Cognitive processes in Decision Making

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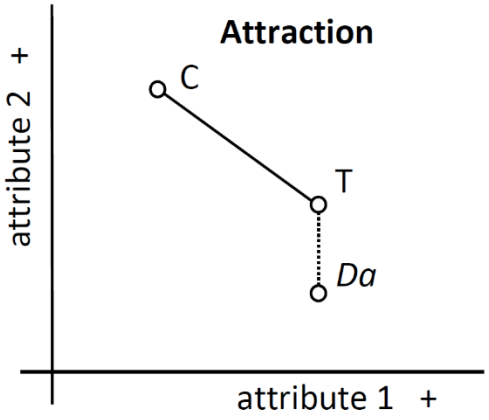
Where innovation starts

context effects

- Context effects are widely studied in Marketing and psychology
  - Attraction and compromise effect
- Many theories how these come about
  - Dynamic models (drift diffusion models) and static models like relative evaluation models
  - Dual processes or single processes?
- Can a value construction model also explain context effects?
  - Similarities between Reference dependence and context effects!

Attraction Effect



	TC	DTC
T		
C		

Adding Decoy Da to TC set

D is dominated by target T but not by competitor C (and hardly ever chosen)

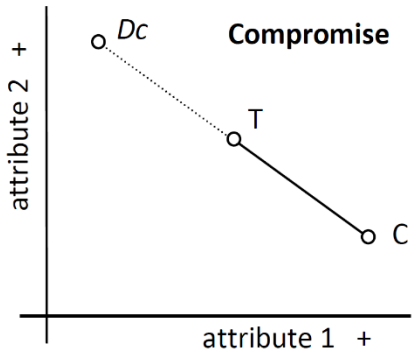
P(T;DTC) > P(T;TC)

Violation of Regularity

This study:

between: $X^2(1)=3.4$, p=.066
within (log. regression): p<.05

Compromise Effect



	TC	DTC
C		
T		
D		

- Adding third option Dc to TC
- Target T becomes middle (compromise) option
- Preference for T relative to C increases with Dc
- Violation of proportionality
- This study:
  - Between: $X^2(1)=7.1$, $p=.008$
  - within (log. Regression): $p<.001$

Accounts for context effects

Dual process models

- Attraction is more perceptual: strong target focus
- Compromise is more cognitive: within-attribute comparisons

Relative valuation models

- Extensions of VM based on LA / reference points

Drift diffusion models

- Dynamic computational models of an information search (sampling) process that accumulates evidence for each of the options

Value construction accounts

- Biased information search
- **Unique:** Order effects due to early leaders

Relative Advantage Model

- R(x,y) represents the relative advantage of x over y
- All options are compared to all others

$$V(x;S) = \sum \beta_i v_i(x_i) + \theta \sum_{y \in S} R(x,y)$$

$$where \quad R(x,y) = \frac{A(x,y)}{A(x,y) + D(x,y)}$$

Attraction:

Relative advantage of T over C and D is larger than that of C over T and D

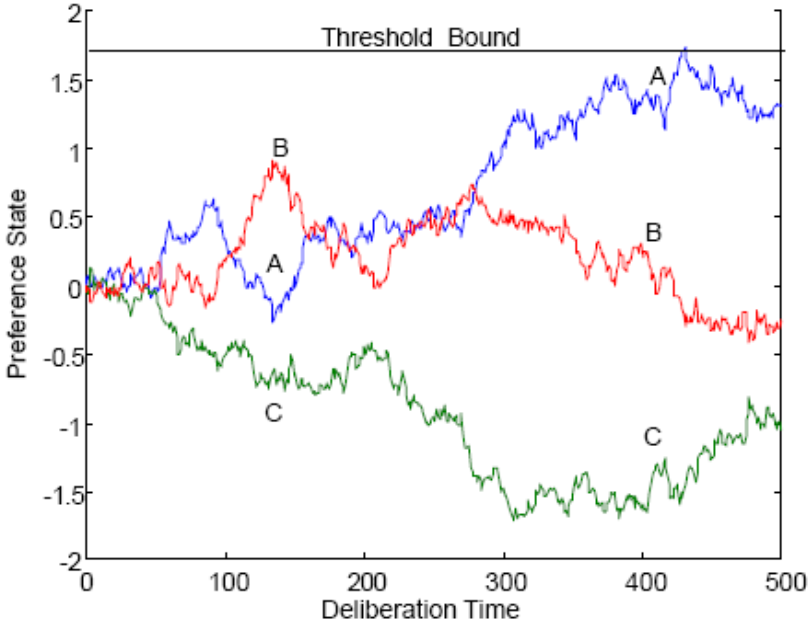
Compromise:

Middle option (T) smaller disadvantages (and advantages)

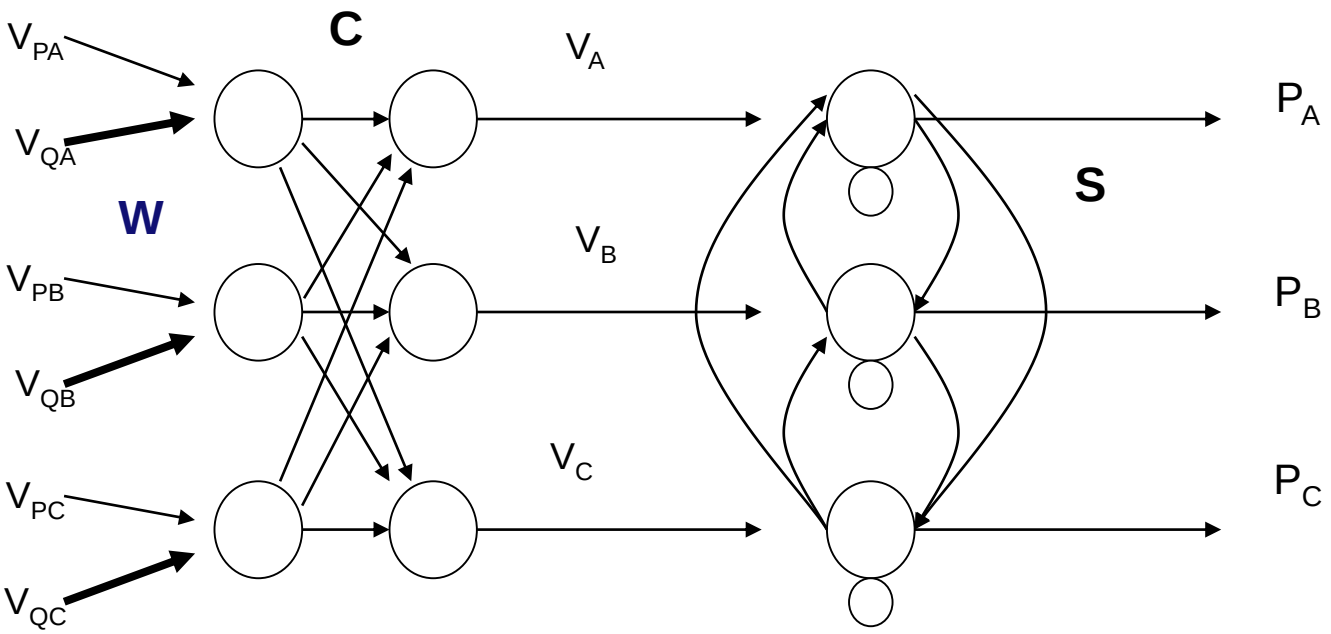
Process predictions: all comparisons are made, uniform attention within attributes and uniform (non-directed) search

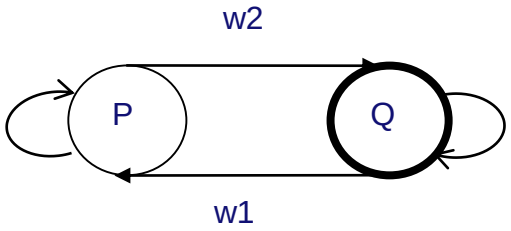
Drift Diffusion Models (DDM)

- Computational model of choice
- Dynamic Accumulation of noisy activation for each option
- Preference states accumulate over time
- states are updated by deliberation over the outcomes for each option on one of its attributes
- Decision is made when threshold is reached



General model DFT

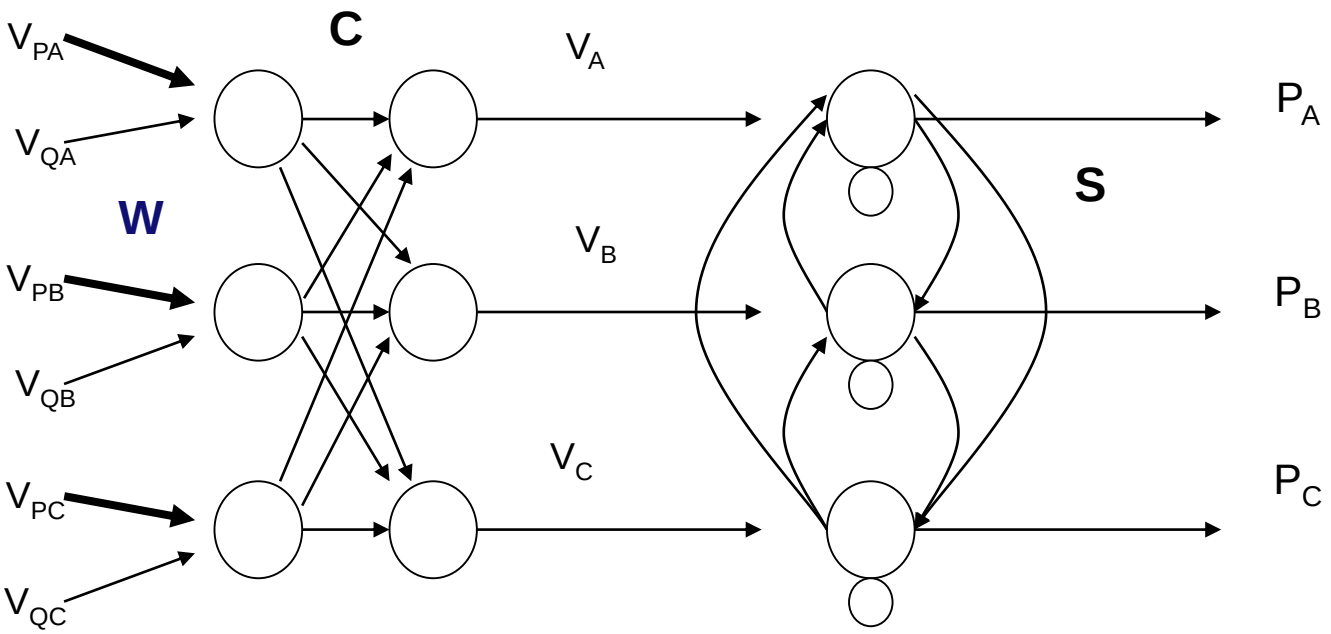


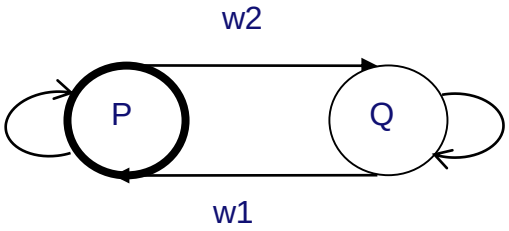


Sampling **quality**

$P(t+1) = S*P(t) + V(t+1)$

General model DFT





Sampling **price**

$P(t+1) = S*P(t) + V(t+1)$

Process predictions of DFT

What assumptions does DFT makes about the process?

Sequential Sampling model

- Attribute-based processing, can not predict differences in attention to options.
- Stochastic attention switching: no change over time
- Order effects: hard to model…

Value Construction Theories

- Current preference influences perception of new information in direction of current leader
  - Pre-decisional distortion of Information (Russo et al.)
- Comparisons are directional
  - Tversky (1977), Houston et al. (1989), Dhar and Simonson (1992)
  - Current leader becomes the focal option (the referent)
  - Comparisons originate from the focal option (looking for reasons why to choose it, rather than why not)
- Order effects in choice
- Consistent with gaze-shifts (Shimojo et al. 2003)

Research questions

1. **Do the Compromise and Attraction Effects have common or different origins?**

   Test 1: Attention will differ across context effects

2. **Does search focus on the target option when it is chosen?**

   Test 2: Increased attention to the target option is associated with Context dependent choice

3. **Does focus on the target option increase over time?**

   Test 3&4: Attention to the target option will increase over time and will be associated with choice of the target.

4. **Are Context Effects affected by order of presentation?**

   Test 5: Choice and Mediation models

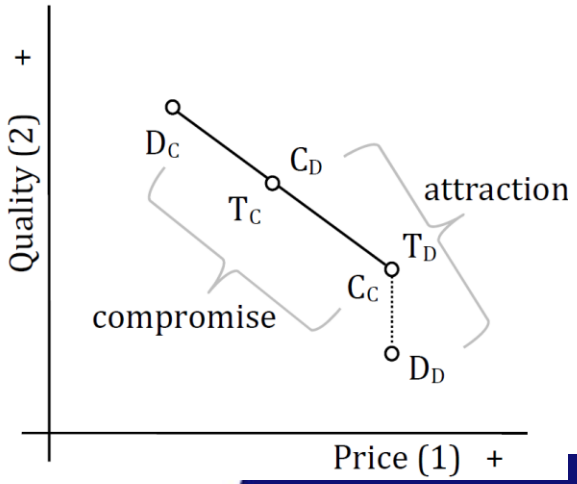
Experiment

Participants: 374 US citizens, age 18-65, all educational levels, online experiment

4 product types:

- Printers, cell phones, dvd-players and small TVs
- Two attributes: features (Quality) and price
- Each participant did a
- binary choice (TC)
  compromise (TCD_c)
  attraction (TCD_a)
- (Four option choice)

Within subject analysis of context effects!



Example: Compromise

Cell Phone

Imagine you are moving to a different city. Your current cell phone provider does not serve this new city and you have to select a new plan with a new cell phone from another provider. In the new city there are several providers that offer similar network coverage. Their plans and the cell phones they offer are presented below. Because you are not sure how long you will remain in this area, you have decided not to commit to a long term plan. Thus the phones are not (fully) subsidized by the providers and you will have to pay some amount for the phone.

Make a choice among these cell phones and plans by pressing the button below the phone/plan of your choice.

	A-plus	B-ext	Freedom-C
Features			
Price			
	A-plus	B-ext	Freedom-C

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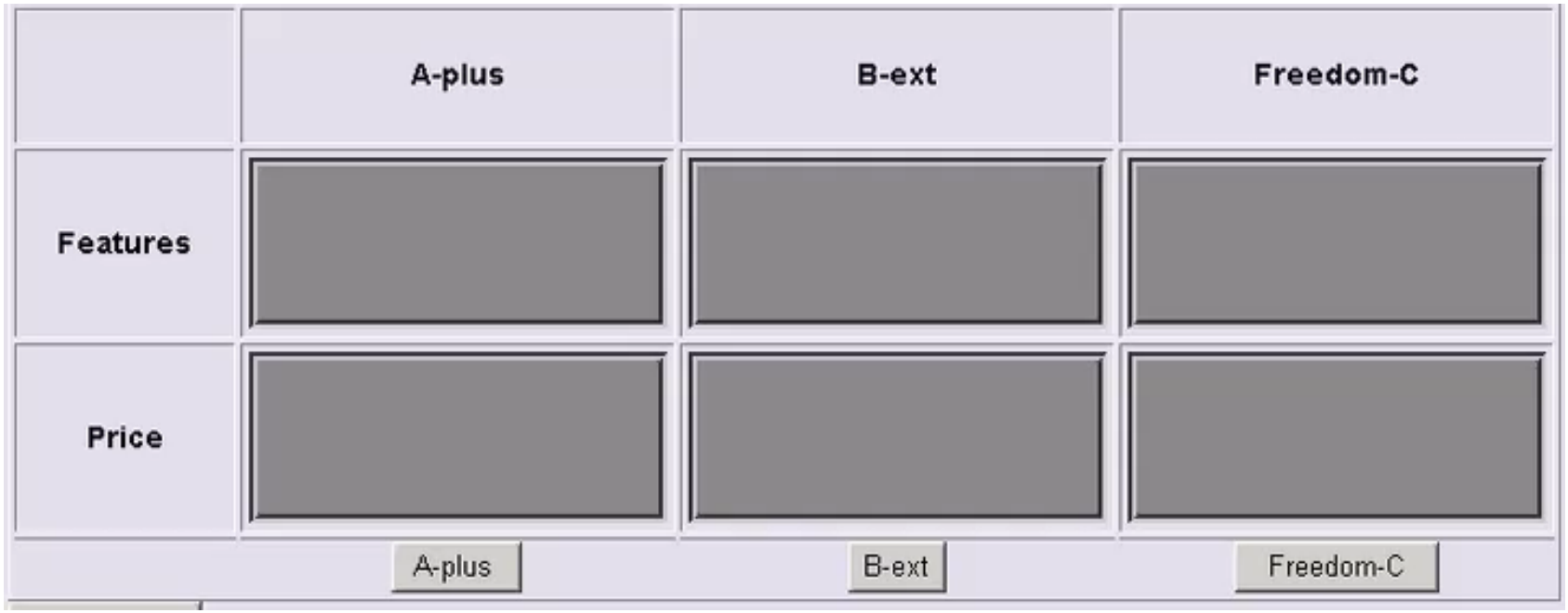
Compromise Movie: subject 5231



Process analysis

Use Icon graphs for each context

Dynamics:

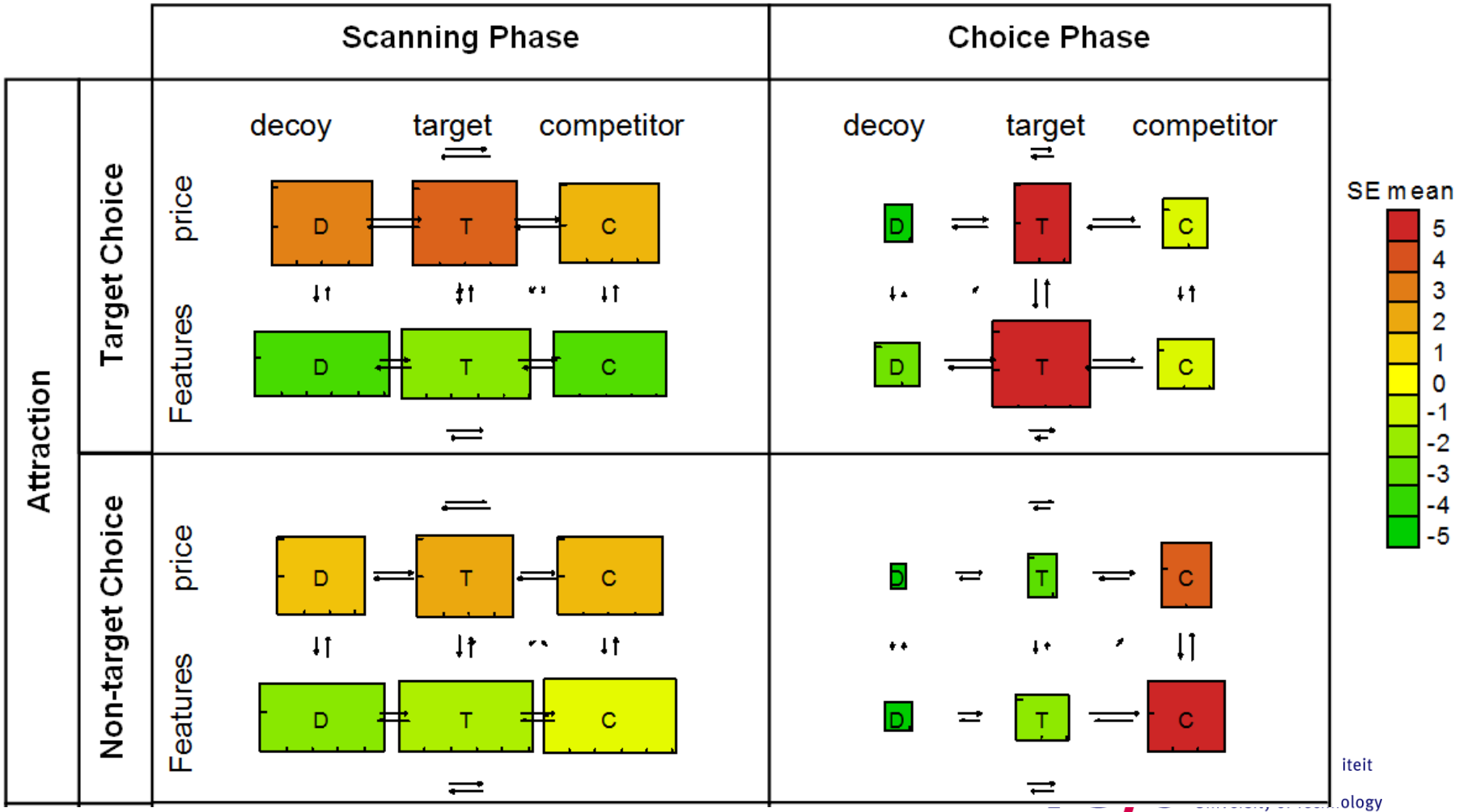
Scanning Phase (all acquisitions until all boxes have been opened once)

Choice phase (all remaining acquisitions)

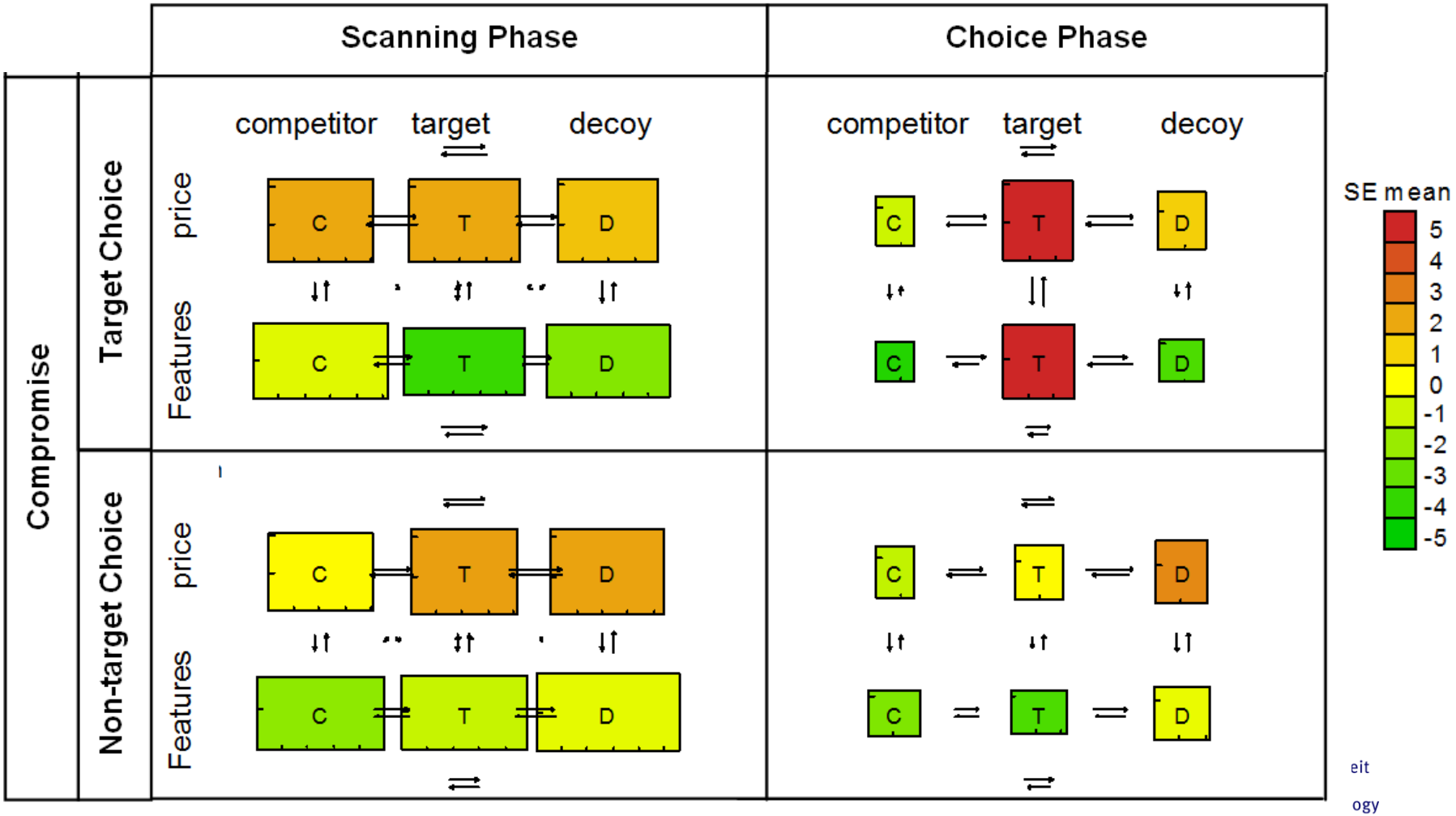
For Choice of target and not

In our multilevel model we contrast target-attention to non-target attention, against choice and time

Icon graphs Attraction



Icon Graphs Compromise

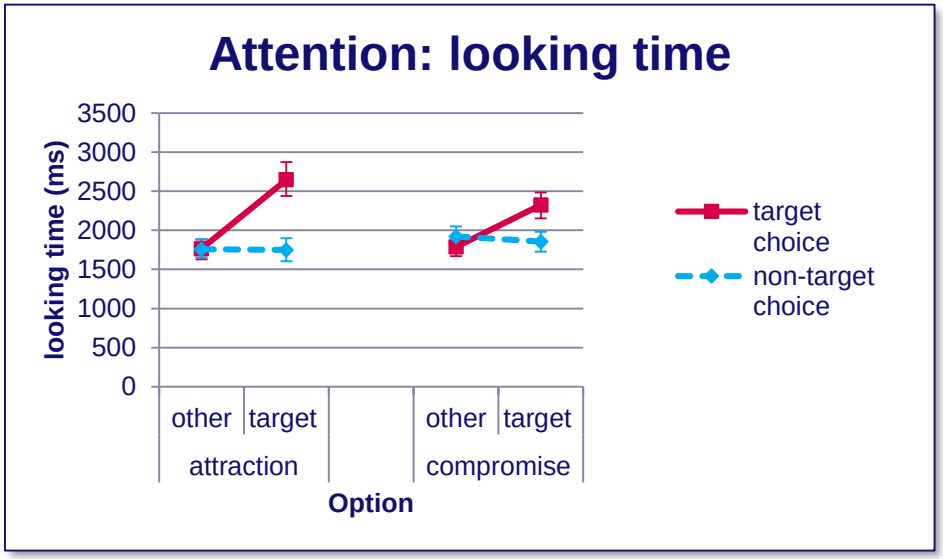


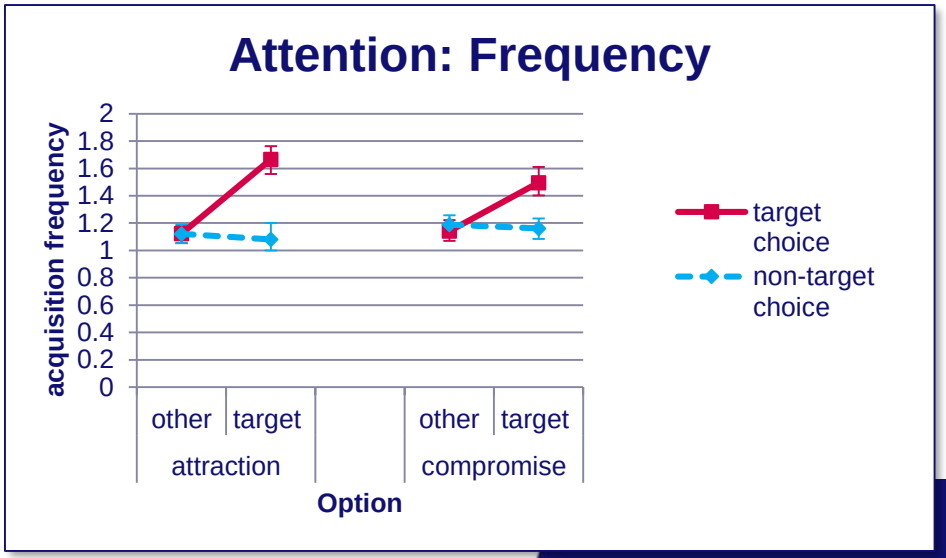
Process Results attention

Estimated means of our contrasts from the model

1. Few differences in attention between context effects

2. Search focuses on the target when it is chosen





How do the contrasts work?

Y's

cluster

X's

Freq	Time	ID	context	phase	option	attribute	CTarget	Ccomp	CT
0	0	789	compromise	scanning	T	price	1	1	-1
1	505	789	compromise	scanning	C	Price	-.5	1	-1
2	2134	789	compromise	scanning	D	Price	.5	1	-1
1	789	789	compromise	scanning	T	features	1	1	-1
0	0	789	compromise	scanning	C	Features	-.5	1	-1
0	0	789	compromise	scanning	D	Features	.-5	1	-1
1	1235	789	compromise	choice	T	price	1	1	1
3	6754	789	compromise	choice	C	Price	-.5	1	1
1	1056	789	compromise	choice	D	Price	-.5	1	1

Attention models

1. Few differences in attention between context effects
2. Search focuses on the target when it is chosen equally for both contexts
3. This effect increases over time for both context
4. And is associated with choice

	Parameters			
	Looking time		frequencies	
Model contrasts	β	SE	β	SE
test 1: attention will differ across contexts				
β_{Target}	0.082 ***	0.012	0.072 ***	0.009
$\beta_{Target \times Comp}$	-0.024 *	0.012	-0.013	0.009
test 2: increased attention to the target is associated with context-dependent choice				
$\beta_{Target \times Ch}$	0.196 ***	0.023	0.185 ***	0.018
$\beta_{Target \times Ch \times Comp}$	-0.037	0.023	-0.037 *	0.018
test 3: Attention to the target option will increase over time in the decision				
$\beta_{Target \times T}$	0.084 ***	0.012	0.069 ***	0.009
$\beta_{Target \times Comp \times T}$	0.002	0.012	-0.004	0.009
test 4: Increases in Attention over time will be associated with choice of the target				
$\beta_{Target \times Ch \times T}$	0.182 ***	0.023	0.204 ***	0.018
$\beta_{Target \times Ch \times Comp \times T}$	-0.012	0.023	-0.001	0.018

And what about order?

Value construction suggests that some presentation orders should install initial leaders easier:

- **Compromise:** target in the middle facilitates its perspective as the compromise (Chang and Liu, 2008)
- If the target is first, it always looses from C or Dc on one attribute, and it will be chosen less often
- **Attraction:** seeing T and D first reveals the dominance structure and boosts the target as an initial leader

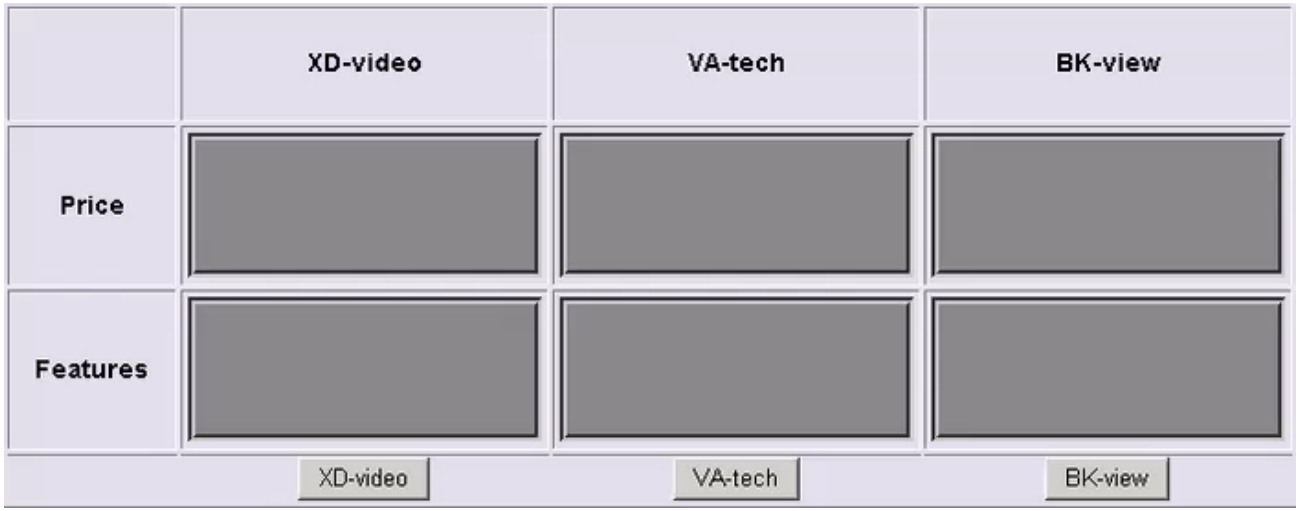
Particular order effects thus support a value construction account

- especially if mediated by process

Movie Attraction: subject 5384

Direct impact of the decoy (DTC order, price first)

D T C

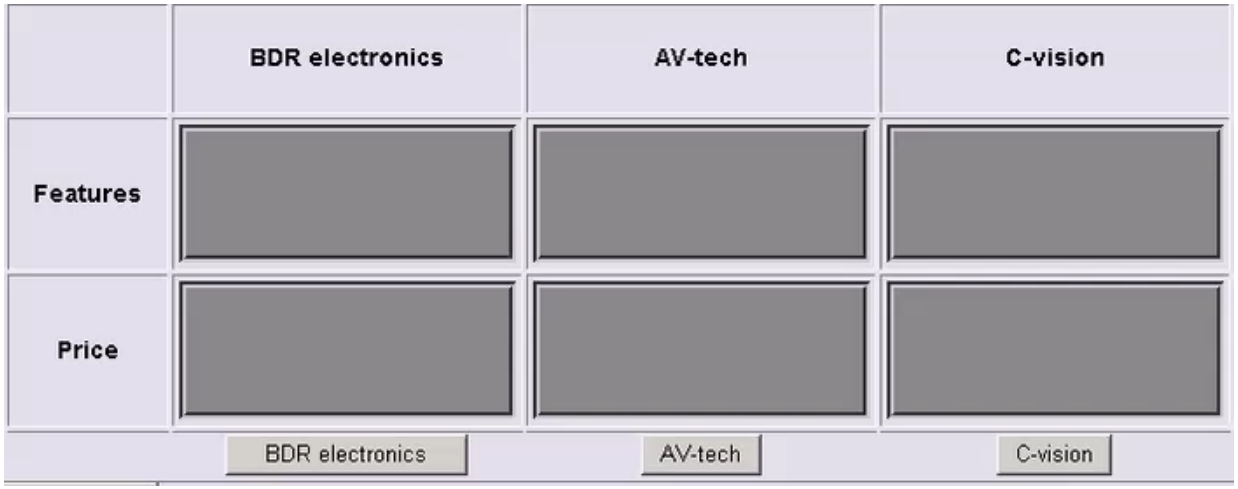


Movie Compromise: subject 5200

Choice for Dc, when T is first (on features)

Strong evidence of directed comparisons

T C D



Order effects

Compromise:

No comp. effect for T first

Strong effects for others first

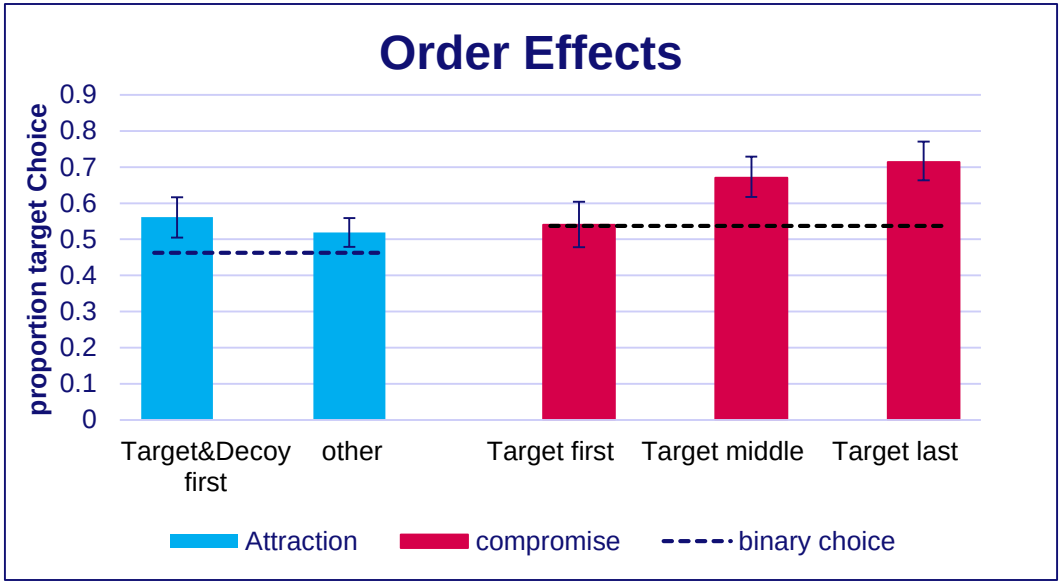
$\beta_{compromise\ T\ middle} = -.783,\ p<.01$

$\beta_{compromise\ T\ last} = -1.03,\ p<.001$

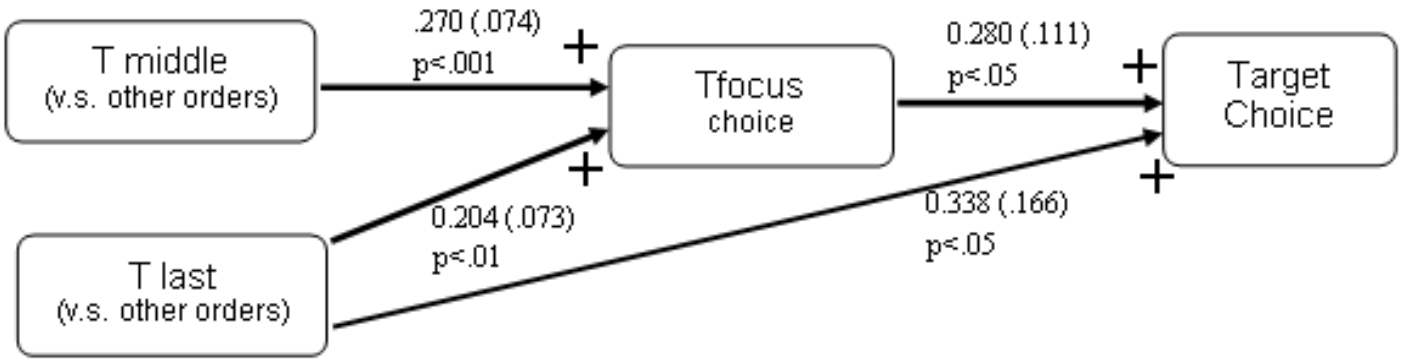
Attraction:

No effect for ‘other’, small effect for TD first

$\beta_{attraction\_TD\ first} = 0.493,\ p<.1$



Mediation Compromise



Indirect effect of T middle on Target Choice is 0.076 (0.039), p=0.055

bootstrap-corrected 90% CI is [0.011, 0.140]

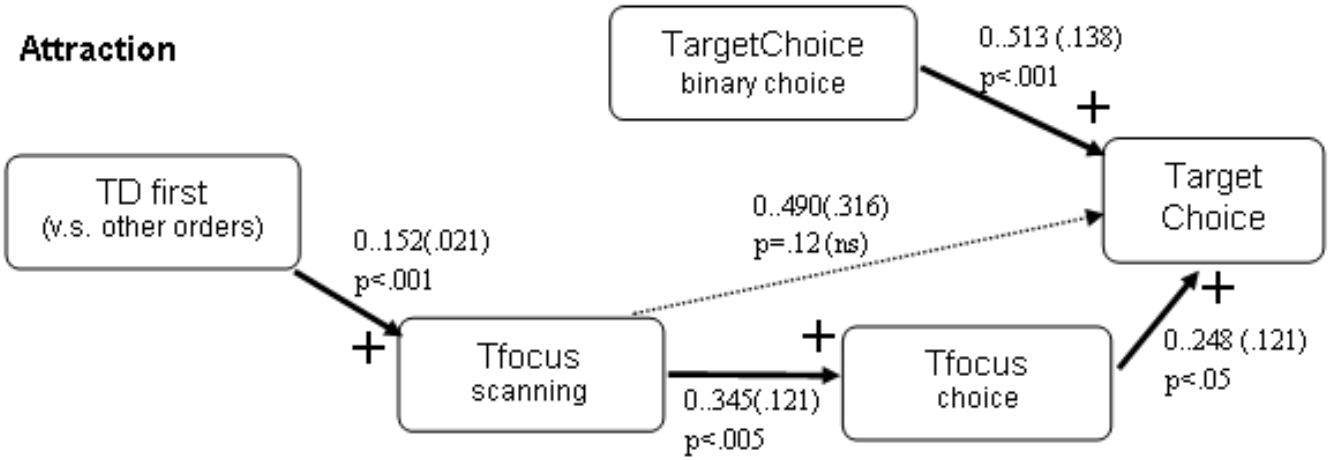
Bootstrap-corrected 95% CI is [-0.002, 0.153]

indirect effect of T last on Target Choice is 0.050 (0.031), p=0.065

bootstrap-corrected 90% CI is [0.006, 0.108]

Bootstrap-corrected 95% CI is [-0.004, 0.118]

Mediation Attraction



Total indirect effects: 0.088 (0.050), p=0.079

Bootstrap-corrected 90% CI: [0.006, 0.170]

Bootstrap-corrected 95% CI: [-0.010, 0.185]

The order effect is mediated by increased attention for the target over the trial

Conclusions Context effects

- Process data provide additional information to compare existing models
  - Drift diffusion models need to incorporate differential attention within an attribute and biased information search towards the target
- Attraction and Compromise can be explained by a leader-driven value construction account
- Order effects are meaningful to understand the causality of the mechanisms proposed

Questions?

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