An IRT analysis of a verbal aggression data set

Joachim Vandekerckhove

Spring 2025

Verbal aggression

By verbal aggression we mean verbal actions, such as cursing at oneself, scolding another person, or shouting

Verbal aggression

By verbal aggression we mean verbal actions, such as cursing at oneself, scolding another person, or shouting

While common, verbal aggression can be harmful

Verbal aggression

By verbal aggression we mean verbal actions, such as cursing at oneself, scolding another person, or shouting

While common, verbal aggression can be harmful

Others see verbal aggression as a negative character trait

Verbal aggression

By verbal aggression we mean verbal actions, such as cursing at oneself, scolding another person, or shouting

While common, verbal aggression can be harmful

Others see verbal aggression as a negative character trait

Verbal aggression can cause mutual aggressive reactions and further escalation

Verbal aggression

By verbal aggression we mean verbal actions, such as cursing at oneself, scolding another person, or shouting

While common, verbal aggression can be harmful

Others see verbal aggression as a negative character trait

Verbal aggression can cause mutual aggressive reactions and further escalation

People differ in the degree to which they are able to inhibit their verbally aggressive impulses

Verbal aggression data set

Collected at the University of Leuven, Belgium, by Kristof Vansteelandt

Verbal aggression data set

Collected at the University of Leuven, Belgium, by Kristof Vansteelandt

Reported on in many publications, including De Boeck and Wilson (2004)

Verbal aggression data set

Collected at the University of Leuven, Belgium, by Kristof Vansteelandt

Reported on in many publications, including De Boeck and Wilson (2004)

Responses of 316 subjects (243 women and 73 men) to a questionnaire of 24 items, about verbal aggression

Verbal aggression data set

Collected at the University of Leuven, Belgium, by Kristof Vansteelandt

Reported on in many publications, including De Boeck and Wilson (2004)

Responses of 316 subjects (243 women and 73 men) to a questionnaire of 24 items, about verbal aggression

Items describe a frustrating situation together with a possible verbal agression response

Verbal aggression data set

The subset we will consider has 8 items. Each item starts with one of the situations below:

- *A bus fails to stop for me*
- *I miss a train because a clerk gave me faulty information*
- *The grocery store closes just as I am about to enter*
- *The operator disconnects me when I had used up my last dime for a call*

Verbal aggression data set

The subset we will consider has 8 items. Each item starts with one of the situations below:

- *A bus fails to stop for me*
- *I miss a train because a clerk gave me faulty information*
- *The grocery store closes just as I am about to enter*
- *The operator disconnects me when I had used up my last dime for a call*

The item then continues either

- *I would want to curse*
- *I would curse*

Verbal aggression data set

The subset we will consider has 8 items. Each item starts with one of the situations below:

- *A bus fails to stop for me*
- *I miss a train because a clerk gave me faulty information*
- *The grocery store closes just as I am about to enter*
- *The operator disconnects me when I had used up my last dime for a call*

The item then continues either

- *I would want to curse*
- *I would curse*

The corresponding item response is 1 if the respondent agrees with that sentence, and 0 if not

Formal description of the data subset

Item-side variables

- Scenario $\in \{1, 2, 3, 4\}$
- Behavior mode $\in \{\text{Do}, \text{Want}\}$

Person-side variable

- Gender: $\in \{\text{M}, \text{F}\}$

Dependent variable

- Response $\in \{0, 1\}$

Research questions

- Item effect: Do we see a difference between *wanting* and *doing*?
- Person effect: Do we see a gender difference in saying they would exhibit a verbally aggressive response?
- Person-by-item interaction effect: Do we see a gender difference in the difference between wanting and doing?

Research questions

- Item effect: Do we see a difference between *wanting* and *doing*?
- Person effect: Do we see a gender difference in saying they would exhibit a verbally aggressive response?
- Person-by-item interaction effect: Do we see a gender difference in the difference between wanting and doing?

In all these cases, we are interested in the probability that a respondent p will answer 'yes' on an item i. In IRT, we investigate this response through the dominance parameter $\eta_{ip} = \theta_p - \beta_i$

Research questions

- Item effect: Do we see a difference between *wanting* and *doing*?
- Person effect: Do we see a gender difference in saying they would exhibit a verbally aggressive response?
- Person-by-item interaction effect: Do we see a gender difference in the difference between wanting and doing?

In all these cases, we are interested in the probability that a respondent p will answer 'yes' on an item i. In IRT, we investigate this response through the dominance parameter $\eta_{ip} = \theta_p - \beta_i$

In the following analyses, we will look at systematic differences in θ and β

Research questions

- Item effect: Do we see a difference between *wanting* and *doing*?
- Person effect: Do we see a gender difference in saying they would exhibit a verbally aggressive response?
- Person-by-item interaction effect: Do we see a gender difference in the difference between wanting and doing?

In all these cases, we are interested in the probability that a respondent p will answer 'yes' on an item i. In IRT, we investigate this response through the dominance parameter $\eta_{ip} = \theta_p - \beta_i$

In the following analyses, we will look at systematic differences in θ and β

A modern extension of the Rasch model considers more sophisticated views of the person and item parameters (De Boeck & Wilson, 2004)

Explanatory item response models

For example, the item parameter β_i can be re-expressed as $\beta_i = \gamma \times W_i$:

$$W_i = \begin{cases} 1/2 & \text{if } i \text{ is want-item} \\ -1/2 & \text{if } i \text{ is do-item} \end{cases}$$

Explanatory item response models

For example, the item parameter β_i can be re-expressed as $\beta_i = \gamma \times W_i$:

$$W_i = \begin{cases} 1/2 & \text{if } i \text{ is want-item} \\ -1/2 & \text{if } i \text{ is do-item} \end{cases}$$

So that

$$\beta_i = \begin{cases} \gamma/2 & \text{if } i \text{ is want-item} \\ -\gamma/2 & \text{if } i \text{ is do-item} \end{cases}$$

Explanatory item response models

For example, the item parameter β_i can be re-expressed as $\beta_i = \gamma \times W_i$:

$$W_i = \begin{cases} 1/2 & \text{if } i \text{ is want-item} \\ -1/2 & \text{if } i \text{ is do-item} \end{cases}$$

So that

$$\beta_i = \begin{cases} \gamma/2 & \text{if } i \text{ is want-item} \\ -\gamma/2 & \text{if } i \text{ is do-item} \end{cases}$$

We could then use this equation for the dominance:

$$\eta_{ip} = \theta_p - (\gamma W_i)$$

Explanatory item response models

For example, the item parameter β_i can be re-expressed as $\beta_i = \gamma \times W_i$:

$$W_i = \begin{cases} 1/2 & \text{if } i \text{ is want-item} \\ -1/2 & \text{if } i \text{ is do-item} \end{cases}$$

So that

$$\beta_i = \begin{cases} \gamma/2 & \text{if } i \text{ is want-item} \\ -\gamma/2 & \text{if } i \text{ is do-item} \end{cases}$$

We could then use this equation for the dominance:

$$\eta_{ip} = \theta_p - (\gamma W_i)$$

Now γ is an effect size parameter – it captures the difference in β between the two kinds of items

Explanatory item response models

For example, the item parameter β_i can be re-expressed as $\beta_i = \gamma \times W_i$:

$$W_i = \begin{cases} 1/2 & \text{if } i \text{ is want-item} \\ -1/2 & \text{if } i \text{ is do-item} \end{cases}$$

So that

$$\beta_i = \begin{cases} \gamma/2 & \text{if } i \text{ is want-item} \\ -\gamma/2 & \text{if } i \text{ is do-item} \end{cases}$$

We could then use this equation for the dominance:

$$\eta_{ip} = \theta_p - (\gamma W_i)$$

Now γ is an effect size parameter – it captures the difference in β between the two kinds of items

Explanatory item response models

When we 'decompose' parameters in this way – replacing an item parameter β_i by an expression like γW_i – we call the resulting models *explanatory*

Explanatory item response models

When we 'decompose' parameters in this way – replacing an item parameter β_i by an expression like γW_i – we call the resulting models *explanatory*

We say we have added a predictor (W) on the 'item side' of the model

Explanatory item response models

When we 'decompose' parameters in this way – replacing an item parameter β_i by an expression like γW_i – we call the resulting models *explanatory*

We say we have added a predictor (W) on the 'item side' of the model

This lets us say not only that items differ in their difficulty, but also why

Explanatory item response models

When we 'decompose' parameters in this way – replacing an item parameter β_i by an expression like γW_i – we call the resulting models *explanatory*

We say we have added a predictor (W) on the 'item side' of the model

This lets us say not only that items differ in their difficulty, but also why

$\eta_{ip} =$		
person part	item part	model type
θ_p	$-\beta_i$	doubly descriptive
θ_p	$-\gamma W_i$	item explanatory

Explanatory item response models

When we 'decompose' parameters in this way – replacing an item parameter β_i by an expression like γW_i – we call the resulting models *explanatory*

We say we have added a predictor (W) on the 'item side' of the model

This lets us say not only that items differ in their difficulty, but also why

$\eta_{ip} =$		
person part	item part	model type
θ_p	$-\beta_i$	doubly descriptive
θ_p	$-\gamma W_i$	item explanatory
$\alpha G_p + \epsilon_p$	$-\beta_i$	person explanatory

Explanatory item response models

When we 'decompose' parameters in this way – replacing an item parameter β_i by an expression like γW_i – we call the resulting models *explanatory*

We say we have added a predictor (W) on the 'item side' of the model

This lets us say not only that items differ in their difficulty, but also why

$\eta_{ip} =$		
person part	item part	model type
θ_p	$-\beta_i$	doubly descriptive
θ_p	$-\gamma W_i$	item explanatory
$\alpha G_p + \epsilon_p$	$-\beta_i$	person explanatory
$\alpha G_p + \epsilon_p$	$-\gamma W_i$	doubly explanatory

Explanatory item response models

When we 'decompose' parameters in this way – replacing an item parameter β_i by an expression like γW_i – we call the resulting models *explanatory*

We say we have added a predictor (W) on the 'item side' of the model

This lets us say not only that items differ in their difficulty, but also why

$\eta_{ip} =$		
person part	item part	model type
θ_p	$-\beta_i$	doubly descriptive
θ_p	$-\gamma W_i$	item explanatory
$\alpha G_p + \epsilon_p$	$-\beta_i$	person explanatory
$\alpha G_p + \epsilon_p$	$-\gamma W_i$	doubly explanatory
$\alpha G_p + \epsilon_p - \gamma W_i - \delta W_i G_p$		interaction explanatory

Research questions

Do we see a difference between *wanting* and *doing*?

$\rightarrow$ Need an item explanatory model

Do we see a gender difference in saying they would exhibit a verbally aggressive response?

$\rightarrow$ Need a person explanatory model

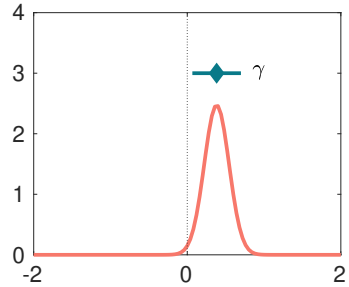
Do we see a gender difference in the difference between wanting and doing?

$\rightarrow$ Need an interaction explanatory model

Item-side question (wanting, $W = \frac{1}{2}$, vs. doing, $W = -\frac{1}{2}$)

$$P\left(X_{ip}\right) = \text{ilogit}\left(\theta_p - \gamma W_i\right)$$

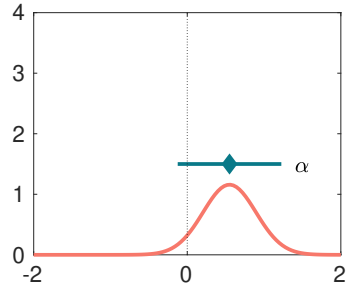
	Posterior			95% Cred. Int.	
Parameter	Mean	Median	SD	Lower	Upper
gamma	0.385	0.383	0.163	0.064	0.706



Person-side question (female, $G = -\frac{1}{2}$, vs. male, $G = \frac{1}{2}$)

$$P\left(X_{ip}\right) = \text{ilogit}\left(\alpha G_p + \epsilon_p - \beta_i\right)$$

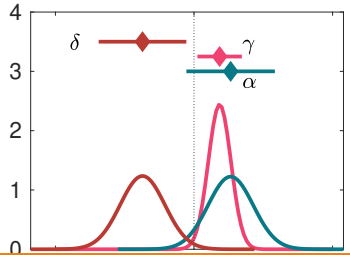
	Posterior			95% Cred. Int.	
Parameter	Mean	Median	SD	Lower	Upper
alpha	0.542	0.536	0.342	-0.116	1.228



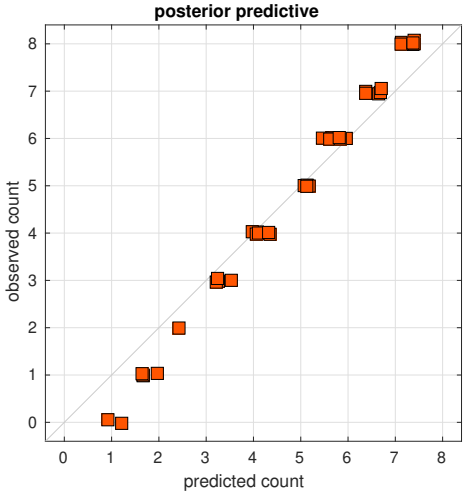
Interaction question (gender × wanting vs. doing)

$$P\left(X_{ip}\right) = \text{ilogit}\left(\alpha G_p + \epsilon_p - \gamma W_i - \delta G_p W_i\right)$$

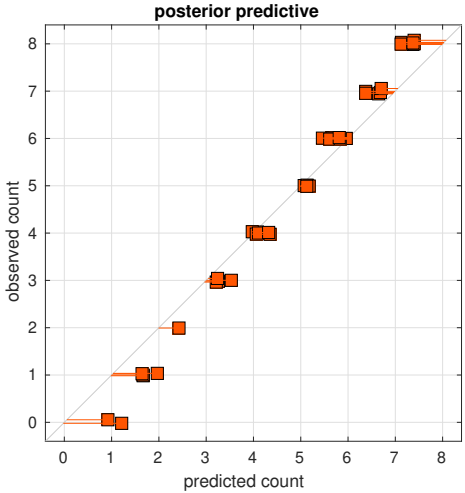
	Posterior			95% Cred. Int.	
Parameter	Mean	Median	SD	Lower	Upper
alpha	0.522	0.520	0.330	-0.133	1.172
delta	-0.736	-0.735	0.315	-1.365	-0.117
gamma	0.365	0.365	0.166	0.035	0.692



Posterior predictive



Posterior predictive



Conclusions

Do we see a difference between *wanting* and *doing*?

Do we see a gender difference in saying they would exhibit a verbally aggressive response?

Do we see a gender difference in the difference between wanting and doing?

Conclusions

Do we see a difference between *wanting* and *doing*?

$\rightarrow$ Yes, wanting is more commonly selected than doing

Do we see a gender difference in saying they would exhibit a verbally aggressive response?

Do we see a gender difference in the difference between wanting and doing?

Conclusions

Do we see a difference between *wanting* and *doing*?

$\rightarrow$ Yes, wanting is more commonly selected than doing

Do we see a gender difference in saying they would exhibit a verbally aggressive response?

$\rightarrow$ We don't see a main effect

Do we see a gender difference in the difference between wanting and doing?

Conclusions

Do we see a difference between *wanting* and *doing*?

$\rightarrow$ Yes, wanting is more commonly selected than doing

Do we see a gender difference in saying they would exhibit a verbally aggressive response?

$\rightarrow$ We don't see a main effect

Do we see a gender difference in the difference between wanting and doing?

$\rightarrow$ Yes, the difference is smaller among male respondents

References

De Boeck, P., & Wilson, M. (2004). *Explanatory item response models*. Wiley Online Library.

An IRT analysis of a verbal aggression data set

Joachim Vandekerckhove

Spring 2025

Verbal aggression complete data set (part 1)

		Mode		Blame		Behavior		
Item	Situations	Want	Do	Other	Self	Curse	Scold	Shout
1	S1	1	0	1	0	1	0	0
2	S1	1	0	1	0	0	1	0
3	S1	1	0	1	0	0	0	1
4	S2	1	0	1	0	1	0	0
5	S2	1	0	1	0	0	1	0
6	S2	1	0	1	0	0	0	1
7	S3	1	0	0	1	1	0	0
8	S3	1	0	0	1	0	1	0
9	S3	1	0	0	1	0	0	1
10	S4	1	0	0	1	1	0	0
11	S4	1	0	0	1	0	1	0
12	S4	1	0	0	1	0	0	1

Verbal aggression complete data set (part 2)

		Mode		Blame		Behavior		
Item	Situations	Want	Do	Other	Self	Curse	Scold	Shout
13	S1	0	1	1	0	1	0	0
14	S1	0	1	1	0	0	1	0
15	S1	0	1	1	0	0	0	1
16	S2	0	1	1	0	1	0	0
17	S2	0	1	1	0	0	1	0
18	S2	0	1	1	0	0	0	1
19	S3	0	1	0	1	1	0	0
20	S3	0	1	0	1	0	1	0
21	S3	0	1	0	1	0	0	1
22	S4	0	1	0	1	1	0	0
23	S4	0	1	0	1	0	1	0
24	S4	0	1	0	1	0	0	1