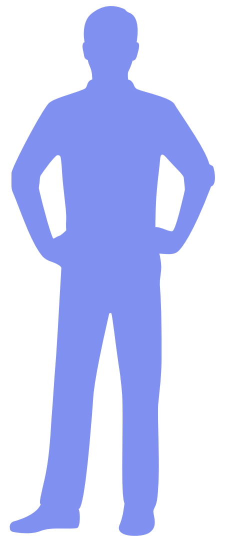


Books read

Continuous

Time



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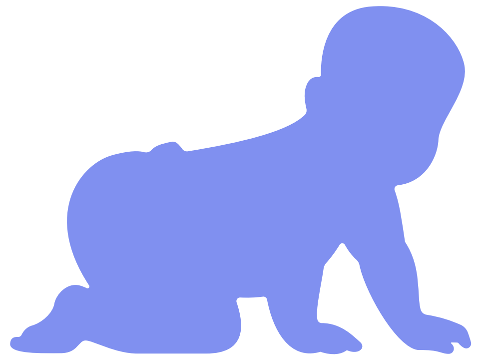

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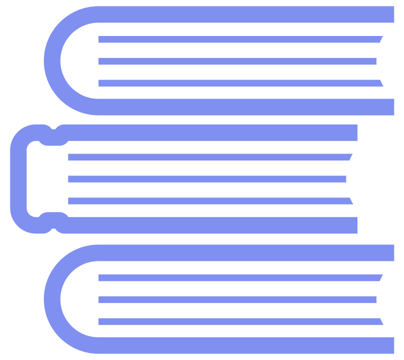
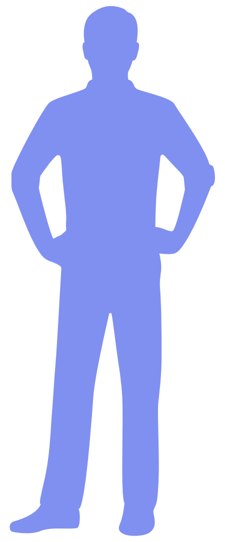


Books read

Continuous

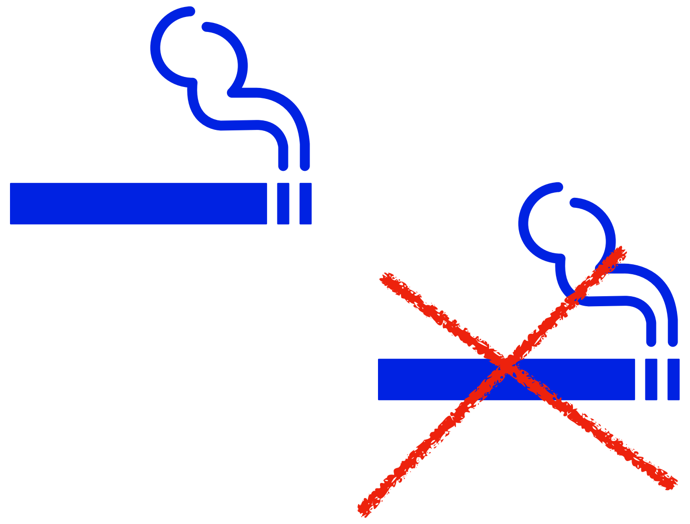
Time



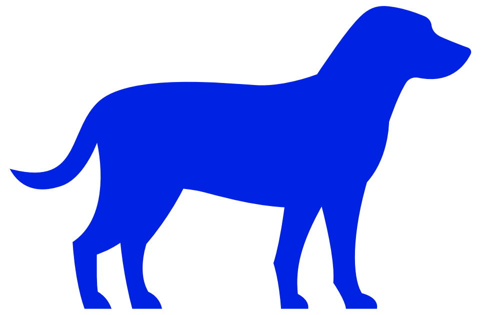
Age

Categorical variables

Nominal



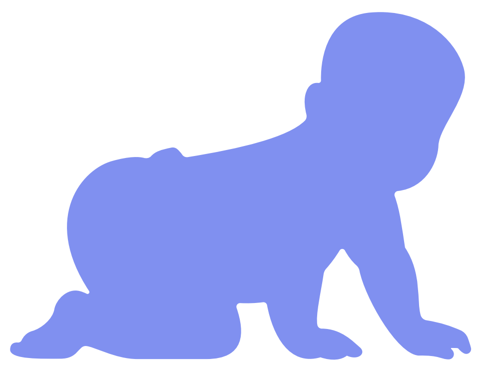
Smoker vs. non-smoker



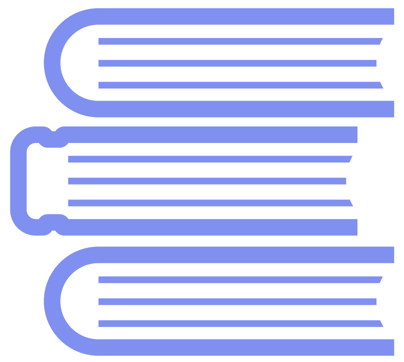
Dog breed

Quantitative variables

Discrete



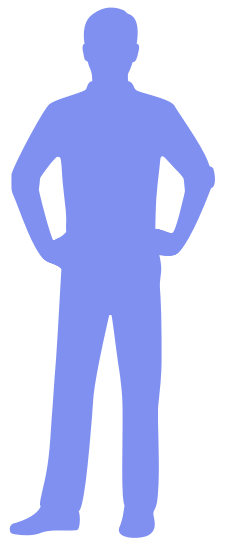
Number of children



Books read

Continuous

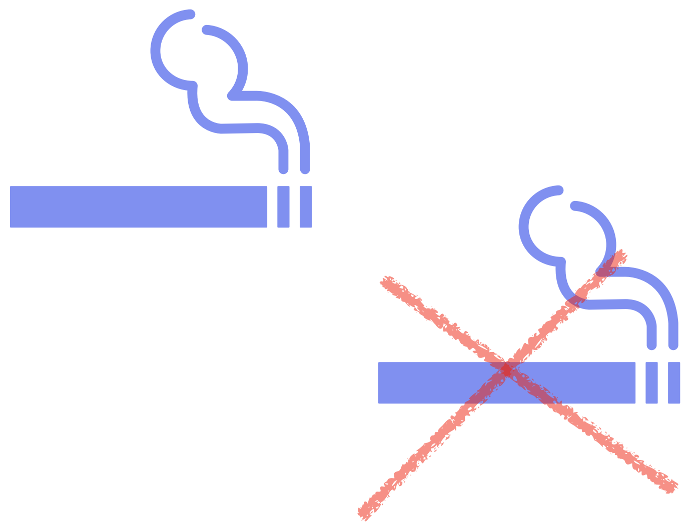
Time



Age

Categorical variables

Nominal



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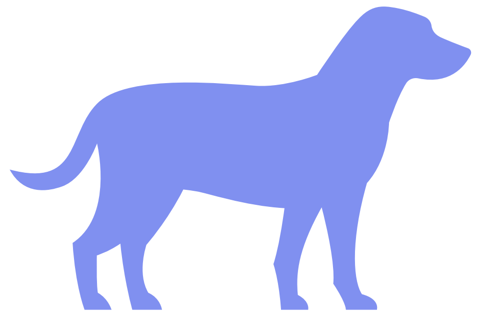
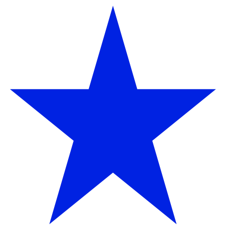
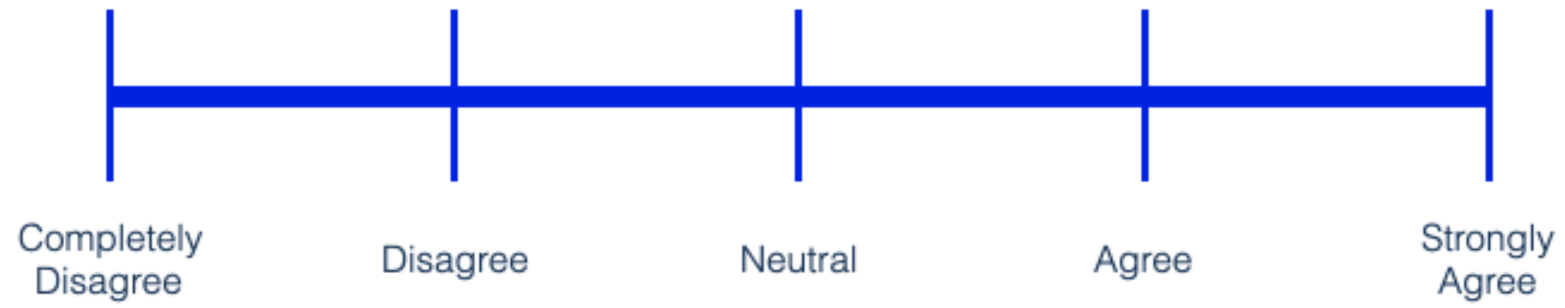


Dog breed

Ordinal



Star ratings



Likert scales

How should you analyze ordinal data?

How should you analyze ordinal data?

In the same way as numeric data?

How should you analyze ordinal data?

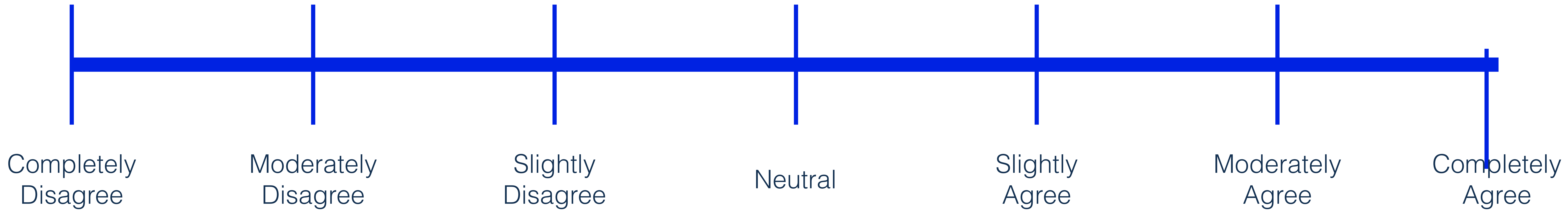
~~In the same way as numeric data?~~

Why can't we use the same models for ordinal and numeric data?

Let's look at three reasons!

Why can't we use numeric models on ordinal data?

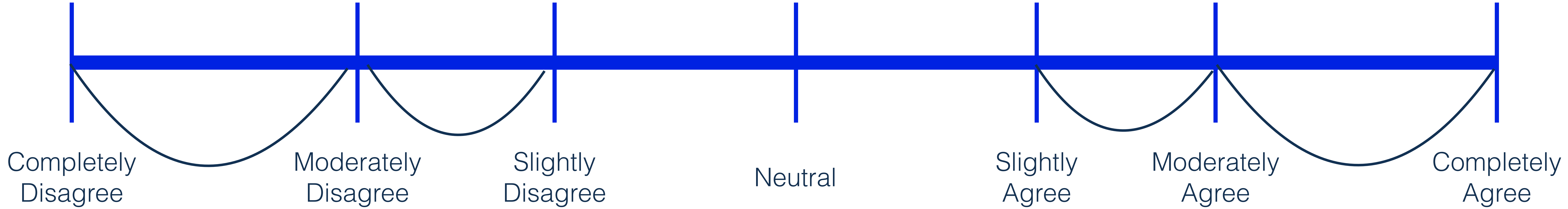
1 | Numeric models assume that the distance between adjacent responses is equidistant….



Why can’t we use numeric models on ordinal data?

1 | Numeric models assume that the distance between adjacent responses is equidistant….

But in reality, participants might perceive the distance between certain ratings to be much larger/smaller



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Why can’t we use numeric models on ordinal data?

1 | Numeric models assume that the distance between adjacent responses is equidistant….

2 | They also assume that the data is normally distributed which is often not the case with ordinal data

3 | They treat the data as continuous instead of categorical

What might happen if we use numeric models on ordinal data?

a | Low rates of detecting effects

b | Distorted effect-size estimates

c | Inflated false alarm rates

d | Inversion of differences between groups

How should you analyze ordinal data?

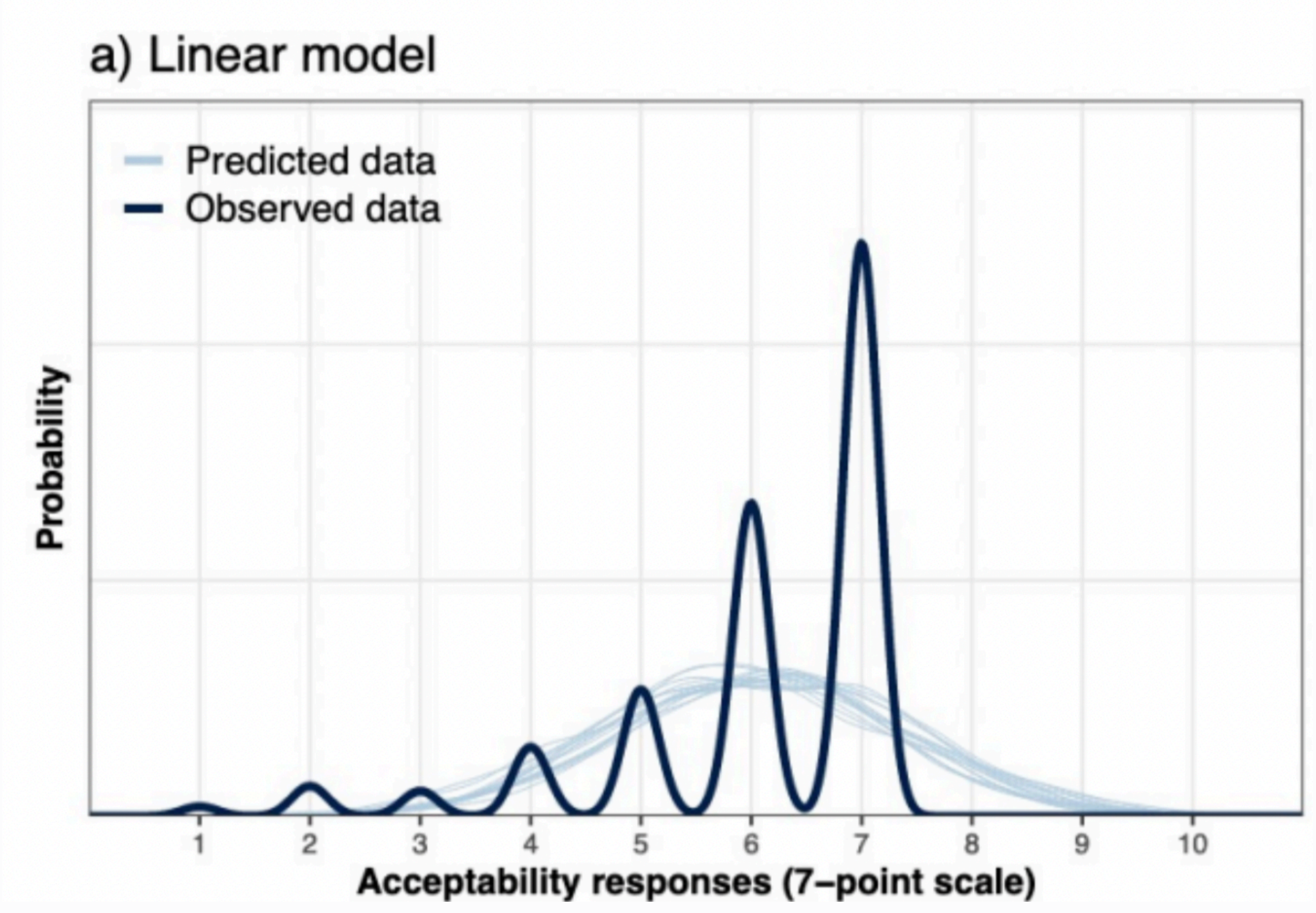
Should we use specialized models instead?

YES! ORDINAL REGRESSION MODELS

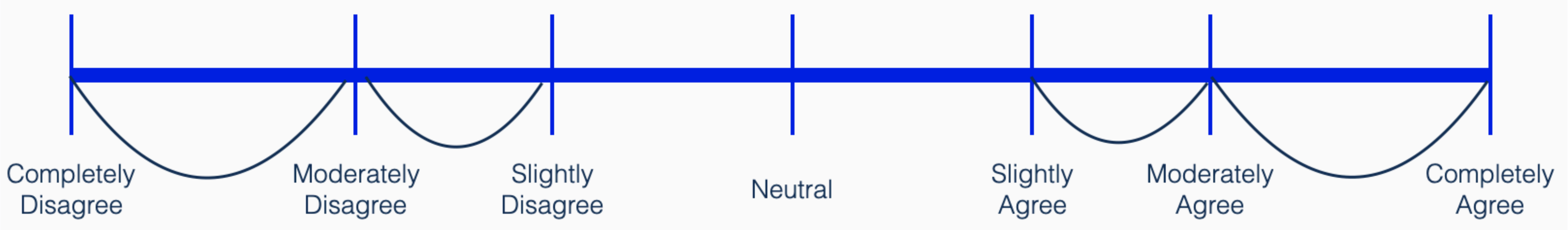
ORDINAL REGRESSION MODELS

As one of more of the independent variables changes, there is a shift towards either end of the spectrum of the ordinal response for the DV.

They can handle non-normally distributed data



They allow for unequal distances between responses



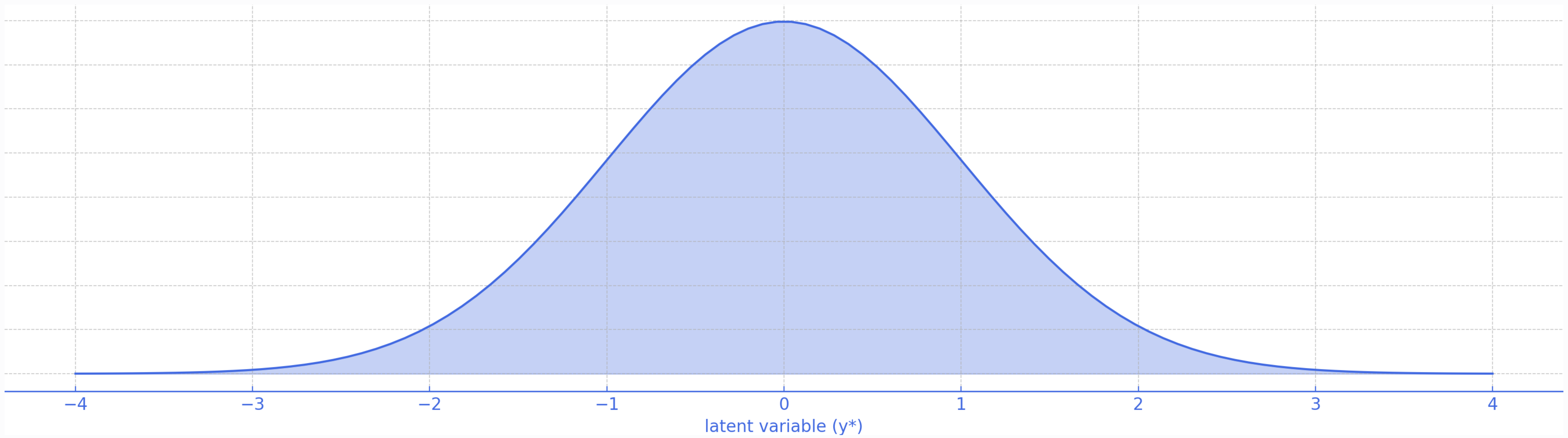
1 | CUMULATIVE MODELS

2 | SEQUENTIAL MODELS

2 | ADJACENT-CATEGORY MODELS

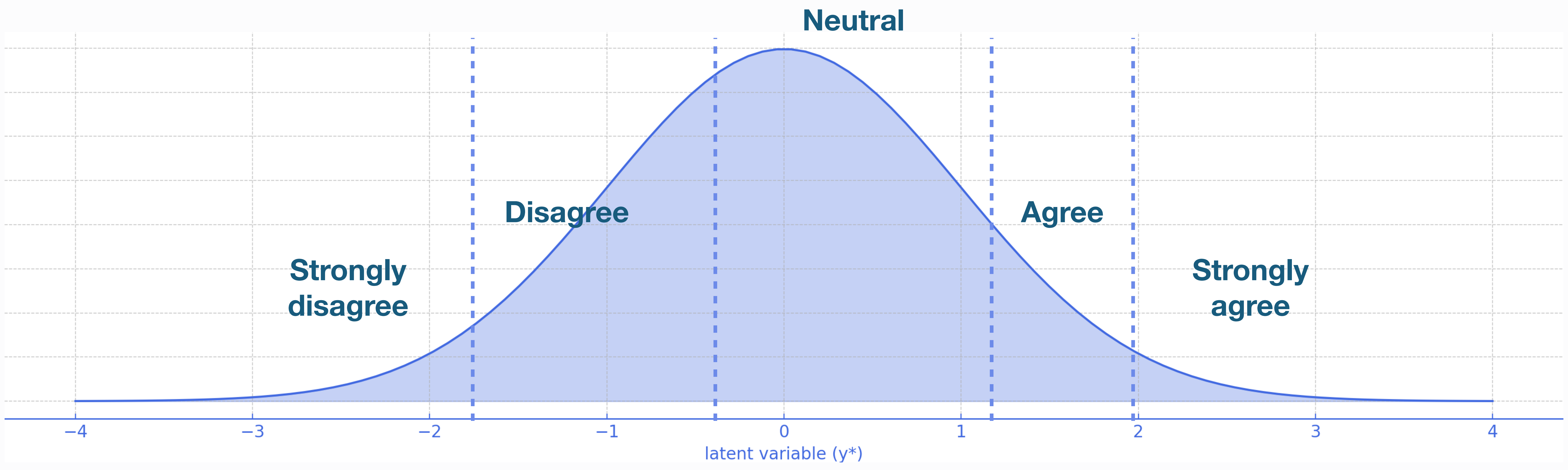
1 | CUMULATIVE MODELS

1 | Assume that the observed data originate from the categorization of a latent continuous variable



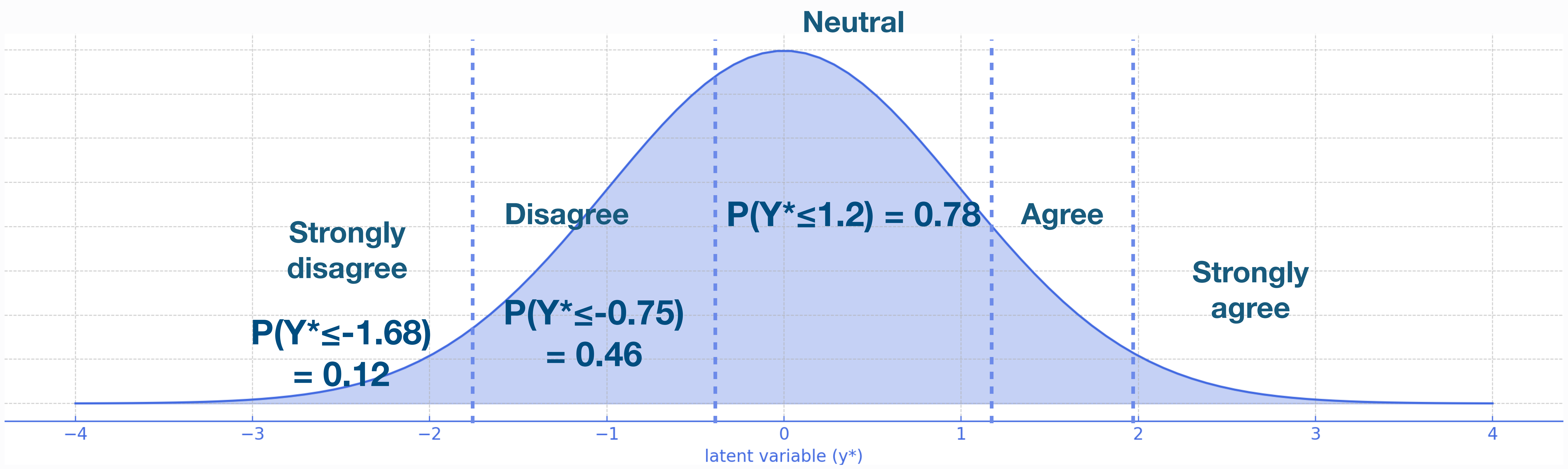
1 | CUMULATIVE MODELS

2 | Set thresholds: Each category has a threshold on this latent continuum. The distance between these thresholds isn't fixed and is part of what the model estimates



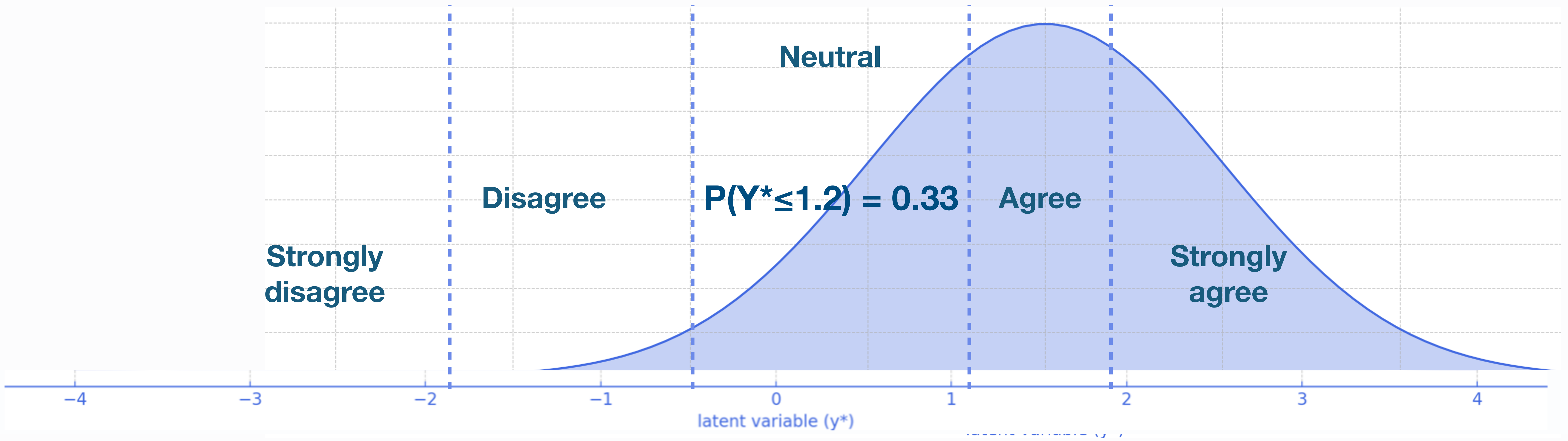
1 | CUMULATIVE MODELS

3 | Estimating **cumulative probabilities**: The model calculates the probability of the latent variable falling within or blow specific categories. $\mathbf{F(Y^*) = P(Y^* \leq X)}$



1 | CUMULATIVE MODELS

4 | Independent variables can shift the distribution curve to the left or to the right, thereby affecting the probability of falling within a certain category



1 | CUMULATIVE MODELS

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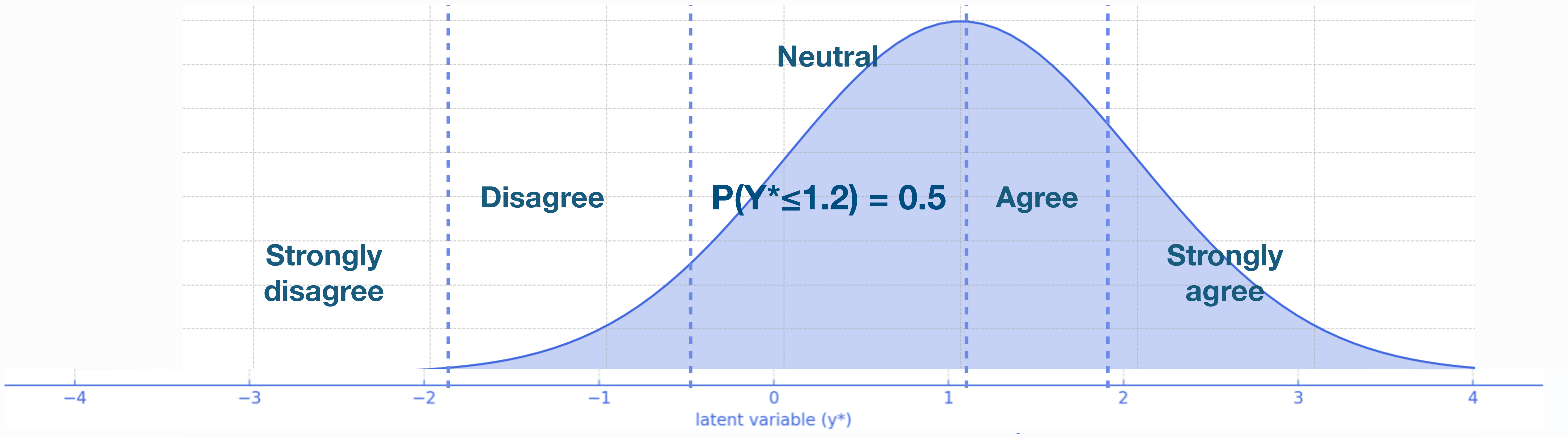

INTERPRETING COEFFICIENT IN AN ORDINAL MODEL

```
dat <- read.dta("https://stats.idre.ucla.edu/stat/data/ologit.dta")
head(dat)
```

```
##            apply pared public  gpa
## 1     very likely     0      0 3.26
## 2 somewhat likely     1      0 3.21
## 3        unlikely     1      1 3.94
## 4 somewhat likely     0      0 2.81
## 5 somewhat likely     0      0 2.53
## 6        unlikely     0      1 2.59
```

INTERPRETING COEFFICIENT IN AN ORDINAL MODEL

```
## Call:
## polr(formula = apply ~ pared + public + gpa, data = dat, Hess = TRUE)
##
## Coefficients:
##          Value Std. Error t value
## pared   1.0477      0.266   3.942
## public -0.0588      0.298  -0.197
## gpa     0.6159      0.261   2.363
##
## Intercepts:
##                             Value  Std. Error t value
## unlikely|somewhat likely     2.204  0.780      2.827
## somewhat likely|very likely  4.299  0.804      5.345
##
## Residual Deviance: 717.02
## AIC: 727.02
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$Y^* = 1.0477 * \text{pared} - 0.0588 * \text{public} + 0.6159 * \text{gpa}$

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THE PROPORTIONAL ODDS ASSUMPTION

The relationship between each pair of outcome groups is statistically the same.

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```

QUESTIONS?