A Theory of Reference Point Formation

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Reference Dependence

- Markowitz [1952], Kahneman and Tversky [1979], and Tversky and Kahneman [1991]
- The idea of reference-dependence has played a very significant role in economics

Reference Dependence

- Explain observed behavior such as
  - pension and insurance choice, selection of internet privacy, organ donation
  - Attitudes towards risk, equity premium puzzle, annuitization puzzle, disposition effect in financial markets and in housing markets
  - golf players, poker players, cab drivers, physicians, fishermen, deer hunters, drivers,...
  - Samuelson and Zeckhauser [1988], Kahneman Tversky [1984], Banford et al. [1979], Heberlein and Bishop [1985], Raymond and Hartman [1991], Boyce et al. [1992], Duborg et al. [1994], Kahneman et.al. [1990], Knetsch and Sinden [1984], Singh, [1991], Shogren et al. [1994], Morrison [1997], Coursey et al. [1987], Bateman et al. [1997], Johnson et al. [1993], Madrian and Shea [2001], Johnson et al. [2000], Johnson and Goldstein [2003],...
  - Thaler and Benartzi [2004], Sydnor [2010], Johnson et al [2002], Johnson-Goldstein [2003], Pope and Schweitzer [2011], Eil and Lien [2014], Camerer et al [1997], Rizzo and Zeckhauser [2003], Rabin [2000], Wakker [2010], Benartzi and Thaler [1995], Benartzi et al. [2011], Odean [1998], Genesove and Mayer [2001]...

What is the reference point?

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- Markowitz [1952]

  It would be convenient if I had a formula [for the reference point].... But I do not have such a rule and formula.

- Tversky and Kahneman [1991]

  The question of the origin and the determinants of the reference state lies beyond the scope of the present article.

What is the issue?

- Wakker [2010] argues that

If too much liberty is left concerning the choice of reference points, then the theory becomes too general and is almost impossible to refute empirically.

A General Model

$$S \;\rightarrow\; r(S) \;\rightarrow\; \max_{x \in S} U_{r(S)}(x) \;\rightarrow\; c(S)$$

- S and $c(S)$ are observable
- $r(S)$ and $\{U_\rho\}$ are not observable

A General Model

$$S \;\rightarrow\; r(S) \;\rightarrow\; \max_{x \in S} U_{r(S)}(x) \;\rightarrow\; c(S)$$

- S and $c(S)$ are observable
- $r(S)$ and $\{U_\rho\}$ are not observable

- Take $r(S) = c(S)$ and $U_\rho(\rho) > U_\rho(x)$ for all $x \in X \setminus \rho$
- any choice can be rationalizable
- without any structure, there is no empirical content!!!
- reference point formation is the key

Most Salient Alternative

- "Most salient alternative" as the reference point

Brickman, Coates, and Janoff-Bulman [1978], Samuelson and Zeckhauser [1988], Pratkanis [2007], DellaVigna [2009], Larrick and Wu [2012], Bhatia and Golman [2015], Bhatia [2017]

- Bhatia and Golman [2015]

...reference points are merely options that are especially salient to the decision maker.

Our Aim

- We provide a simple theory of reference point formation
  - How the reference point endogenously determined
  - How it affects choices
- Based on the idea of most salient alternative

Our Model

$$S \rightarrow r(S) \rightarrow \max_{x \in S} \; U_{r(S)}(x) \rightarrow c(S)$$

Choice Set	Most Salient Alternative	Reference-Dependent Utility Maximization	Choice

Our Model

$$S \rightarrow r(S) \rightarrow \max_{x \in S} U_{r(S)}(x) \rightarrow c(S)$$

Choice Set | Most Salient Alternative | Reference-Dependent Utility Maximization | Choice

- $\gg$: salience ranking
- $r(S)$: the highest ranked alternative in S w.r.t. $\gg$

Salience based Endogenous Reference Model (**SER**)

Salience Ranking

Salience ranking

- a reflection of what grabs the decision maker's attention
- subjective
- unobservable

An Illustration

Consider a decision maker with a salient ranking

$$z \gg x \gg y$$

and reference-dependent utility functions

$$U_z(y) > U_z(z) > U_z(x) \text{ and } U_x(x) > U_x(y)$$

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Implied choices

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Implied choices

S	$\rightarrow$	$r(S)$	$\rightarrow$	$c(S)$
$\{x, y, z\}$		z		y
$\{x, y\}$		x		x
$\{y, z\}$		z		y
$\{x, z\}$		z		z

Behavioral Patterns

SER accommodates

- Cyclical behavior
- Attraction Effect
- Compromise Effect
- More...

Attraction Effect

- An inferior product increases the attractiveness of dominating another
- Huber, Payne, and Puto [1982]
- more than 7300 Google scholar articles

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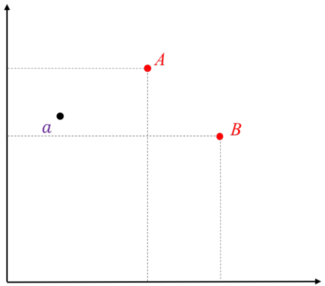

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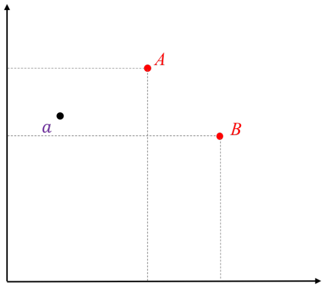
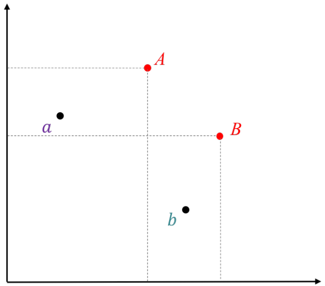


$$c(A,B) = B \text{ and } c(A,B,a) = A$$

Attraction Effect

4-alternative version of AE

$$c(A, B, a) = A \text{ and } c(A, B, b) = B$$



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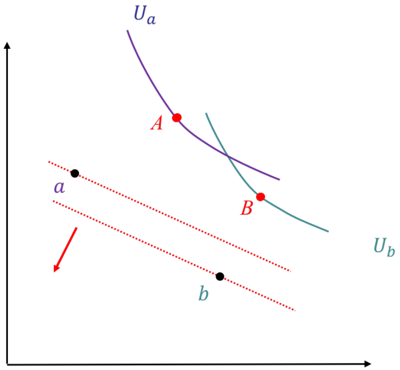

Compromise Effect

- Tendency to choose the middle option
- Simonson [1989], Simonson and Tversky [1992]
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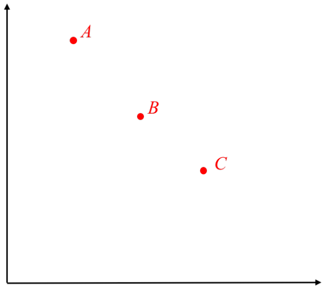
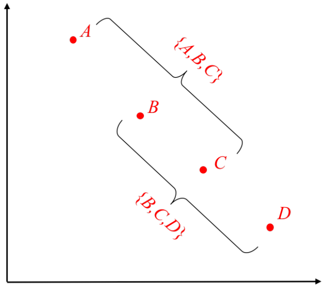


$$c(A, B, C) = B$$

Compromise Effect

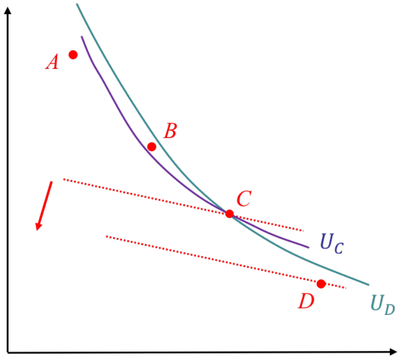
4-alternative version of CE

$$c(A, B, C) = B \text{ and } c(B, C, D) = C$$



Compromise Effect

$$c(A, B, C) = B \text{ and } c(B, C, D) = C$$



Prediction Power

- Is the model too general?

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- SER can be falsified.
  - For example, the following c is outside of the model.

S	$c(S)$
$\{x, y, z\}$	y
$\{x, y\}$	x
$\{y, z\}$	z
$\{x, z\}$	x

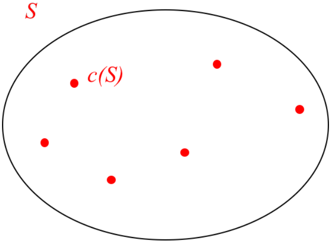
Behavioral Foundation

Behavioral Foundation

Single Reversal Axiom: For each S, T and distinct x, y with $\{x, y\} \subseteq S \cap T$,

$$\text{if } x \neq c(S) \neq c(S \setminus x) \text{ and } c(T) \neq y \text{ then } c(T \setminus y) = c(T).$$

Single Reversal Axiom



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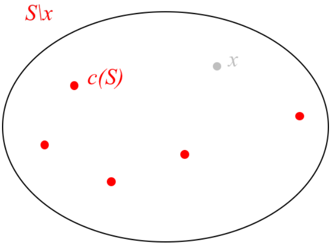

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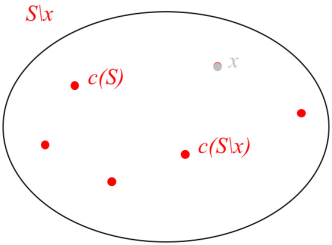

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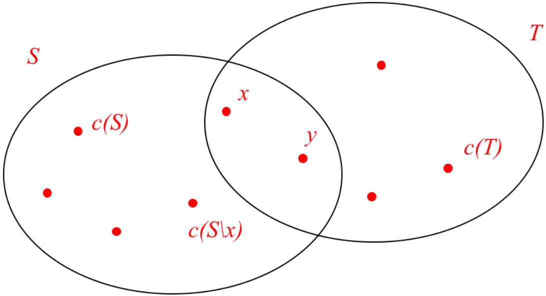

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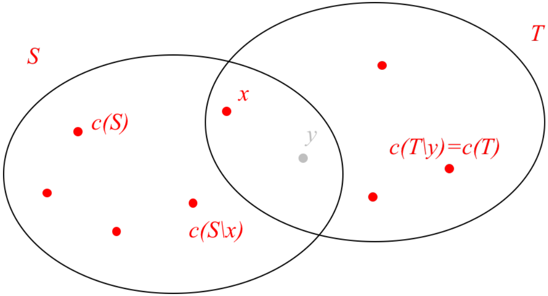

Behavioral Foundation

Theorem

A choice function c admits a SER representation if and only if it satisfies Single Reversal.

Uniqueness / Identification

a choice reversal $\Rightarrow$ the reference point

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$x \gg_R y$ if there is $S \supseteq \{x, y\}$ such that $x \neq c(S) \neq c(S \setminus x)$

Uniqueness / Identification

a choice reversal $\Rightarrow$ the reference point

$$x \gg_R y \text{ if there is } S \supseteq \{x, y\} \text{ such that } x \neq c(S) \neq c(S \setminus x)$$

Proposition

(Revealed Salience) Suppose c admits a SER representation. Then x is revealed to be more salient than y if and only if $x \gg_R y$.

Uniqueness / Identification

- How to reveal preference between x and y when the reference point is z?

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- Find a choice problem such that
  - x, y, z are feasible
  - z is the reference point
  - x is chosen

Uniqueness / Identification

How to reveal preference between x and y when the reference point z?

xP_zy if there are $S \supseteq T \supseteq \{x, y, z\}$ s.t.

$$(i) \quad z \neq c(S) \neq c(S \setminus z)$$

$$(ii) \quad x = c(T).$$

Uniqueness / Identification

How to reveal preference between x and y when the reference point z?

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$$(i) \quad z \neq c(S) \neq c(S \setminus z)$$

$$(ii) \quad x = c(T).$$

Proposition

(Revealed Preference) Suppose c admits a SER representation. Then x is revealed to be preferred to y under reference point z if and only if xP_zy.

Summary

$$S \rightarrow r(S) \rightarrow \max_{x \in S} U_{r(S)}(x) \rightarrow c(S)$$

Choice Set | Most Salient Alternative | Reference-Dependent Utility Maximization | Choice

- an intuitive reference formation
- simple model
- simple axiomatization

Psychological Constrained Model

Psychological Constrained Model

A new underlying reference dependent choice (Masatlioglu and Ok [2014])

$$S \;\rightarrow\; r(S) \;\rightarrow\; \max_{x \in S \cap \mathcal{Q}(r(S))} U(x) \;\rightarrow\; c(S)$$

Psychological Constrained Model

A new underlying reference dependent choice (Masatlioglu and Ok [2014])

$$S \;\rightarrow\; r(S) \;\rightarrow\; \max_{x \in S \cap \mathcal{Q}(r(S))} U(x) \;\rightarrow\; c(S)$$

- $r(S)$: the most salient alternative in S
- U: reference-free
- Enable welfare analysis

Psychological Constrained SER (**PC-SER**)

Behavioral Foundation

Behavioral Foundation

Consistency: For each $S \in \mathcal{X}$, there is $x \in S$ such that if $\{x, z\} \subseteq T \subseteq T'$, $z \neq c(T') \neq c(T' \setminus z)$ and $x = c(x, z)$, then either $c(T) = x$ or $c(T) \notin S$.

Behavioral Foundation

Theorem

A choice function c admits a PC-SER representation if and only if it satisfies Single Reversal and Consistency.

Uniqueness / Identification

For any x, y, z such that $x \neq y$, we define

$$xPy \text{ if } \exists S, T \text{ with } \{x, y, z\} \subseteq T \subseteq S \text{ such that}$$

$$\begin{aligned} &(i) \quad z \neq c(S) \neq c(S \setminus z), \\ &(ii) \quad c(y, z) = y, \ \textit{and} \\ &(iii) \quad x = c(T). \end{aligned}$$

Uniqueness / Identification

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$$(i) \quad z \neq c(S) \neq c(S \setminus z),$$
$$(ii) \quad c(y, z) = y, \text{ and}$$
$$(iii) \quad x = c(T).$$

Let P^T be the transitive closure of P.

Proposition

(Revealed Preference) Suppose c admits a PC-SER representation. Then x is revealed to be preferred to y if and only if xP^Ty.

Uniqueness / Identification

$$Q_M(x) = \{y \in X \mid \exists S \supseteq T \supseteq \{x, y\} \text{ s.t. } x \neq c(S) \neq c(S \setminus x) \text{ and } y = c(T)\}$$

Uniqueness / Identification

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Proposition

(Revealed Psychological Constraint) Suppose c admits a PC-SER representation. Then
(i) x is revealed to be in the psychological constraint set of y iff $x \in Q_M(y)$,
(ii) x is revealed to be outside the psychological constraint set of y if and only if xP^Ty and $c(x, y) = y$.

Uniqueness / Identification

For any $x \neq y$

$$x \gg_R y \text{ if } (i) \quad \exists S \supseteq \{x, y\} \text{ such that } x \neq c(S) \neq c(S \setminus x), \text{ or}$$
$$(ii) \quad y P^T x \text{ and } x = c(x, y).$$

Let $\gg_R^T$ stand for the transitive closure of $\gg_R$.

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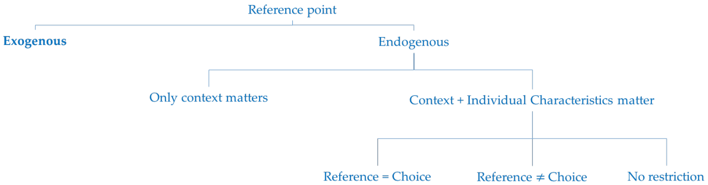
Proposition

(Revealed Salience) Suppose c admits a PC-SER representation. If $x \gg_R^T y$ then x is revealed to be more salient than y.

Existing Literature



Reference-dependent choice		Exogenous	Only context matters	Reference = Choice	Reference ≠ Choice	No restriction
	$\{U_r\}$	Tversky and Kahneman, 1991 Munro and Sugden, 2003 Sugden, 2003 Sagi, 2006 Salant and Rubinstein, 2008	Bodner and Prelec, 1994 Kivetz et al, 2004 Orhun, 2009 Bordalo et al, 2013 Tserenjigmid, 2015	Koszegi and Rabin, 2006 Freeman, 2017		This paper (SER)
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Existing Literature

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  - Context + Individual Characteristics matter
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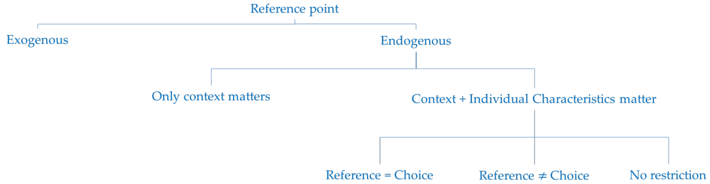

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A Comparison

- Consider riskless outcomes
- The constant loss aversion as the underlying reference-dependent model
- Consider two different reference point formations:
  - PPE (Koszegi and Rabin 2006)
  - Salience Based (This paper)

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  Answers

  - WARP (hence No Compromise or Attraction Effects) (KR, 2006 Prop. 3)

A Comparison

- The constant loss aversion model as the underlying reference-dependent model
- Consider two different reference point formations:
  - PPE (Koszegi and Rabin 2006)
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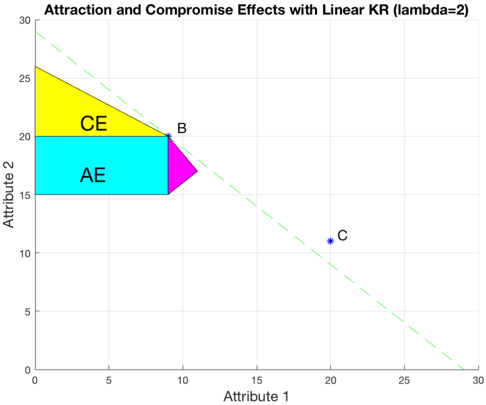
  Answers

  - WARP (hence No Compromise or Attraction Effects) (KR, 2006 Prop. 3)
  - accommodates both Compromise and Attraction Effects

A Comparison



Conclusion

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THANK YOU

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