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Can a Life-Cycle Assessment Model Aid Sustainability Negotiations?

Ellen Czaika, PhD

What is Sustainability?

"Humanity has the ability to make development sustainable to ensure that it meets the needs of the present without compromising the ability of future generations to meet their own needs."

World Commission on Environment and Development, 1987

How to become sustainable?

"Sustainable development is not a fixed state of harmony, but rather **a process of change** in which the exploitation of resources, the direction of investments, the orientation of technological development, and institutional change are made consistent with future as well as present needs. **We do not pretend that the process is easy or straightforward. Painful choices have to be made.**"

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What is involved in these “painful choices?”

- Multiple parties making decisions together.
  - Negotiations are a means for multiple parties to make decisions together.
- Sustainability negotiations frequently involve some issues that are determined by **physical world constraints** and some that are influenced by the **parties’ and stakeholders’ interests** alone.
- Sustainability negotiations often contain some **trade-off** and some **win-win** issues.

Models—especially collaboratively built models—can facilitate integrating different kinds of issues.

- Many researchers suggest that models[1] help decision makers make sense of different kinds of issues (physical world & stakeholder interests; win-win & trade-off).

1 . Dowlatabadi, 1995; van Delden et al., 2011; van den Belt, 2004; van den Belt et al., 2013
2 . Edwards et al., 2010; McIntosh et al., 2011

Models—especially collaboratively built models—can facilitate integrating different kinds of issues.

- Many researchers suggest that models[1] help decision makers make sense of different kinds of issues (physical world & stakeholder interests; win-win & trade-off).
- Though, some researchers[2] find evidence that decision makers are not using the models as often as the model-builders anticipated.

1 . Dowlatabadi, 1995; van Delden et al., 2011; van den Belt, 2004; van den Belt et al., 2013
2 . Edwards et al., 2010; McIntosh et al., 2011

Collaborative model building

- To encourage and enable model usage, these and other researchers suggest collaborative modeling[3]—including the decision makers in the model-building process. There are many case studies which provide in-depth research into the application of collaborative modeling processes in real world decisions[4].

3 . Bourget et al, 2013; Langsdale et. al., 2013; Pahl-Wostl, 2009; van de Riet, 2003; Cutcher-Gershenfeld et al., 2004; Rotmans, 2006; McIntosh et al., 2011

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- To encourage and enable model usage, these and other researchers suggest collaborative modeling[3]—including the decision makers in the model-building process. There are many case studies which provide in-depth research into the application of collaborative modeling processes in real world decisions[4].
- By participating in the modeling process, decision makers learn about the enviro-socio-technical system in which the decision is contextualized.

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Questions remain about the impact of not using a model in sustainability decisions and the impact of not involving the decision makers in the model-building.

This study investigates some of these questions.

Addressing Two Open Questions

- Consider what is at stake if negotiators do not use a model in a sustainability negotiation.
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- Consider what is at stake if negotiators do not use a model in a sustainability negotiation.
  - What is the impact of using a model in a sustainability negotiation?
- Consider what is at stake if negotiators are not involved in co-creating the model they use in a negotiation.
  - What is the impact of using existing, expert-created models (compared to negotiator co-created models) in a sustainabilty negotation?

Serious Games

- Serious games allow the social interactions to be more natural[5] while still allowing important variables to be controlled.

- They come in many forms such as management flight simulators[6], wargames for military trainging[7] and **role play simulations[8]**.

5. Corrigan et al., 2015.
6. Bakken et al., 1992; Sterman, 2014.
7. Wilson, 1968
8. Butler, 1991; Curhan et al., 2004)

The Cup Game

- Role-Play Simulation with 5 parties negotiating 5 issues
- Based on real-world used-paper coffee cup value chain[9]
- Issues involve environmental concerns and business strategy interests

9. Czaika, 2010

http://rlv.zcache.com/i_am_not_a_paper_cup_coffee_mugs-r11cd1e8527da4b98b3f4f3c4341b5750_x7jgr_8byvr_512.jpg

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- Issues involve environmental concerns and business strategy interests
- Each party is given individual points to indicate that party's preferences and priorities
- All 5 Parties are independently told they get a bonus if the pilot system saves a certain level of CO_2 emissions.
- The point maximizing agreement is not the environmental optimal.

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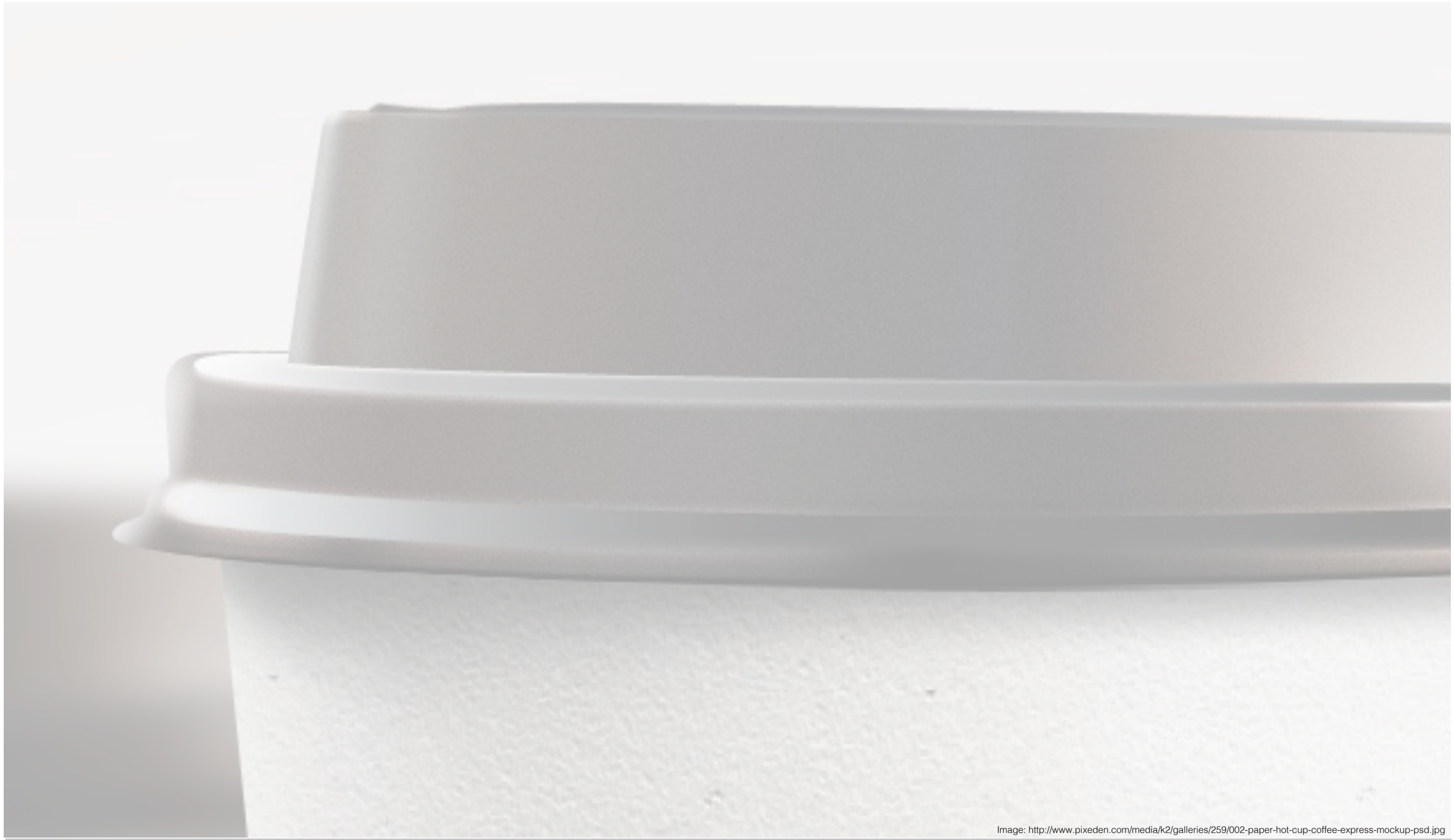
Does model use impact the process and/or outcome of sustainability negotiations? Does model authorship? If so, how?



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Research Questions of the Cup Game:

1. Will negotiators use a model while negotiating a science-intensive dispute such as a sustainability negotiation?
2. Does **model use** influence the **outcome** of the negotiation?

   2.b Does **model authorship** influence the **outcome**?
3. Does **model use** influence the negotiation **process**?

   3.b Does **model authorship** influence the **process**?

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Measurements of Outcome and Process

- Outcome:
  - Favorable Agreements: Value Maximizing and Most Environmental
    - Agreement Value (Table Scores)
    - Value Distribution Among Parties
- Process:
  - Negotiation Duration
  - Manner of model use

Image: http://blogs.scientificamerican.com/media/inline/blog/image/03-25-coffee-cup.jpg

The Cup Game Experimental Set up

- Difference between treatment and control: whether or not the equations for an LCA were given.

Image: http://www.photo-dictionary.com/phrase/4597/paper-coffee-cup.html#b

The Cup Game Experimental Set up

- Difference between treatment and control: whether or not the equations for an LCA were given.
- The necessary data for the LCA was available to both treatment and control.

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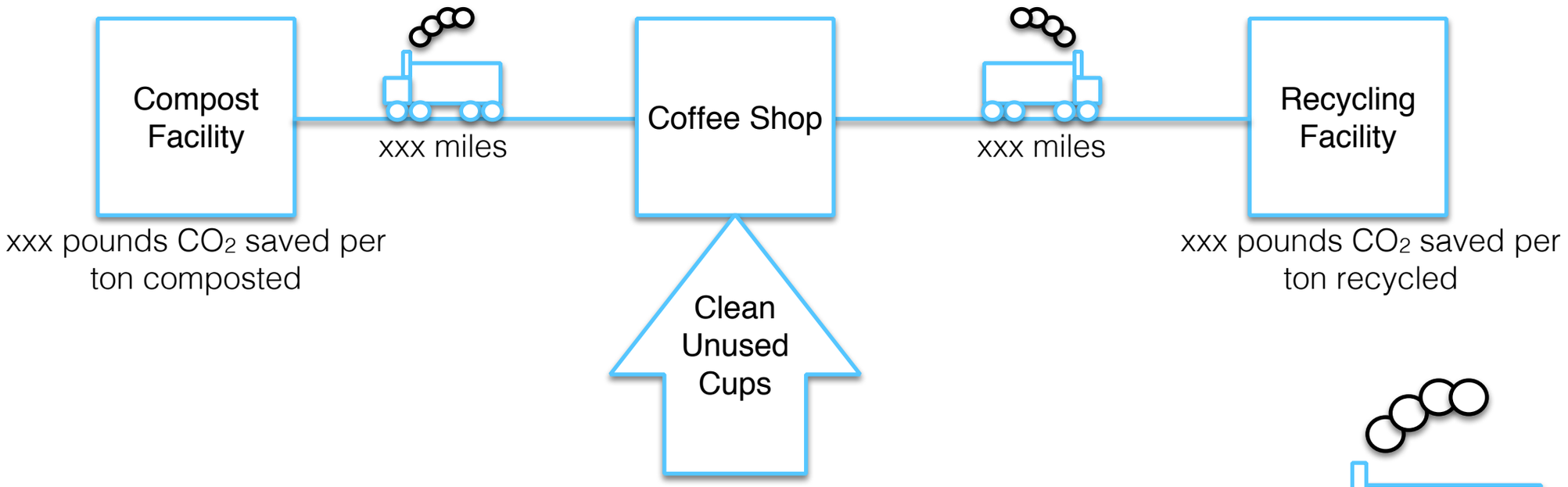

$$$

xxx tons used cups collected per $1000 spent on customer education

xxx tons/ truckload

xxx pounds CO_2 emitted per mile driven

74 Negotiating Tables

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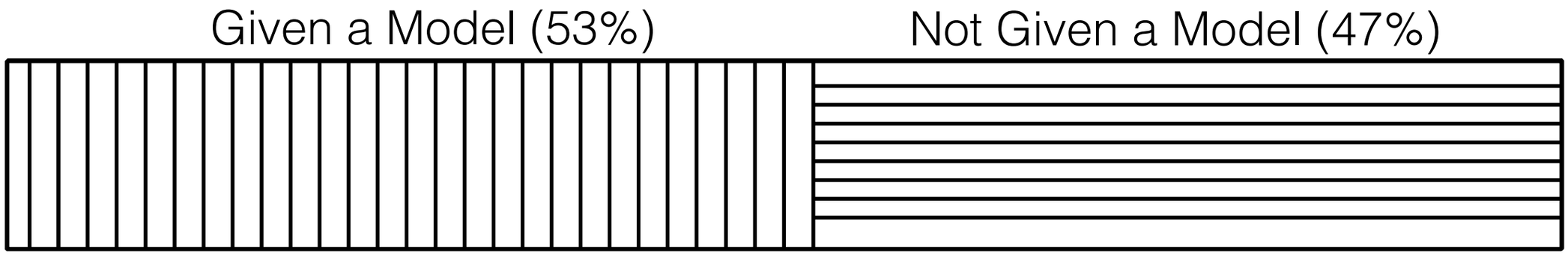

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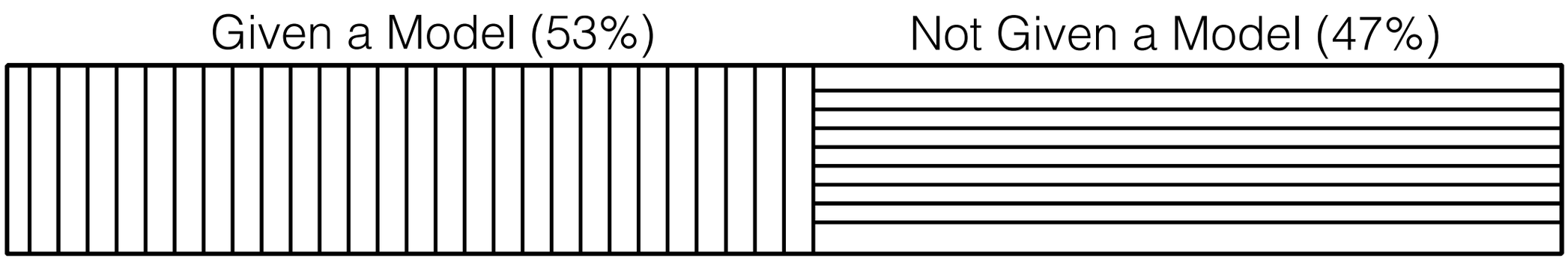

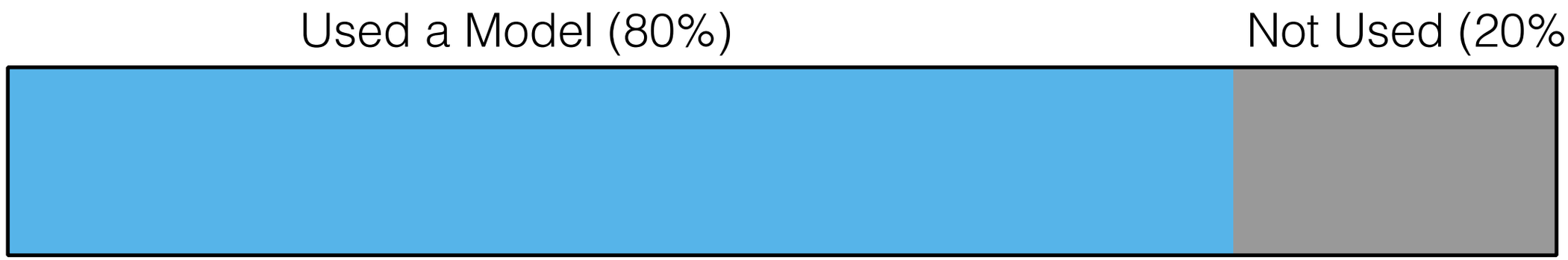

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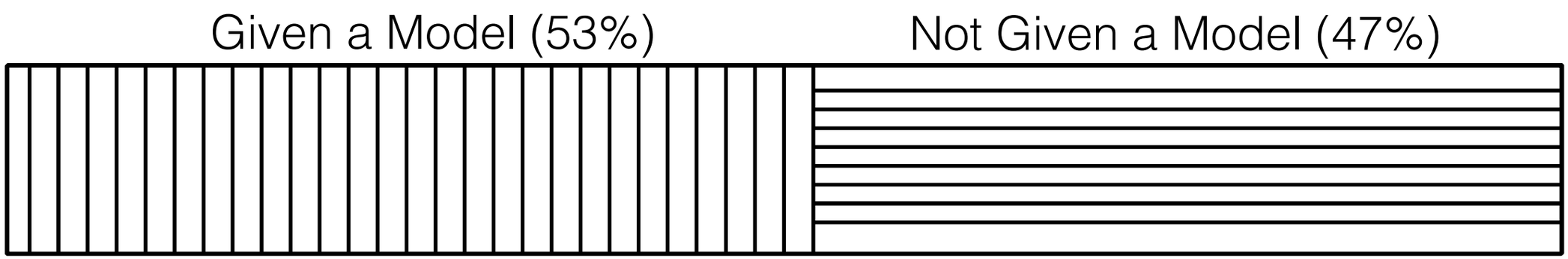

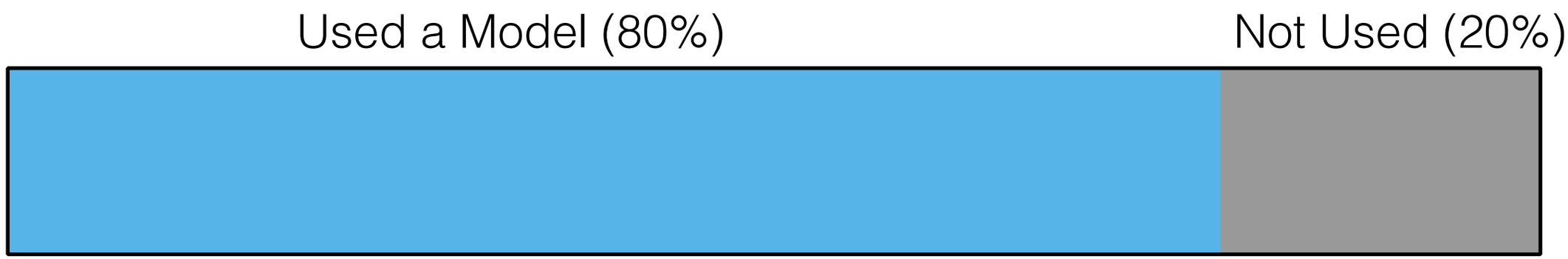

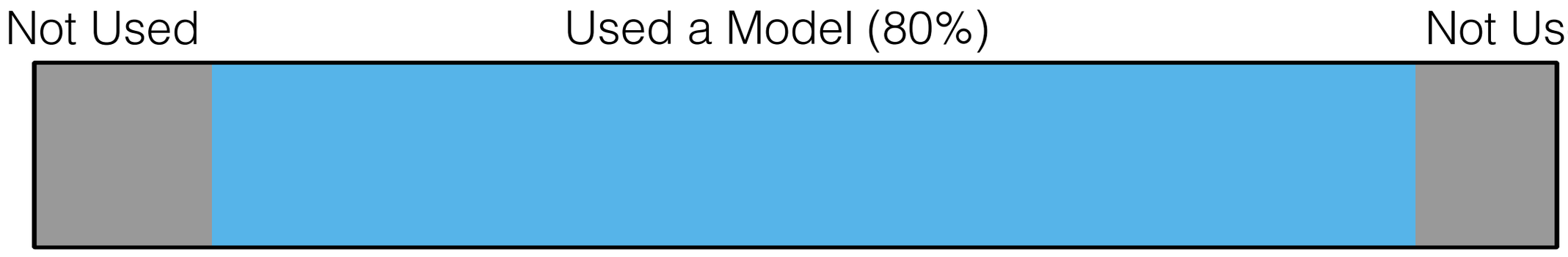

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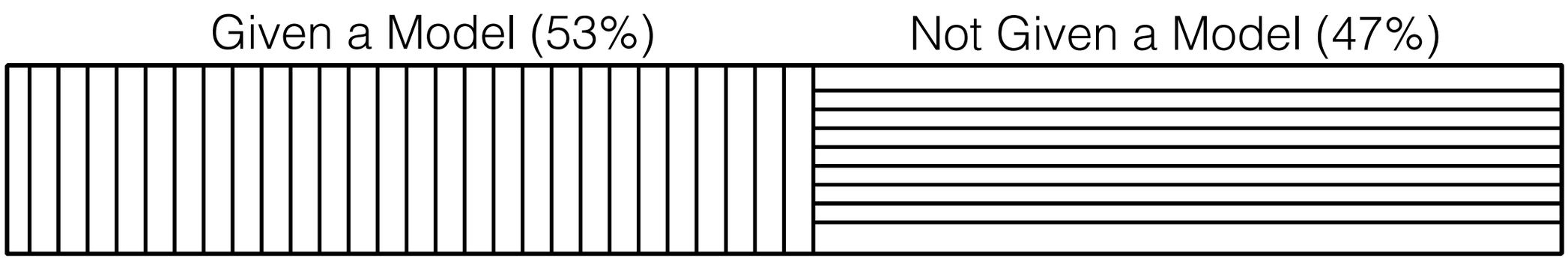

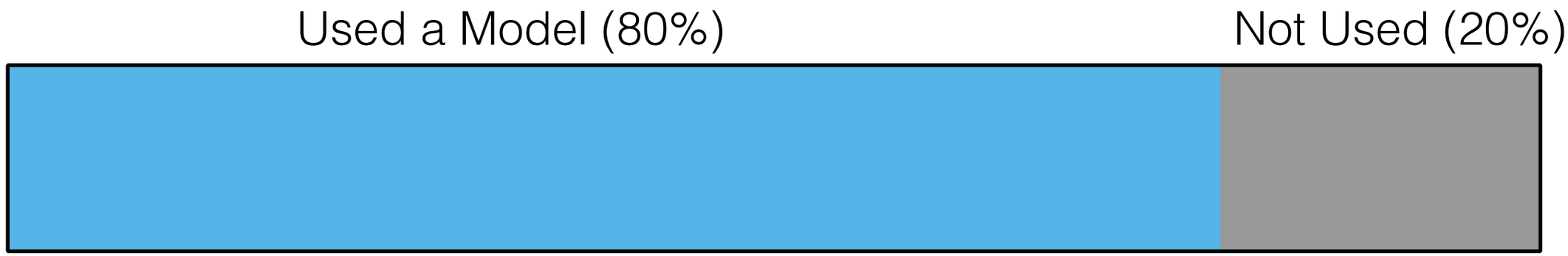

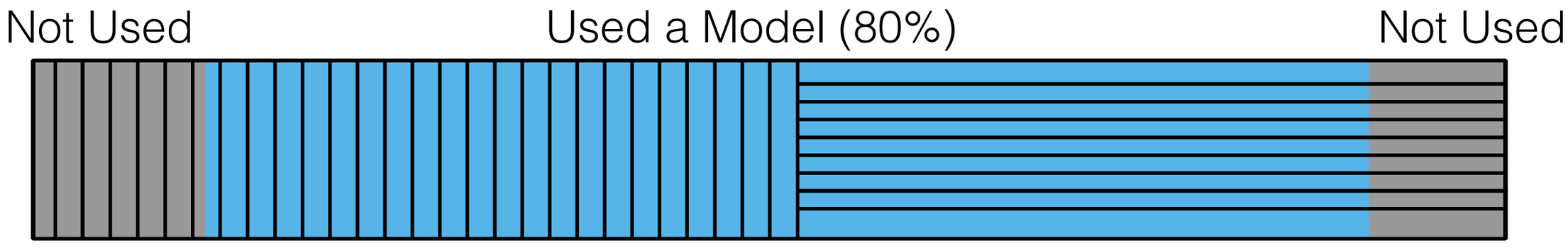

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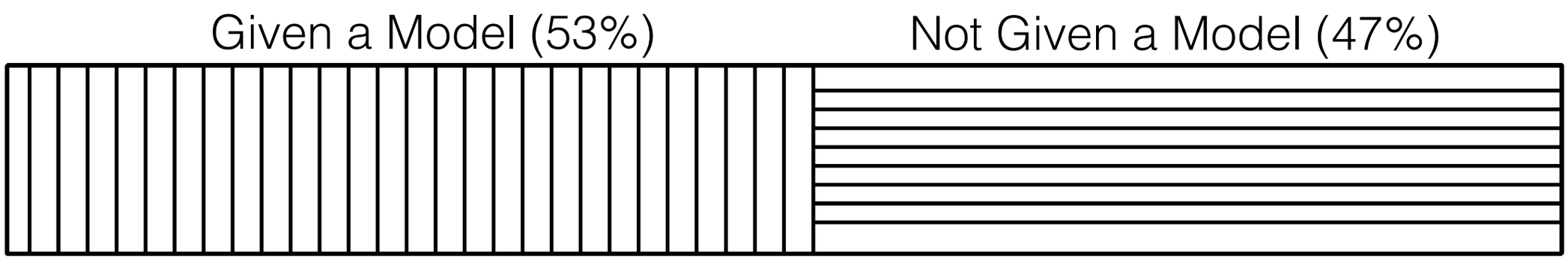

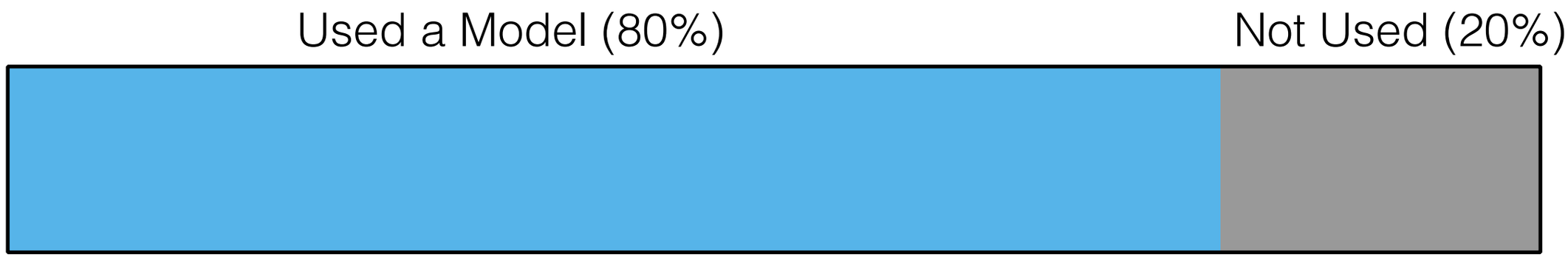

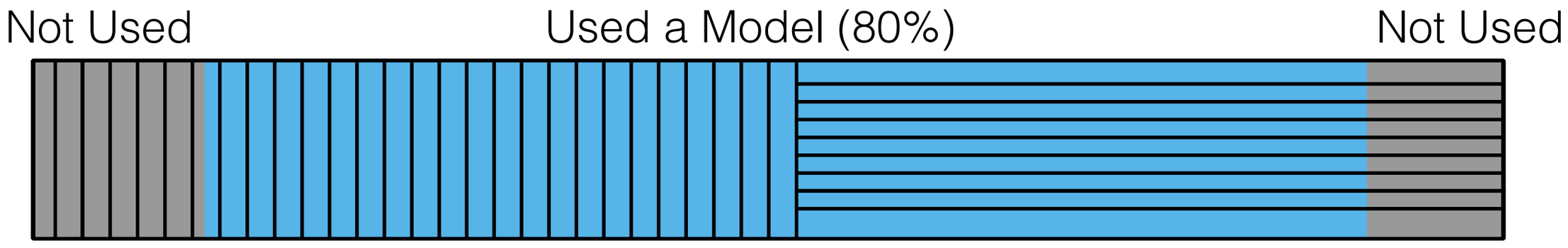

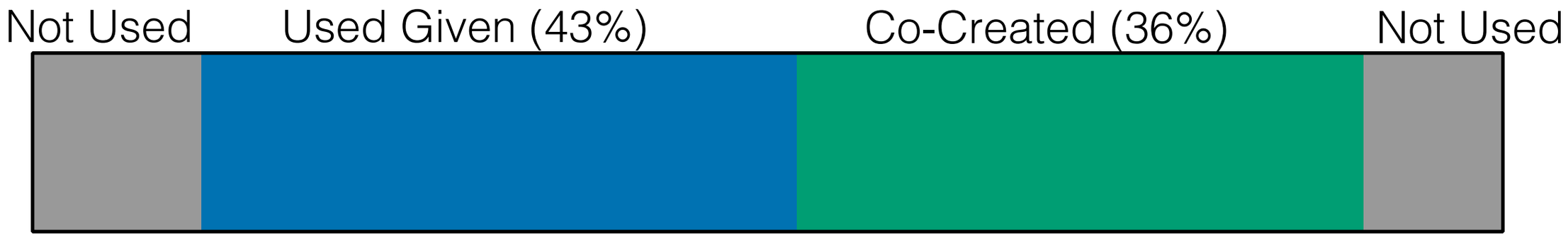

Higher Proportion of Tables Creating Their Own Model Reached Favorable Agreements

2. Does model use or model authorship influence the outcome?

(Czaika and Selin, 2016; Czaika, 2015)

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Favorable Agreements: Most Environmental or Point Maximizing, which are mutually exclusive.

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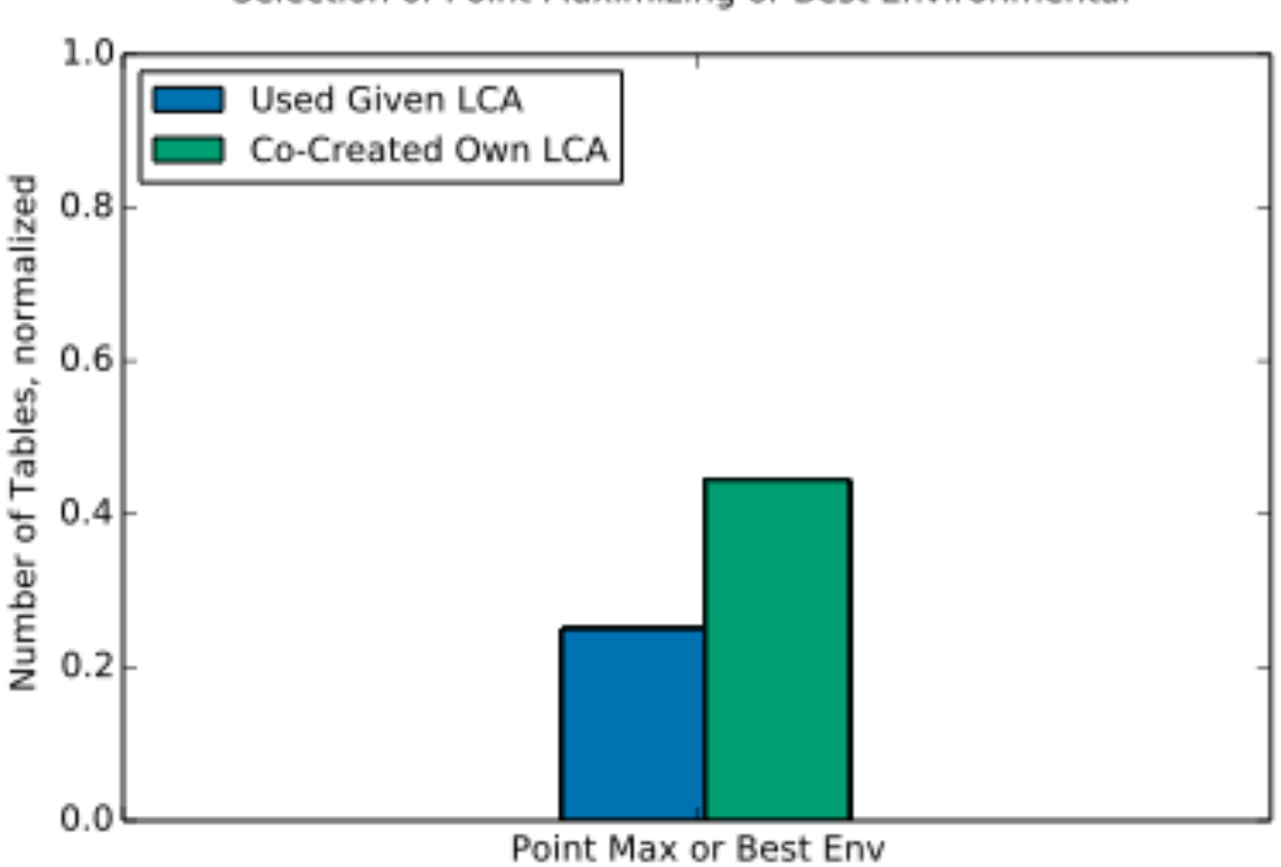
Ratios of success for **Co-Created (44%)** and **Used Given (25%)** reaching favorable agreements are significantly different at 90% (p=0.0975) (Czaika and Selin, 2016).



(Czaika and Selin, 2016; Czaika, 2015)

Which type of favorable agreement?

Type of Favorable Agreement		
	Most Environmental	Point Maximizing
Co-Created	**50%**	50%
Used Given	**37%**	63%
Not Used	**25%**	75%

- Of the tables that reached a favorable agreement and **Co-Created** a model, half chose a most environmental favorable agreement.
- Of the tables that reached a favorable agreement and did **Not Use** a model, only a quarter chose a most environmental favorable agreement.

(Czaika and Selin, 2016)

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Model Using Tables Reached More Targeted Final Agreements

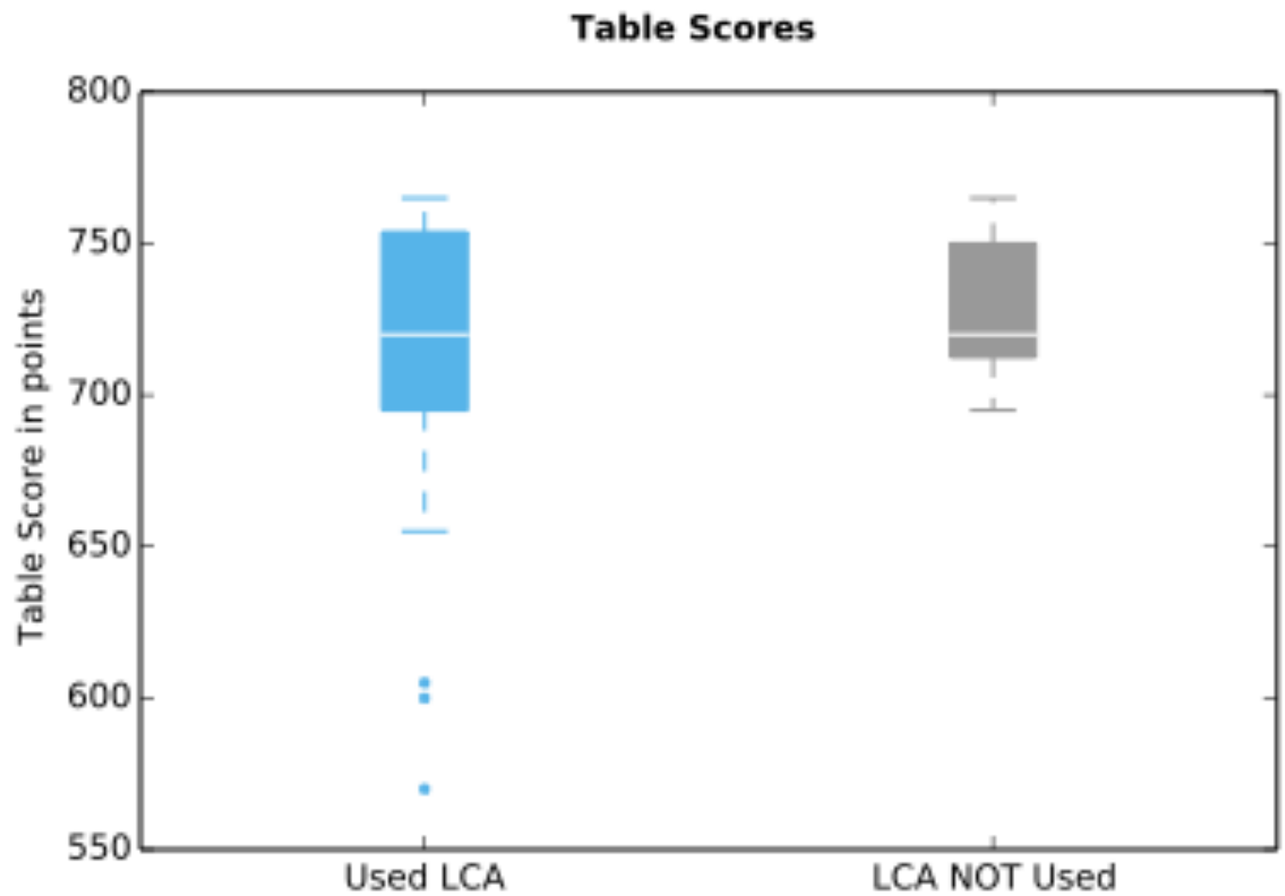
Achieved Final Agreements (normalized by category)	Used Given	Co-Created	Not Used
Unique	38%	41%	47%
Not Unique	62%	59%	53%

- Most model using tables reached a final agreement that is within a small subset of the possible agreements.
- To ascertain how well the tables explored the solution space, I would have needed to record data about which agreements they considered while negotiating. Future research opportunity.

(Czaika and Selin, 2016)

Tables Using a Model had a larger Variance in the Agreement Value than those not using a model

Used and Not Used have significantly different variances in table score ($p=2.2*10^{-6}$) (Czaika and Selin, 2016).

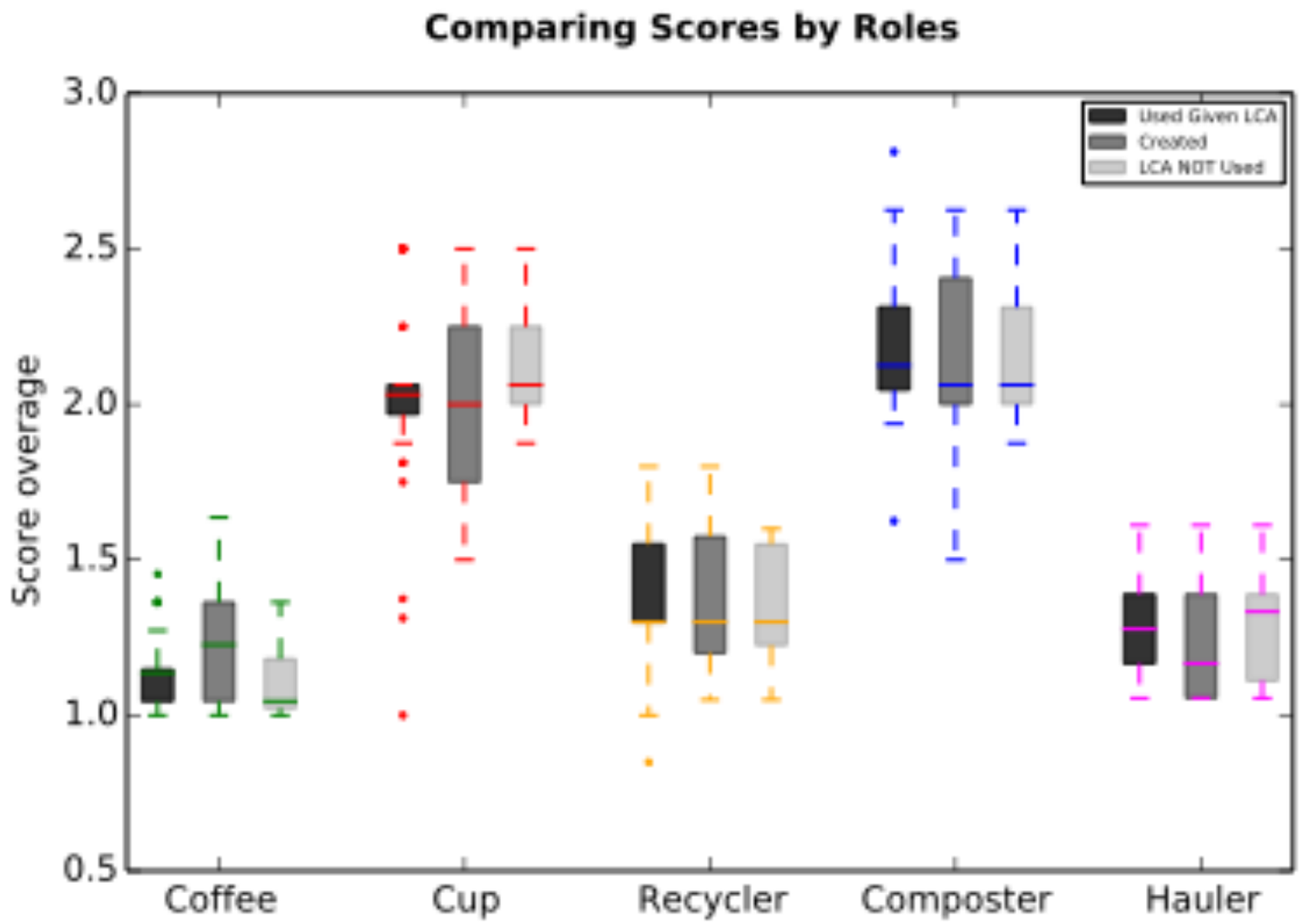


There is one Not Used table that did not reach agreement—a value of 0 for table score. It is not shown in this graph but is included in the analysis.

(Czaika and Selin, 2016; Czaika, 2015)

Model Use did not Alter the Value Distribution Among Parties

The score overage for a role is that role's score normalized by the threshold number of points the role must attain to enter into agreement.



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Process

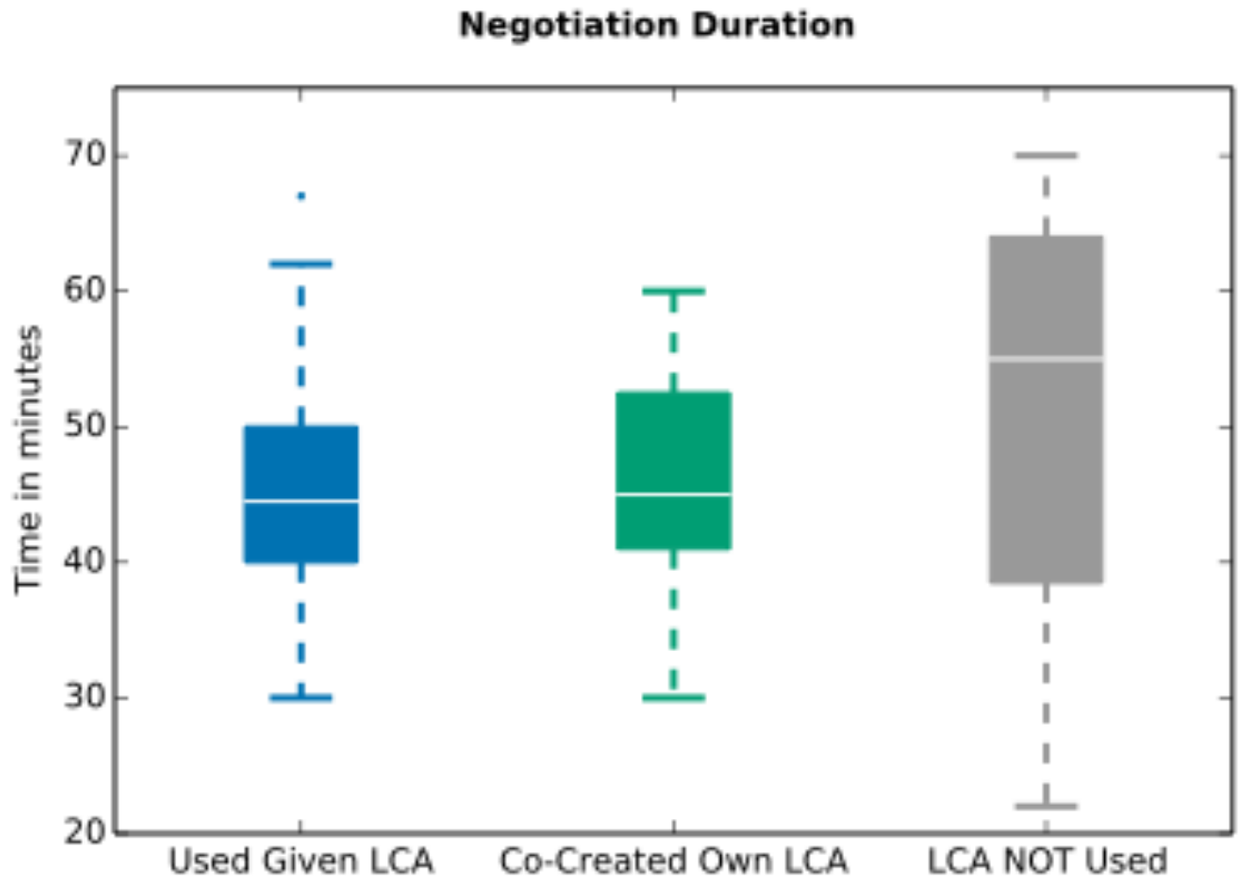
3. Does model use or model authorship influence the negotiation process?

Image: http://blogs.scientificamerican.com/media/inline/blog/image/03-25-coffee-cup.jpg

Model Users had a Shorter Negotiation Duration

3. Does model use or model authorship influence the process?

- **Co-Created** and **Used Given** do not have significantly different variances.
- **Used** and **Not Used** LCA have significantly different variances (p = 0.0016).
- **Used Given** and **Not Used** have significantly different variances (p = 0.0115).
- **Co-Created** and **Not Used** have significantly different variances (p = 0.0053).



(Czaika and Selin, 2016; Czaika, 2015)

Model Users Varied in How they Used the Model

Verify Agreement	“We looked at it [the model] to make sure we had the right decisions to trigger the incentive [bonus for reaching the CO2 savings goal].”

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Test Alternatives	"His [cup maker's] spreadsheet kinda became our fact checking or like a litmus test tool. … [W]hen we started looking at different proposals, we started looking at the Cup Maker's spreadsheet to see [which were] above the threshold."

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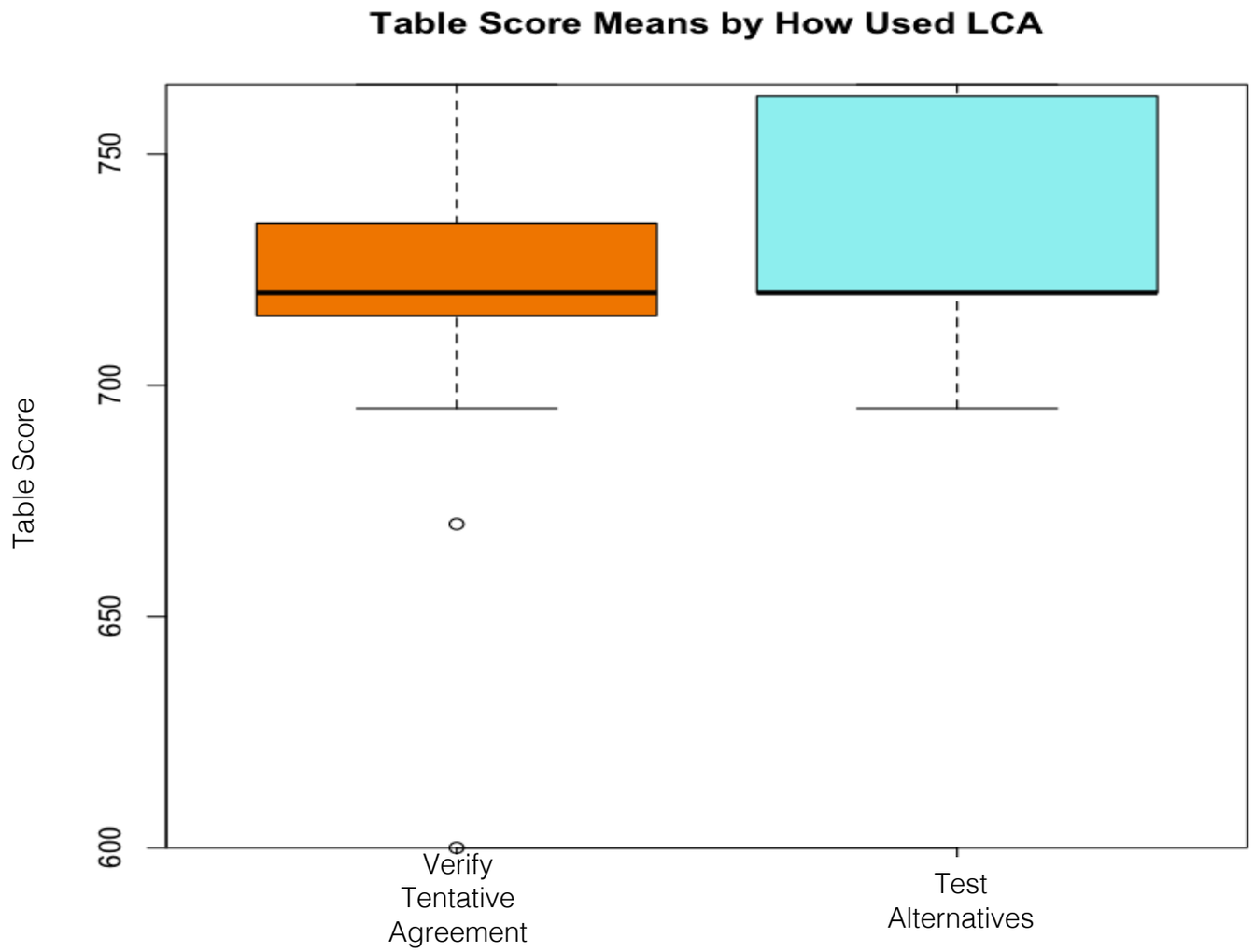
Self Benefit	"He [cup maker] just went around and asked us for numbers to estimate the CO_2 per ton that we would reduce….So we thought maybe there was some sort of spreadsheet he was working with already. We don't know if he was calculating it separately or not…."

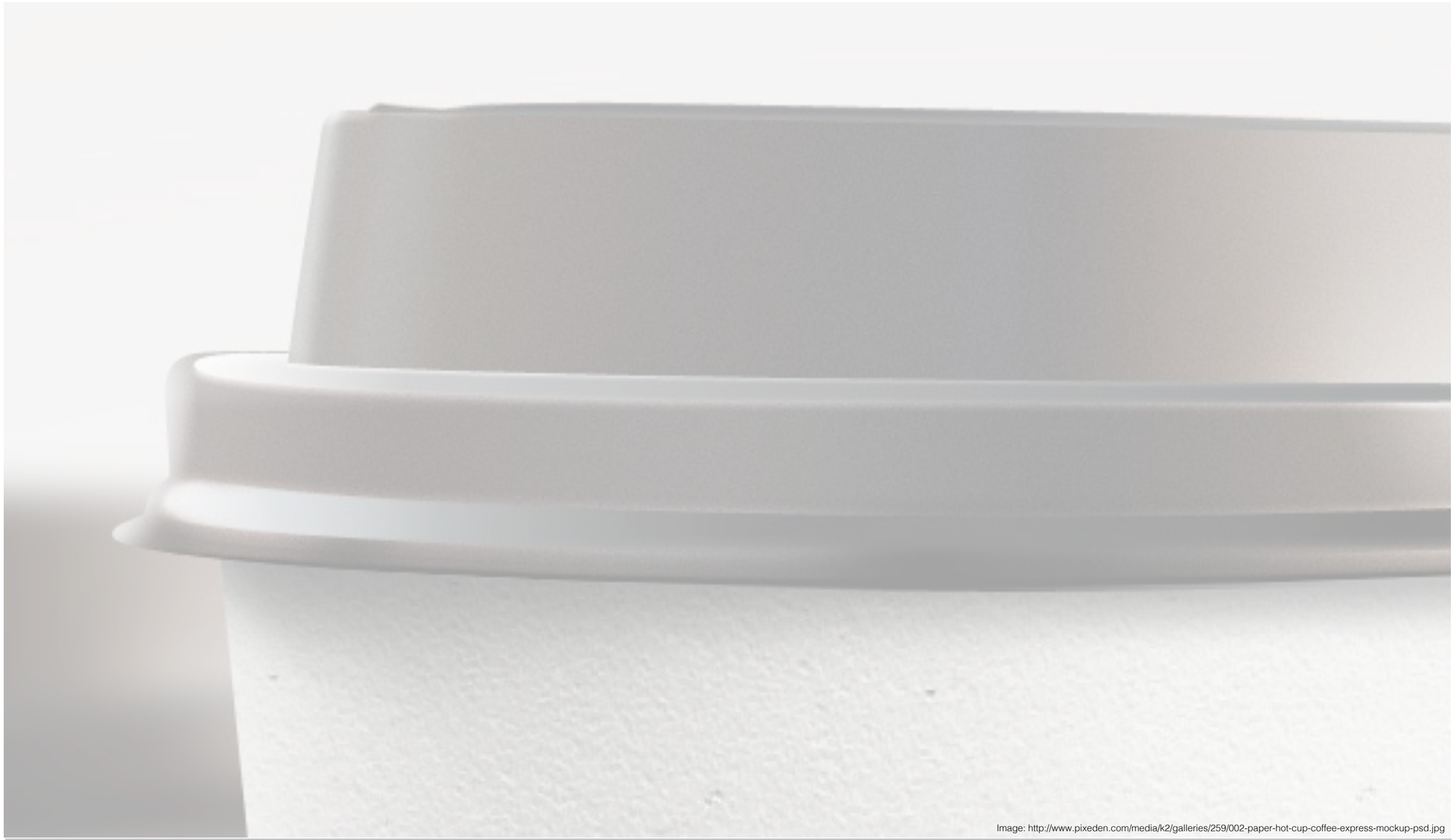
(Czaika and Selin, 2016; Czaika, 2015)

Tables Using the Model to Test Alternatives Had Scores that Skewed Higher than Tables Using the Model to Verify a Tentative Agreement



(Czaika, 2015)

Model use does impact the outcome and process of sustainability negotiations



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1. Will Negotiators use a model in a science-intensive negotiation?
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1. Will Negotiators use a model in a science-intensive negotiation?
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2. Does model use and/or model authorship influence the negotiated outcome?
    - Co-creating teams reached more favorable agreements (i.e. the mutually exclusive most environmental and point-maximizing).
    - Model use increased the variance in the table score value; model authorship did not.
    - Model use did not alter an important component of negotiations: value distribution among parties.

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    - Model use increased the variance in the table score value; model authorship did not.
    - Model use did not alter an important component of negotiations: value distribution among parties.
3. Does model use and/or model authorship influence the negotiation process?
    - Importantly, neither model use nor model authorship lengthened the duration of the negotiation. Model use influenced the variance in negotiation duration; model authorship did not.
    - Manner of use important: Tables using the model to Test Alternatives had scores that skewed higher than tables using the model to Verify a Tentative Agreement.

Image: http://www.pixeden.com/media/k2/galleries/259/002-paper-hot-cup-coffee-express-mockup-psd.jpg

Applying these Findings in Real World Negotiations & Decisions

Advantages of Using a Model and of Co-creating the Model

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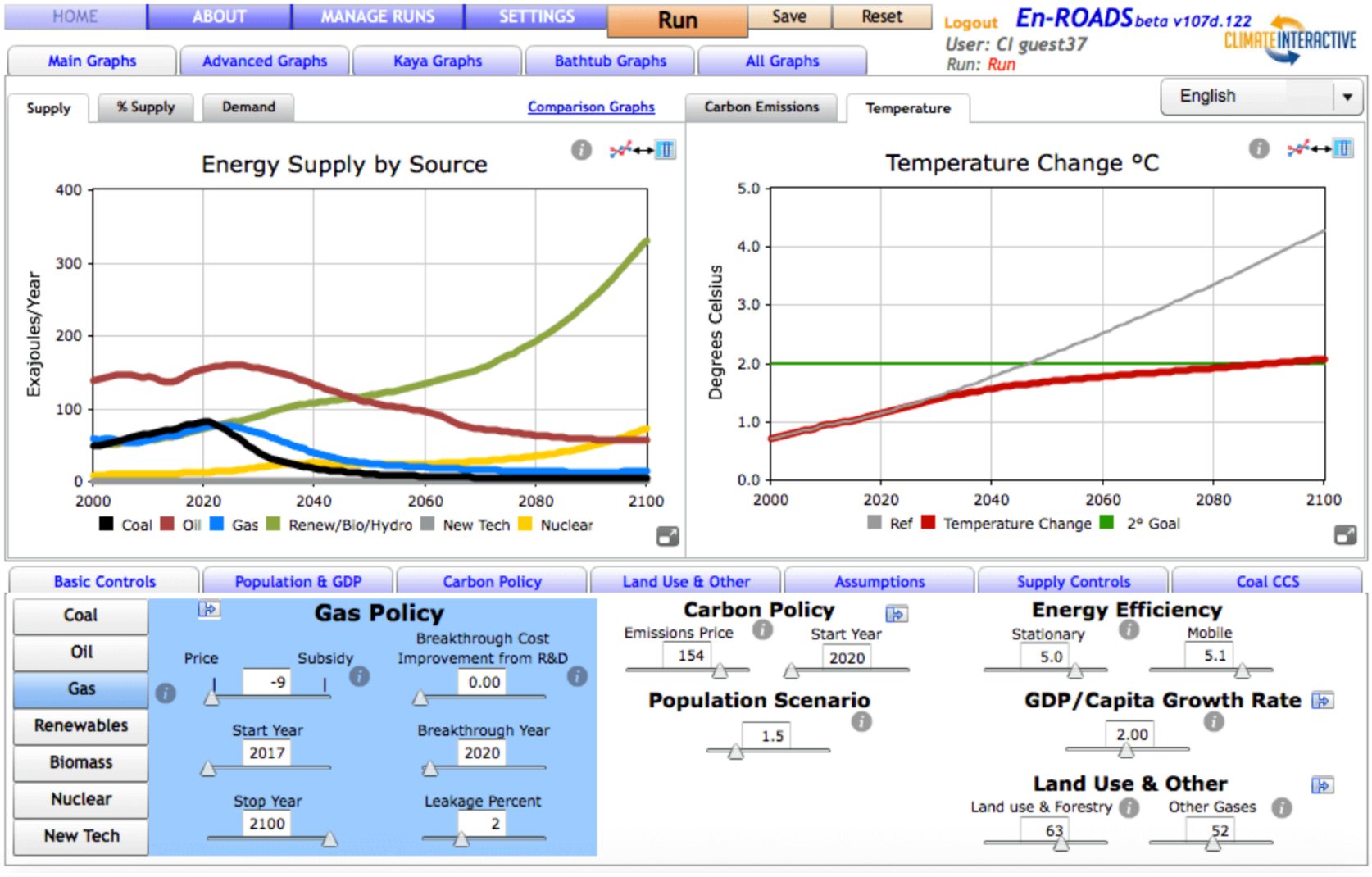
How the model is used:

- Using a model to **test alternatives** rather than to verify a tentative agreement can **increase the likelihood of gaining more value**.

Applying these Findings in Real World Negotiations

It isn't always possible to have the parties co-create a model.
When co-creating a model isn't possible, then encourage the negotiators to use a relevant expert-given model.



https://www.climateinteractive.org/tools/en-roads/

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- Starbucks for funding part of the Cup Game
- My colleagues and mentors in IDSS, DUSP, Sloan, and elsewhere at MIT and Harvard
- The SDM program
- Everyone who took a turn as a negotiator creating a better end of life for used paper coffee cups—the participants!

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