AN EXPERIMENT ON VALUATION QUESTION FORMAT:

IS THERE REALLY A DIFFERENCE BETWEEN "CHOICE EXPERIMENTS" AND "CONTINGENT VALUATION"?

Vic Adamowicz, Patrick Lloyd-Smith and Ewa Zawojska

University of Alberta, Canada

University of Warsaw, Poland

ezawojsk@utk.edu

Stated preference methods

- help determine public's preferences
- provide estimates of economic value
- inform about the benefits for cost-benefit analysis
- are based on surveys
- use various formats

Stated preference methods

- help determine public's preferences
- provide estimates of economic value
- inform about the benefits for cost-benefit analysis
- are based on surveys
- use various formats

Stated preference methods

"Contingent valuation" (CV)

Respondents vote on a proposed change at a specified cost.

"Choice experiment" (CE)

Respondents indicate their preference among two or more multi-attribute alternatives.

- help determine public's preferences
- provide estimates of economic value
- inform about the benefits for cost-benefit analysis
- are based on surveys
- use various formats

Stated preference methods

"Contingent valuation" (CV)

Respondents vote on a proposed change at a specified cost.

Would you be willing to pay $5 per year for the proposed program of building new hiking and bike trails?

Yes / No

"Choice experiment" (CE)

Respondents indicate their preference among two or more multi-attribute alternatives.

Which program would you prefer?

	Program A	Program B
New hiking trails	None	100 km
New bike trails	None	250 km
Cost per year	$0	$5

Stated preference methods

"Contingent valuation" (CV)

"Choice experiment" (CE)

CV and CE are often described as differing in many aspects:

- the number of choice alternatives → only two in CV, any (sensible) number in CE;
- the number of choice situations → typically one in CV, several in CE;
- the use of attributes → no in CV, yes in CE;
- information display → text in CV, table in CE.

Would you be willing to pay $5 per year for the proposed program of building new hiking and bike trails?

Yes / No

Which program would you prefer?

	Program A	Program B
New hiking trails	None	100 km
New bike trails	None	250 km
Cost per year	$0	$5

Stated preference methods

"Contingent valuation" (CV)

"Choice experiment" (CE)

CV and CE are often described as differing in many aspects:

- ~~the number of choice alternatives~~ → only two in CV, any (sensible) number in CE;
- ~~the number of choice situations~~ → typically one in CV, several in CE;
- ~~the use of attributes~~ → no in CV, yes in CE;
- information display → text in CV, table in CE.

- Carson and Louviere (2011): "Most early CV studies … asked respondents about their valuation of multiple goods and they valued changes in attributes".
- Both typically-named "CV" and "CE" are **discrete choice methods**.
- The only real difference is information display.

Stated preference methods

"Contingent valuation" (CV)

"Choice experiment" (CE)

CV and CE are often described as differing in many aspects:

- ~~the number of choice alternatives~~ → only two in CV, any (sensible) number in CE;
- ~~the number of choice situations~~ → typically one in CV, several in CE;
- ~~the use of attributes~~ → no in CV, yes in CE;
- information display → text in CV, table in CE.

- Carson and Louviere (2011): "Most early CV studies … asked respondents about their valuation of multiple goods and they valued changes in attributes".
- Both typically-named "CV" and "CE" are **discrete choice methods**.
- The only real difference is information display.

Why is it important to study?

- Stated preference methods are of considerable research interest. (Bishop et al. 2017)
- Can they provide valid and reliable estimates to inform decision making?
- Many studies tested convergence of estimates from "CV" and "CE".
  (e.g., Hanley et al. 1998; Cameron et al. 2002; Ryan 2004; Jin et al. 2006; Goldberg and Rosen 2007)
  - Evidence is mixed.
  - The comparisons are often not apples to apples (differ in the number of attributes, alternatives, choice tasks, in econometric methods, etc.)
  - The studies did not isolate the effect of information display.

Why could there be a difference between textual vs. tabular displays?

- Stages in decision making: (1) acquiring information + (2) evaluation

Information display

Different displays → Different information extracted → Different decisions made
(Bettman and Kakkar 1977; Shi et al. 2013)

- "Tabular format is likely to better support individuals' assimilation and use of complex information." (Hoehn et al. 2010)
- Processing by attribute is easier because it uses the same units. (Tversky 1969)
- Tabular descriptions may oversimplify important features.
- Textual descriptions may confuse respondents in identification of the effects.

Related studies

Authors	Study description	Results
Bettman and Kakkar (1977)	Hypothetical interviews in a supermarket about choices of cereals	Decisions in a tabular display took substantially less time.
Bettman and Zins (1979)	Choices of food products during classes with students	Shares of correct responses did not differ across textual and tabular displays. Decisions in a tabular display took substantially less time.
Schkade and Kleinmuntz (1994)	Hypothetical choices of loan applications during classes with students	Decisions in a by-alternative (comparable to our textual) display took longer.
Hoehn et al. (2010)	An internet survey about wetland restoration	Larger variances of choices in a textual display. Greater use of heuristics with a textual display.
Oviedo and Caparros (2015)	Hypothetical valuation of a reforestation project in personal interviews and in a lab study with an eye tracker	Respondents paid more attention (more time) to attributed and the bid in a tabular display.

Related studies

Authors	Study description	Results
Bettman and Kakkar (1977)		
Bettman and Zins (1979)		
Schkade and Kleinmuntz (1994)		
Hoehn et al. (2010)		
Oviedo and Caparros (2015)		

Our contribution to the research on textual and tabular displays:

- A valuation study
- A controlled laboratory environment
- Variation only in the information display – a clear effect
- Induced values – known preferences and potential effects related to a good eliminated
- Incentive compatible (incentives for truthful preference disclosure)

Research design

- A lab experiment in Z-tree
- July 2017 at the University of Alberta, Canada
- Based on the study of Jacquemet et al. (2016)

Research design

Jacquemet et al. (2016) – **Table treatment**

Characteristic	Token A	Token B
Colour	Yellow	Blue
Size	Large	Medium
Shape	Triangle	Square
Cost	3.00	4.00

Which token would you like to buy?

- ○ Token A
- ○ Token B
- ○ Neither Token

Research design

Text treatment

Two Tokens are available, Token A and Token B. The colour of Token A is yellow, its size is large, and the shape of Token A is triangle. Token A costs 3.00. The colour of Token B is blue, its size is medium, and the shape of Token B is square. Token B costs 4.00.

Which token would you like to buy?

- ○ Token A
- ○ Token B
- ○ Neither Token

Research design

- A lab experiment in Z-tree
- July 2017 at the University of Alberta, Canada
- Based on the study of Jacquemet et al. (2016)

Size	Small	$0.50
	Medium	$2.50
	Large	$4.00
Colour	Red	$1.00
	Yellow	$1.50
	Blue	$2.00
Shape	Circle	$1.50
	Triangle	$3.00
	Square	$6.00

- 9 choice tasks
- Earnings: 10 CAD + balance from a randomly selected choice task (0 – 9.50 CAD)
- Average earning: 16.04 CAD / 30 min
- 12 sessions; 58 participants in Table, 57 participants in Text

Table treatment

Characteristic	Token A	Token B
Colour	Yellow	Blue
Size	Large	Medium
Shape	Triangle	Square
Cost	3.00	4.00

Text treatment

Two Tokens are available, Token A and Token B. The colour of Token A is yellow, its size is large, and the shape of Token A is triangle. Token A costs 3.00. The colour of Token B is blue, its size is medium, and the shape of Token B is square. Token B costs 4.00.

Socio-demographics across treatments

	Table	Text
Female	53%	61%
Age	27.91 (6.85)	29.77 (11.10)
Student	70%	54%
Enough money for leisure	59%	61%

No statistically significant differences between treatment samples

Research question:

Does information display affect respondents' behavior in stated preference surveys?

Research question:

Does information display affect respondents' behavior in stated preference surveys?

	Table	**Text**
Correct responses	87%	87%
Average time per response	36 sec	48 sec

Research question:

Does information display affect respondents' behavior in stated preference surveys?

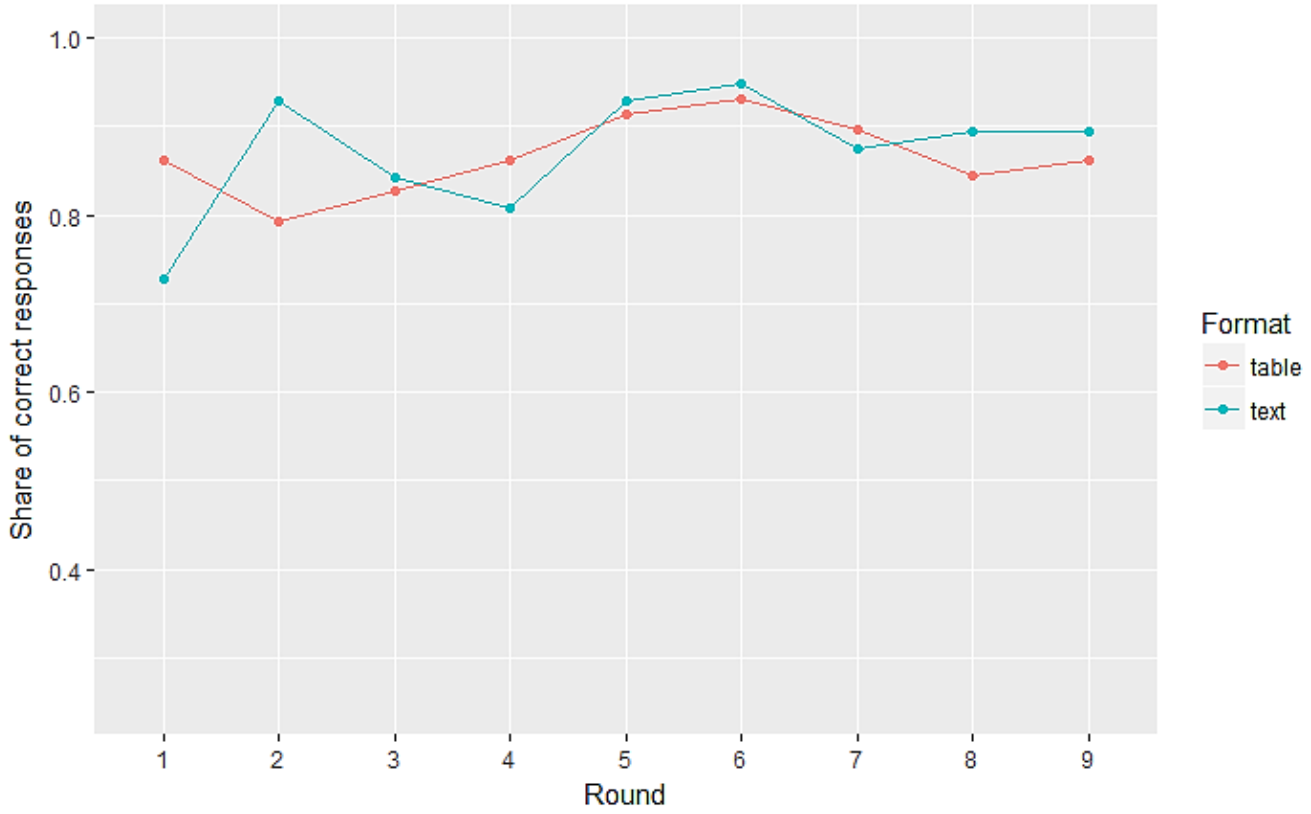
	Table	**Text**
Correct responses	87%	87%
Average time per response	36 sec	48 sec

Verification:
Can we replicate the results of Jacquemet et al. (2016)?

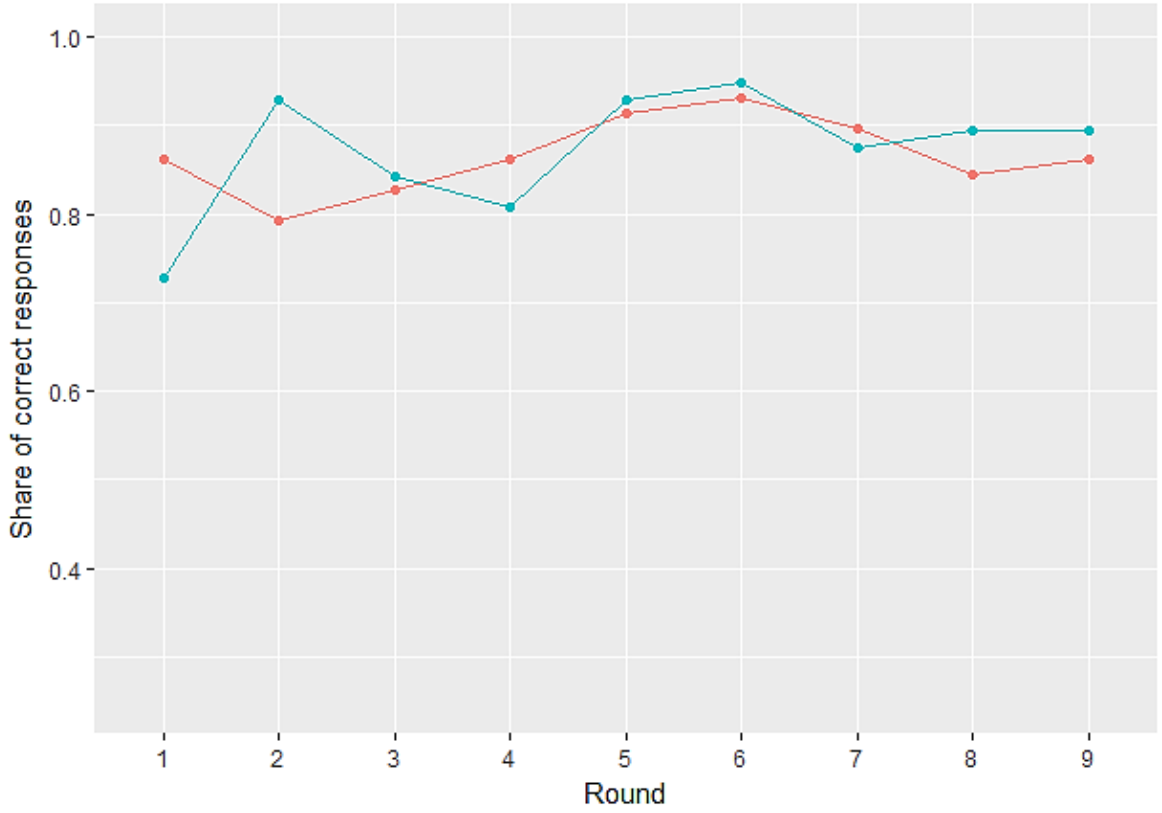
Table: proportion (in %) of correct choices by treatment

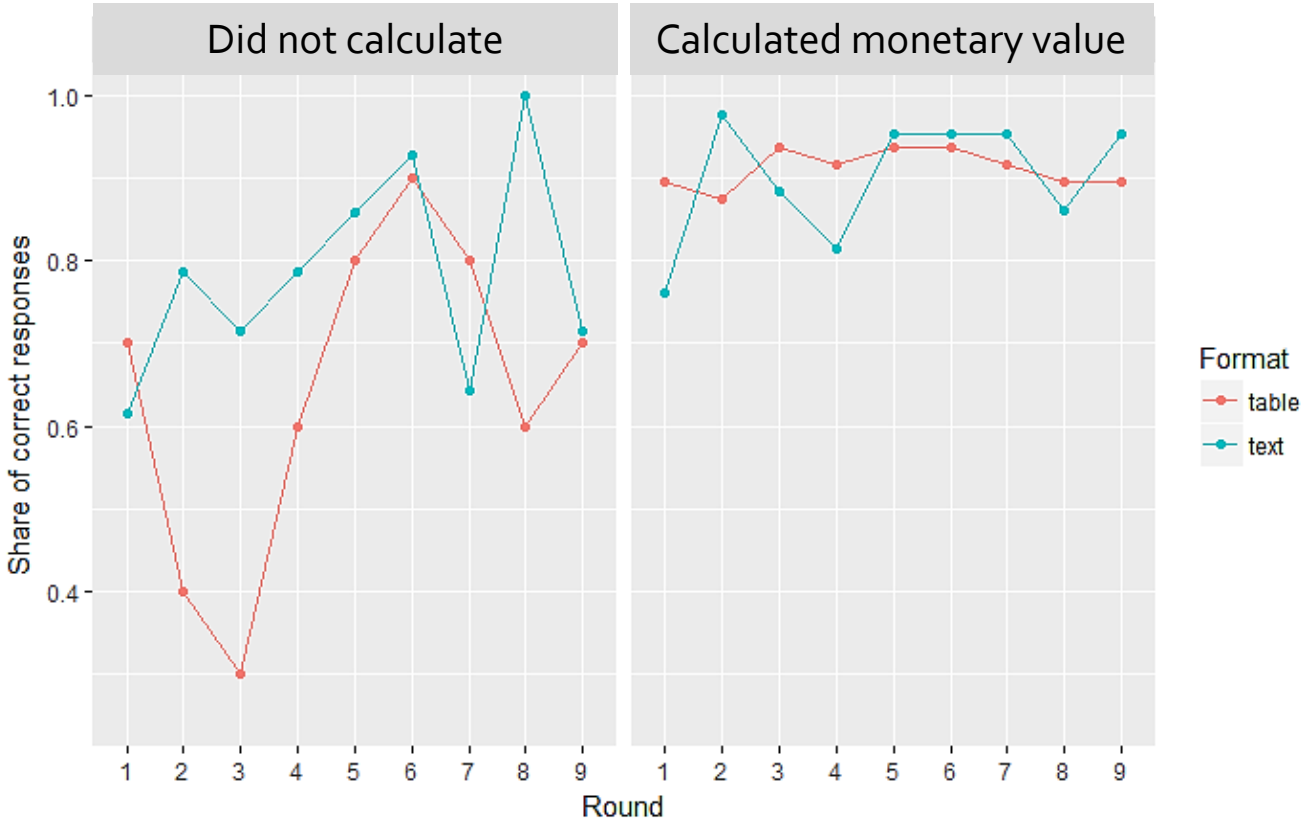
Exp. 1 *Baseline*	Exp. 2 *Calc.*	Exp. 3 *Paid*	Exp. 4 *Paid+Calc.*	Exp. 5 *Truth*	Exp. 6 *Task*	Exp. 7 *Office*
56.3	61.6	59.9	64.9	78.3	63.7	61.6

Correct responses by round



Correct responses by round

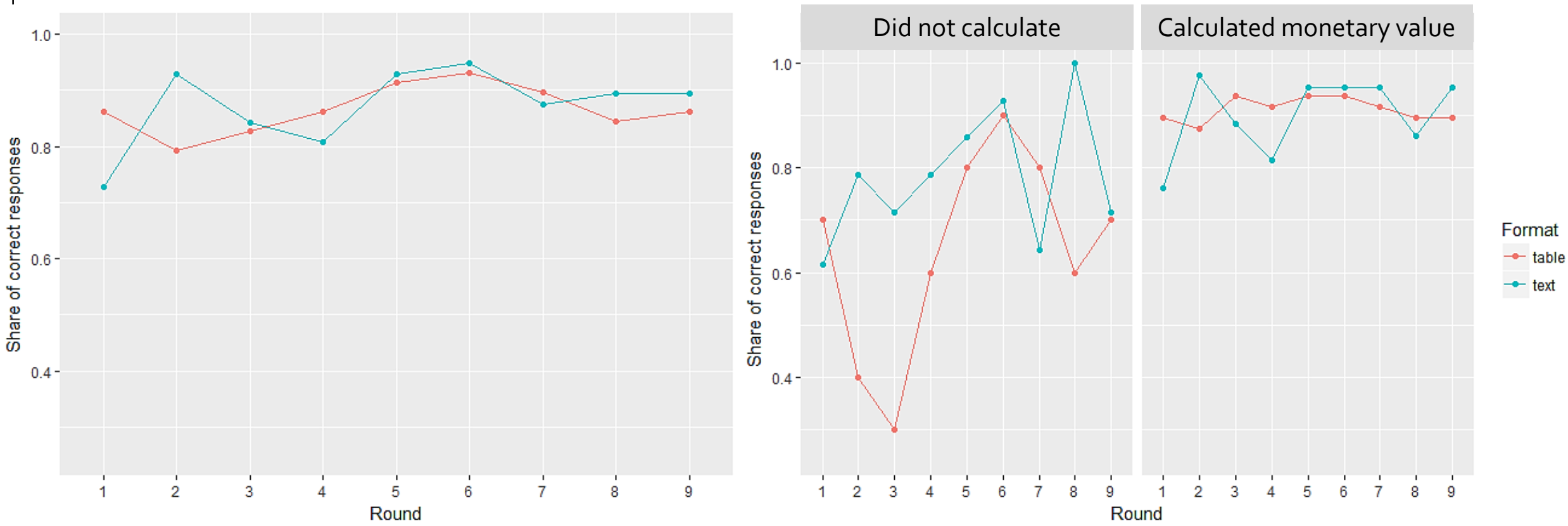




Did you calculate the monetary values of tokens when making your choices?

- ○ Yes, I calculated the values always / precisely.
- ○ Yes, I calculated the value sometimes / approximately.
- ○ No

Correct responses by round



For those who always calculated monetary value (83% in Table, 75% in Text):
more variability in the shares of correct responses in Text than in Table.

Probability of a correct response

A random effects logit model

Variable	Coefficient (St. Error)
Text	-0.131 (0.358)
Responded in up to 20 sec	-1.134*** (0.342)
Round	0.115*** (0.043)
Absolute difference in the tokens' value	0.256*** (0.049)
Morning session	-0.617* (0.356)
Constant	1.548*** (0.404)

← No influence of the information display

← Lower chance of a correct choice for quicker responders

← Learning / Experience

← Easier to make a correct choice when tokens differ more in value

← Tough mornings

Note: *** denotes 1% significance, ** - 5%, * - 10%.

Log-likelihood (constants only) -359.2 AIC 685.0

Log-likelihood -335.5 BIC 719.5

Probability of a correct response

A random effects logit model

Cost appears to have played the most important role. →

Variable	Coefficient (St. Error)
Text	-0.119 (0.353)
Responded in up to 20 sec	-1.102*** (0.333)
Round	0.102** (0.043)
Absolute difference in value of — *Tokens' color*	-0.424 (0.452)
Absolute difference in value of — *Tokens' size*	0.206 (0.132)
Absolute difference in value of — *Tokens' shape*	-0.022 (0.072)
Absolute difference in value of — *Tokens' cost*	0.992*** (0.263)
Morning session	-0.597* (0.350)
Constant	1.156* (0.619)

Log-likelihood (constants only) -359.2 AIC 704.0

Log-likelihood -342.0 BIC 753.4

Probability of a correct response in the first round

A logit model

Variable	**Coefficient (St. Error)**
Text	-1.322** (0.557)
Responded in up to 20 sec	-2.135*** (0.802)
Absolute difference in tokens' value	0.215* (0.111)
Constant	1.456*** (0.559)
Log-likelihood (constants only) -57.1	AIC 107.7
Log-likelihood -49.8	BIC 118.6

← Lower chance of a correct choice in Text

Distribution of response time

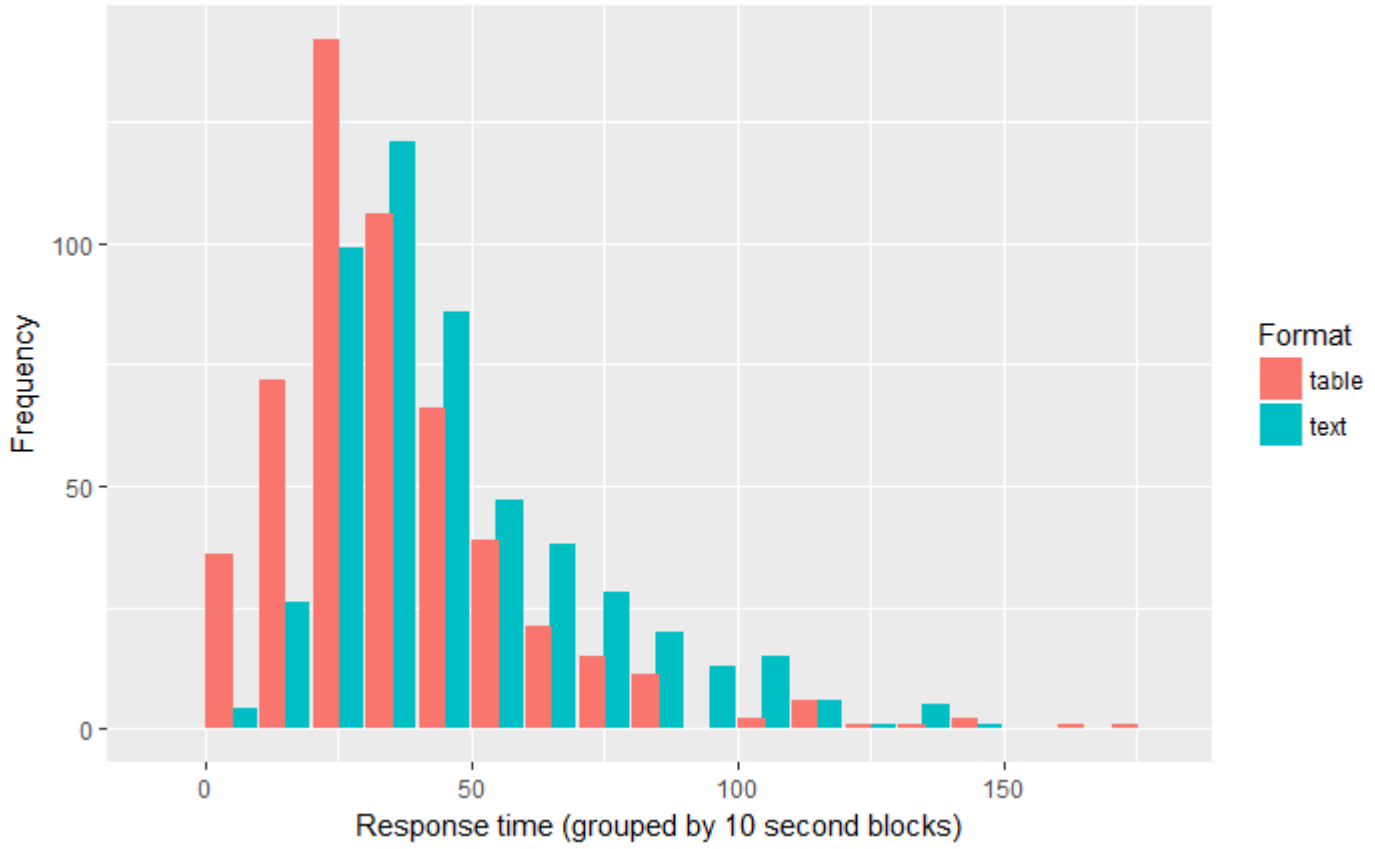


Table associated with quicker responses

	Table	Table	Text	Text
Responded in up to 20 sec	**Yes**	**No**	**Yes**	**No**
Share of participants	21%	79%	5%	95%
Correct responses	71%	91%	67%	89%

Table associated with more rushed responses

	Table	Table	Text	Text
Calculated monetary values	**Yes**	**No**	**Yes**	**No**
Share of participants	83%	17%	75%	25%
Correct responses	91%	64%	90%	78%
Average time per response	40 sec	19 sec	48 sec	49 sec

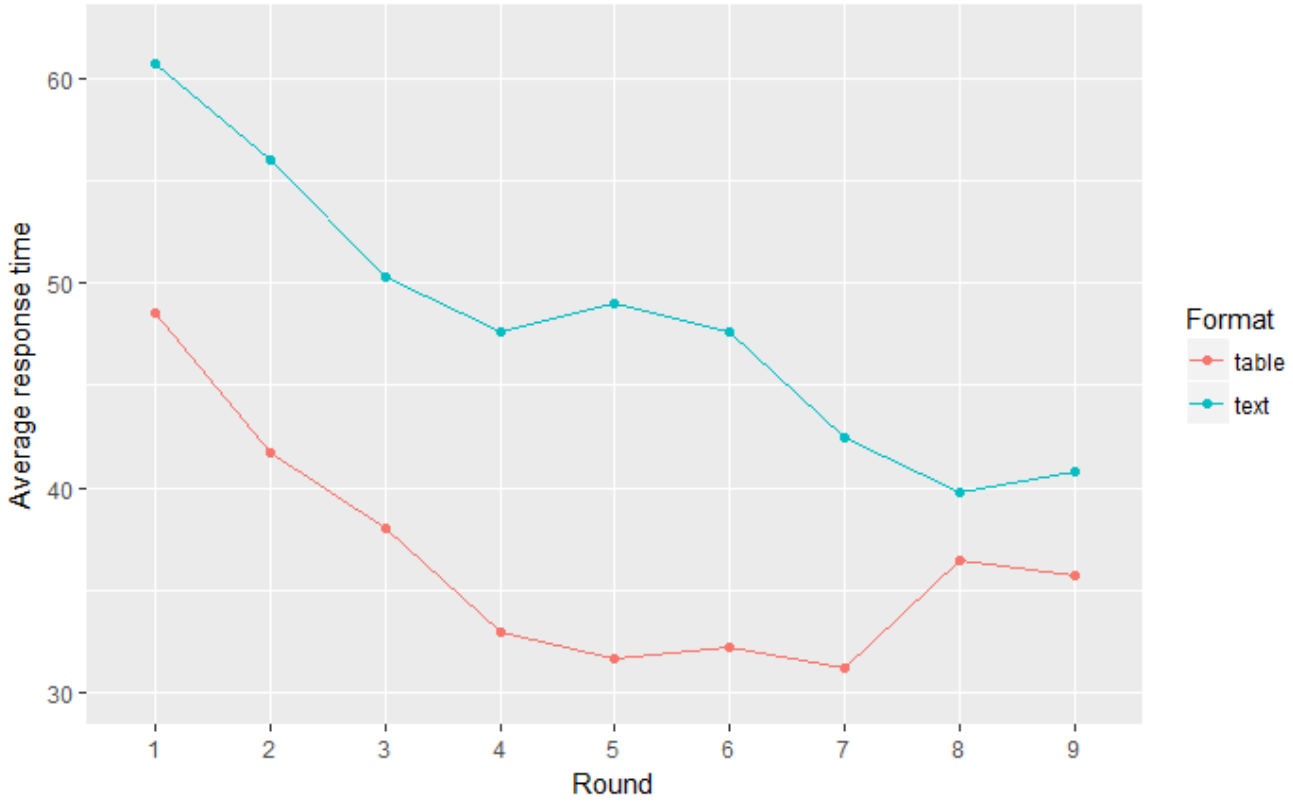
← Similar.

← Even if they did not calculate, they devoted substantial time to figure out the correct response, and succeeded in that.

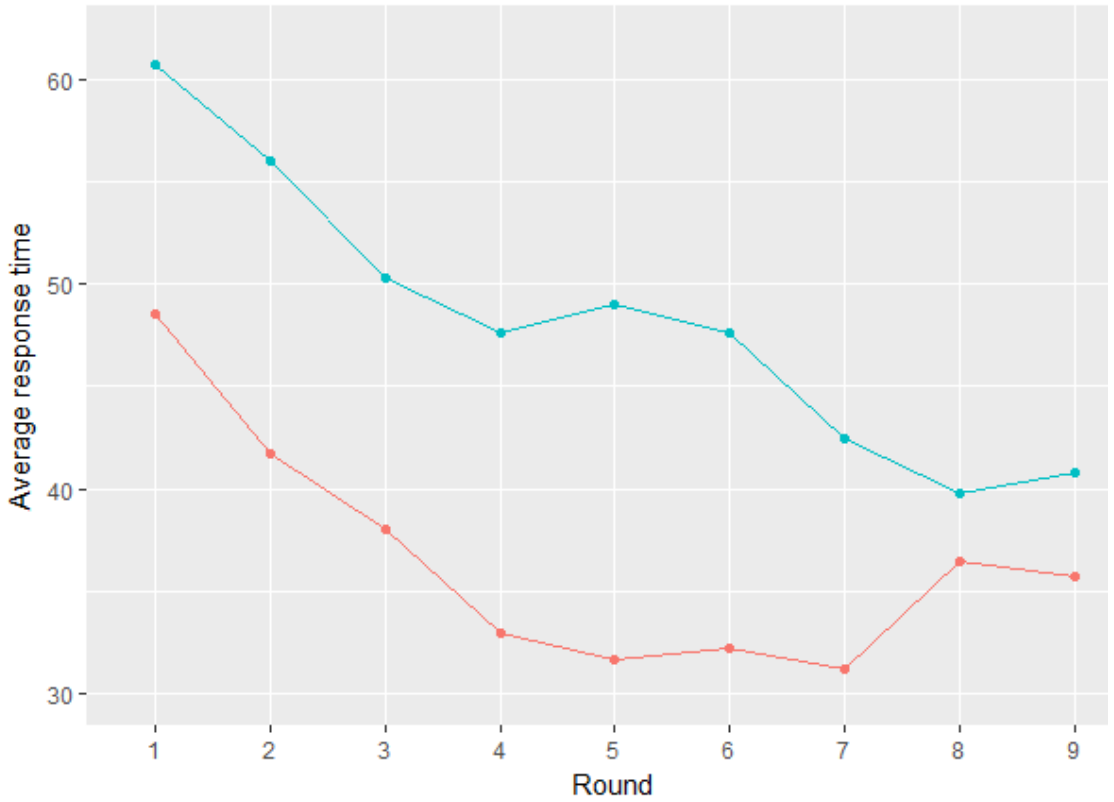
↑ When they did not calculate, they rushed through questions.

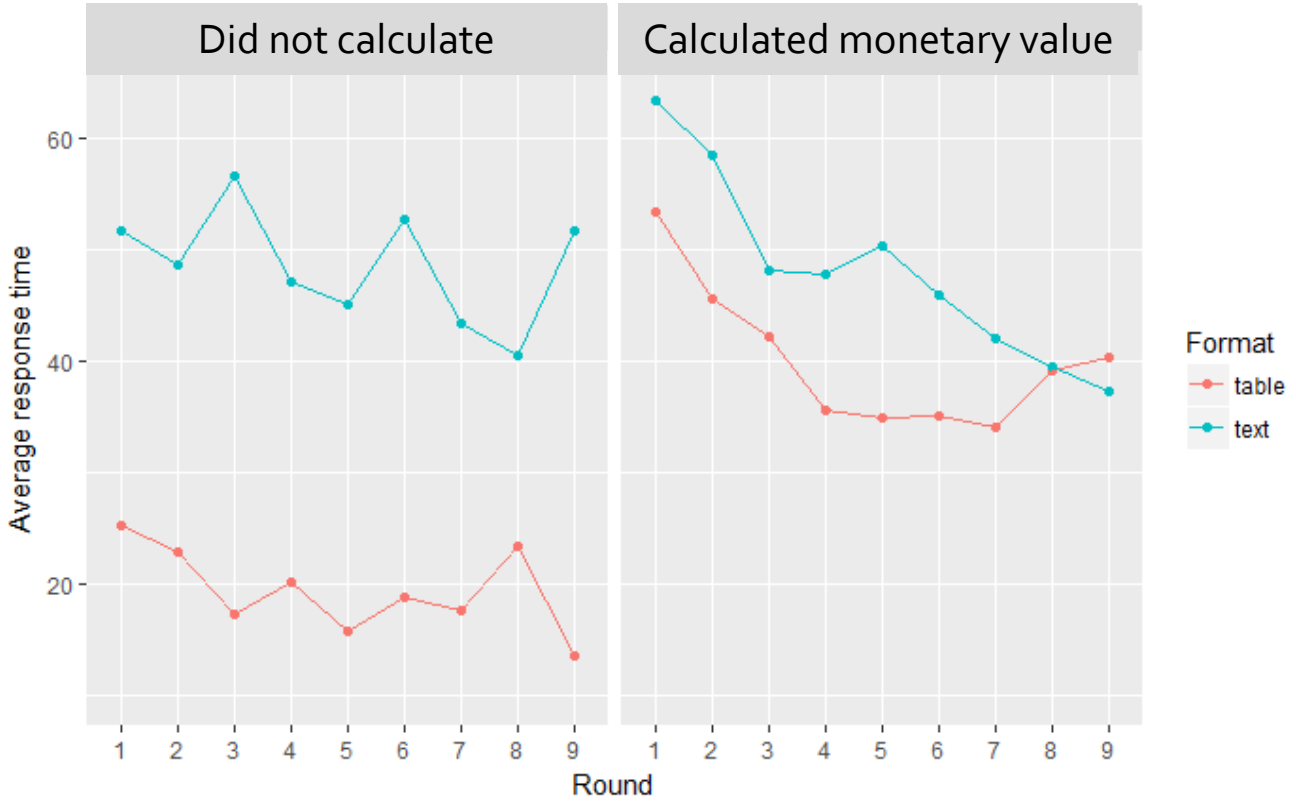
- Is it easier to oversimplify the task in Table?
- Hoehn et al. (2010) claim that tabular descriptions can sometimes oversimplify the scenario.

Average response time by round



Average response time by round





The effect of *Round* seems not to be present for those who did not (always) calculate the monetary value.

Response time

A random effects linear model

	Means (St. Error)	Interactions with Text (St. Error)
Round	-5.317*** (1.477)	4.795** (2.086)
Round squared	0.553*** (0.127)	-0.490*** (0.181)
Calculated monetary value	26.149*** (6.601)	-15.324* (8.835)
*Round*Calculated monetary value*	-1.091 (0.749)	-1.237 (1.001)
Absolute difference in tokens' value	-1.305*** (0.304)	-0.044 (0.432)
No time pressure (longest response time in a session)	0.143*** (0.032)	0.052 (0.046)
Constant	21.609** (7.723)	16.954 (10.597)

Log-likelihood (constants only) -4,597.0 AIC 8,986.5

Log-likelihood -4,477.3 BIC 9,065.6

Response time

A random effects linear model

	Means (St. Error)	Interactions with Text (St. Error)
Round	-5.317*** (1.477)	4.795** (2.086)
Round squared	0.553*** (0.127)	-0.490*** (0.181)
Calculated monetary value	26.149*** (6.601)	-15.324* (8.835)
*Round*Calculated monetary value*	-1.091 (0.749)	-1.237 (1.001)
Absolute difference in tokens' value	-1.305*** (0.304)	-0.044 (0.432)
No time pressure (longest response time in a session)	0.143*** (0.032)	0.052 (0.046)
Constant	21.609** (7.723)	16.954 (10.597)

Log-likelihood (constants only) -4,597.0 AIC 8,986.5

Log-likelihood -4,477.3 BIC 9,065.6

- A non-linear effect of *Round* – response time decreases to about the 5th round and then starts to increase.
- Calculating monetary values considerably increases response time.
- Shorter response time for a larger difference in tokens' value.
- Longer response time when others answer slowly.

Response time

A random effects linear model

	Means (St. Error)	Interactions with Text (St. Error)
Round	-5.317*** (1.477)	4.795** (2.086)
Round squared	0.553*** (0.127)	-0.490*** (0.181)
Calculated monetary value	26.149*** (6.601)	-15.324* (8.835)
*Round*Calculated monetary value*	-1.091 (0.749)	-1.237 (1.001)
Absolute difference in tokens' value	-1.305*** (0.304)	-0.044 (0.432)
No time pressure (longest response time in a session)	0.143*** (0.032)	0.052 (0.046)
Constant	21.609** (7.723)	16.954 (10.597)

Log-likelihood (constants only) -4,597.0 AIC 8,986.5

Log-likelihood -4,477.3 BIC 9,065.6

- Response time in Text differs because of differences in the influence of *Round* and *Calculated monetary value*.
- The effect of *Round* on response time in Text is negligible (statistically insignificant).
- Calculating monetary value increases response time in both treatments, however, the effect is by far weaker in Text.

Response time

A random effects linear model

	Means (St. Error)	Interactions with Text (St. Error)
Round	-5.317*** (1.477)	4.795** (2.086)
Round squared	0.553*** (0.127)	-0.490*** (0.181)
Calculated monetary value	26.149*** (6.601)	-15.324* (8.835)
*Round*Calculated monetary value*	-1.091 (0.749)	-1.237 (1.001)
Absolute difference in tokens' value	-1.305*** (0.304)	-0.044 (0.432)
No time pressure (longest response time in a session)	0.143*** (0.032)	0.052 (0.046)
Constant	21.609** (7.723)	16.954 (10.597)

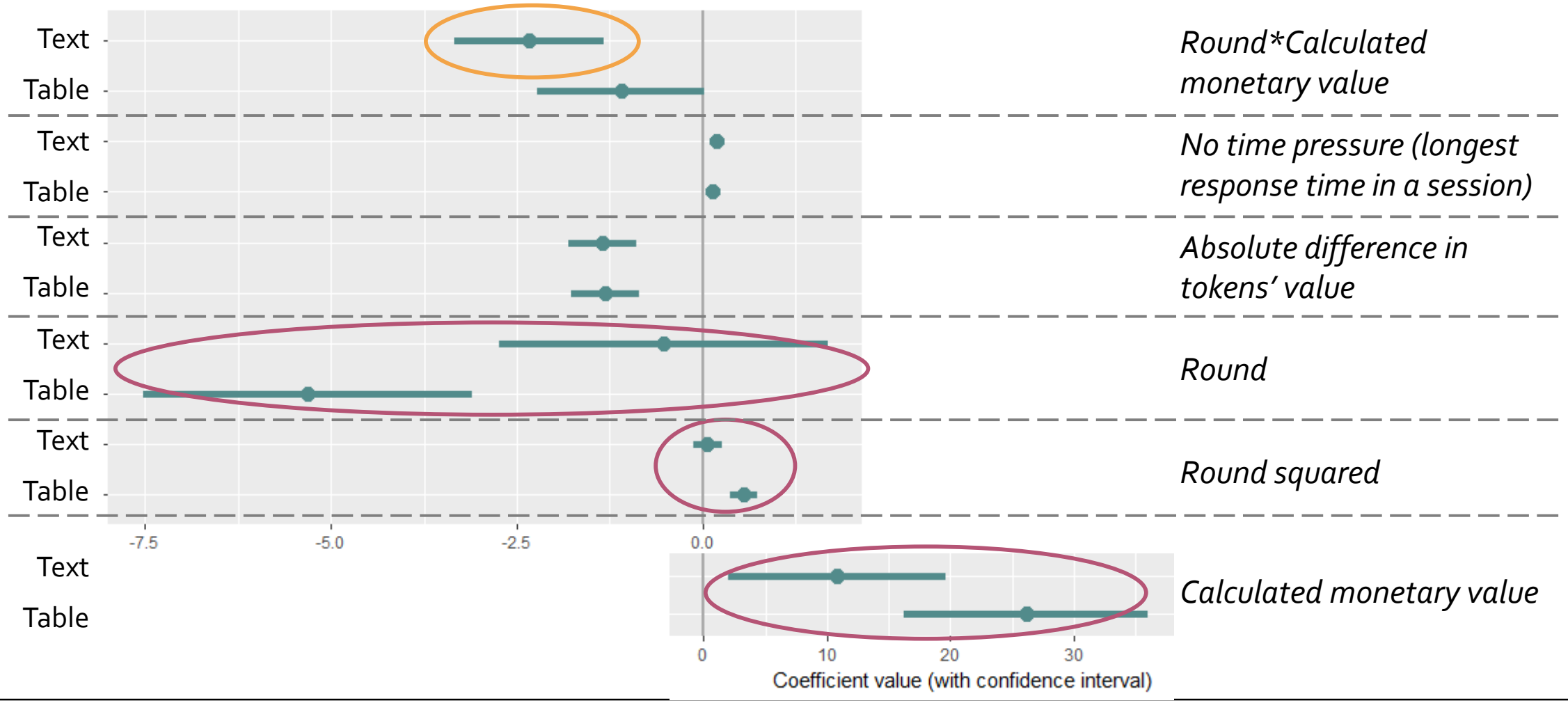
Log-likelihood (constants only) -4,597.0 AIC 8,986.5

Log-likelihood -4,477.3 BIC 9,065.6

- Response time in Text differs because of differences in the influence of *Round* and *Calculated monetary value*.
- The effect of *Round* on response time in Text is negligible (statistically insignificant).
- Calculating monetary value increases response time in both treatments, however, the effect is by far weaker in Text.
- The effect of *Round* is significant in Text only for those who calculated monetary value – response time shortens over rounds.

Response time

A random effects linear model



Findings

1) Information display does not affect the ability to provide a correct response.

- Except for the first round in which Text results in a significantly smaller probability of a correct response than Table.

2) Information display affects response time.

- Quicker responses in Table.
- More rushed (quick and incorrect) responses in Table.
- In Text, response time decreases over rounds. In Table, the effect is non-linear – response time decreases until about the 5th round, is constant for a while and starts to increase.
- In Text, the effect of a round is significant only for those who always calculated monetary value.

Conclusions

IS THERE REALLY A DIFFERENCE BETWEEN "CV" AND "CE"?

- No, in terms of preference disclosure (except for the first choice task)

- Yes, in terms of response time

Findings in the light of existing evidence

- Information display affects information processing (Bettman and Kakkar, 1977; Shi et al., 2013).
- This could potentially give a rise to different answers, but…
- Schkade and Kleinmuntz (1994) – information display influences mainly the information acquisition rather than the information evaluation.
- Ettlin and Bröder (2015) – the decision behavior is unaffected by display manipulations which induce no note-worthy costs of information processing.
- Bettman and Zins (1979) – no effect of information display on accuracy of responses because people could adjust response time.
- We also find that **adjustment** to different information displays **is made through time** – comparisons by attribute are easier (Tversky, 1969), so response time in Table is shorter.

Implications for stated preference research

- "Multiple studies have investigated the convergent validity of estimates from these two formats [CV and CE] … . These studies provide mixed results, but the many differences between the framing of CV and CE questions (e.g., text versus tabular presentation …) can make it difficult to conduct clean and controlled comparisons." (Johnston et al., 2017, *Contemporary Guidance for Stated Preference Studies*)
- Our research fills in this gap.
- Information display (table versus text) appears not to affect stated preferences if an incentive compatible (randomized) sequence of valuation questions is used.
- However, significant differences can appear when only a single question is used (which is important taking into account theoretically suggested valuation formats).

“whatsoever things are true”

Vic Adamowicz, Patrick Lloyd-Smith and Ewa Zawojska

ezawojsk@utk.edu