

Saliency and valuation in decisions

- an online behavioral experiment

Xiaomin Li
Nina Solovyeva

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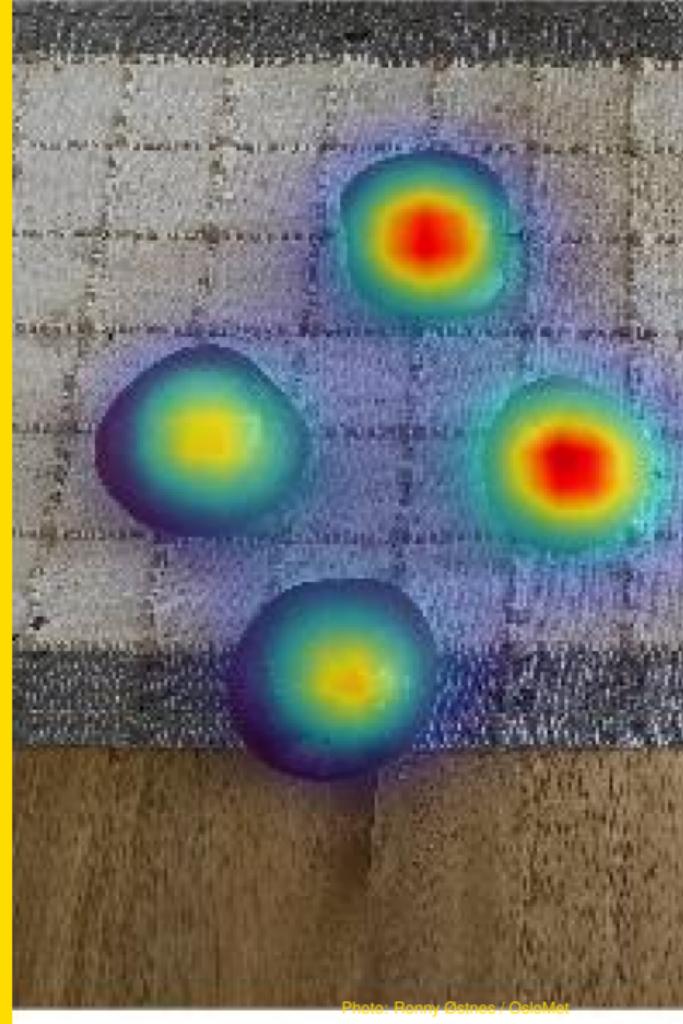


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Research Question

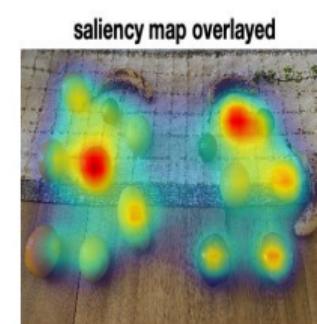
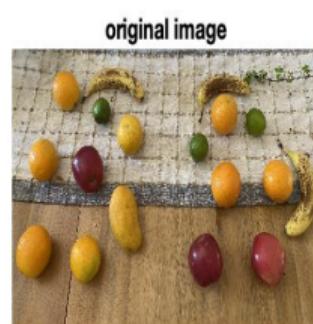
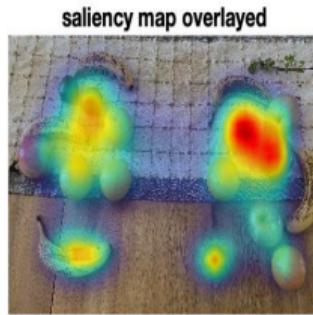
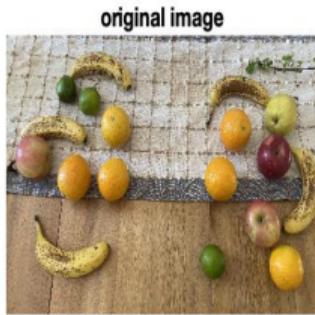
- 1 In simple choice problem, attention and valuation affects decisions
(Krajbich, Armel and Rangel, 2010; Koch et.al,2012, Perona, et.al,2010)
- 2 Previous literature uses measured attention (eye-tracking) and subjectively reported valuation.
- 3 How will attention affect decisions when we control reward values?
 - Can we affect decisions by affecting the representation of the stimuli through saliency?
 - How do valuation and saliency affect choices?
 - How do valuation and saliency affect response time?

Experiment Design



- Subjects choose either left pile or right pile under time pressure.
- Each unit fruit is associated with a monetary amount.
- Pile value = sum of all fruits.
- Two designs:
 - 1) many fruits (left)
 - 2) few fruits (middle)

Saliency and the Stimuli



- Saliency measure is determined from SAM algorithm.
- SAM is trying to predict the attention allocation of the whole image.
- We select only images with one -side saliency center (left example).

Stimulus and Parameters

Two types of stimuli

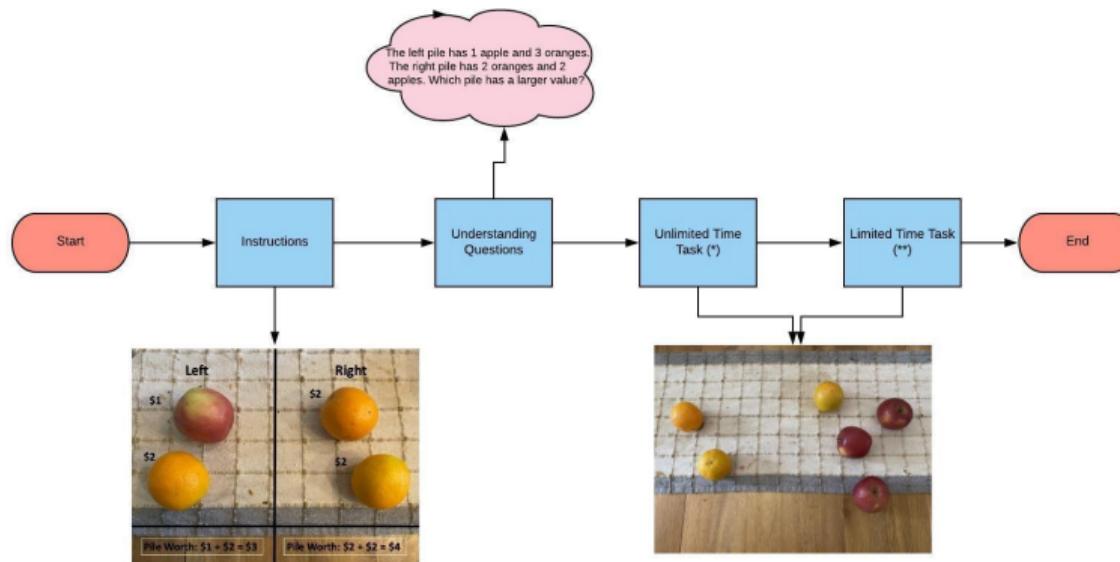
Congruent Condition: The rewarding pile is also the more salient pile.

Incongruent Condition: The rewarding pile is the less salient pile.

- Each subject: 20 image trials, with 10 congruent trials and 10 incongruent trials.
- Value difference: Design 1) 10 images below 5 and 10 images ranging from 5-11 Design 2) ranging from 0.4 - 4
- Left right balanced for saliency
- D1: Six types of fruits, unit value in integers from 3 to 6.
- D2: Two fruits, apple:1.3, orange: 2.2
- Time limit: D1: 20s D2: 10s

Data

- N=25, on Prolific
- People only with approval rate >75%
- Batch 1) many fruits Batch 2) four fruits

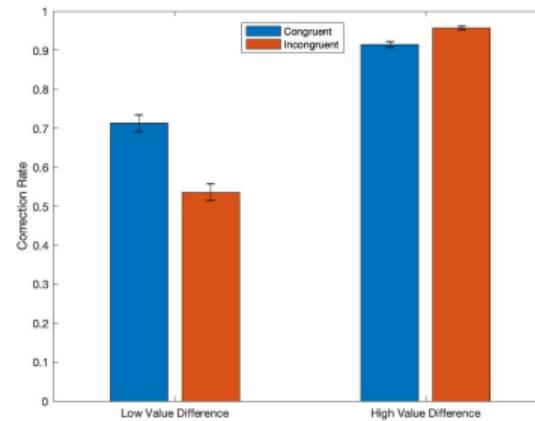
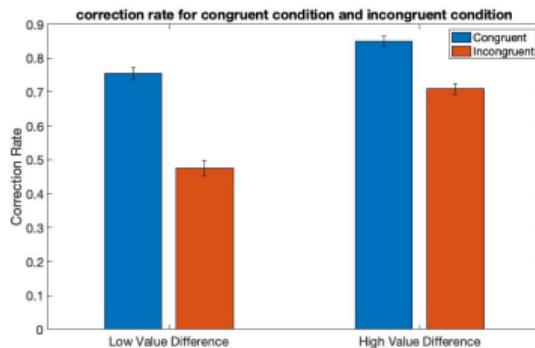


(*): Participants not aware that this part is still training
(**): Part that is used for analysis; 10 sec time constraint

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Result - Error Rate

- People make more mistakes when saliency property conflicts with reward property.
- Such results holds regardless of valuation difference.



Model-Design2

| <i>Dependent variable: Choice</i> | | | | |
|-----------------------------------|----------------------|-----------------------|---------------------|---------------------|
| | (1) | (2) | (3) | (4) |
| Valuation | 1.297*** (0.126) | 1.290 *** (0.199) | 1.238*** (0.121) | |
| Saliency | 0.729*** (0.233) | 0.724 *** (0.258) | | 0.381 ** (0.191) |
| Interaction | | 0.012 (0.258) | | |
| Constant | -0.644*** (0.177) | -0.640 *** (0.199) | -0.251** (0.121) | -0.085 (0.138) |
| Observations | 443 | 443 | 443 | 443 |
| Log Likelihood | -236.477 | -236.476 | -241.538 | -304.372 |
| Akaike Inf. Crit. | 478.955 | 480.953 | 487.076 | 612.744 |

Note:

*p<0.1; **p<0.05; ***p<0.01

| <i>Dependent variable: Correctness</i> | | | |
|--|---------------------|---------------------|---------------------|
| congruency | 1.297*** (0.407) | 0.755*** (0.248) | |
| rt | | | 0.031 (0.050) |
| valueDiff | 1.837*** (0.446) | 1.429*** (0.281) | 1.520*** (0.314) |
| Interaction | -0.914 (0.556) | | |
| Constant | -0.633** (0.282) | -0.412* (0.227) | -0.279 (0.352) |
| Observations | 443 | 443 | 443 |
| Log Likelihood | -197.592 | -198.935 | -203.513 |
| Akaike Inf. Crit. | 403.183 | 403.870 | 413.027 |

| <i>Dependent variable: RT</i> | | | | |
|-------------------------------|----------------------|----------------------|---------------------|----------------------|
| valueDiff | −0.575*** (0.077) | −0.575*** (0.077) | | −0.812*** (0.106) |
| congruency | −0.274 (0.219) | | | −0.971*** (0.305) |
| correctness | | | −0.614** (0.270) | |
| interaction | | | | 0.495*** (0.153) |
| Constant | 5.364*** (0.186) | 5.234*** (0.154) | 4.892*** (0.235) | 5.698*** (0.211) |
| Observations | 443 | 443 | 443 | 443 |
| R ² | 0.115 | 0.111 | 0.012 | 0.135 |
| Adjusted R ² | 0.111 | 0.109 | 0.009 | 0.129 |

Note:

*p<0.1; **p<0.05; ***p<0.01

Model - Design1

| <i>Dependent variable: Choice</i> | | | | |
|-----------------------------------|----------------------|---------------------|---------------------|--------------------|
| Rewarding | 0.913*** (0.116) | 0.887*** (0.192) | 0.773*** (0.106) | |
| Salient | 0.876*** (0.214) | 0.857*** (0.241) | | 0.395** (0.184) |
| Value*saliency | | 0.040 (0.241) | | |
| Constant | -0.492*** (0.159) | -0.474** (0.192) | -0.013 (0.106) | 0.090 (0.128) |
| Observations | 489 | 489 | 489 | 489 |
| Log Likelihood | -296.478 | -296.464 | -305.405 | -331.742 |
| Akaike Inf. Crit. | 598.956 | 600.929 | 614.811 | 667.484 |

Note:

*p<0.1; **p<0.05; ***p<0.01

| <i>Dependent variable: correctness</i> | | | | |
|--|---------------------|---------------------|---------------------|---------------------|
| | (1) | (2) | (3) | (4) |
| congruency | 0.979*** (0.343) | 0.867*** (0.213) | | 0.985*** (0.219) |
| valueDiff | 0.103*** (0.036) | | 0.082*** (0.029) | 0.103*** (0.030) |
| interaction | 0.001 (0.066) | | | |
| Constant | -0.071 (0.214) | 0.457*** (0.120) | 0.383** (0.162) | -0.073 (0.192) |
| Observations | 489 | 489 | 489 | 489 |
| Log Likelihood | -290.304 | -296.601 | -301.186 | -290.304 |
| Akaike Inf. Crit. | 588.607 | 597.203 | 606.371 | 586.608 |

| <i>Dependent variable: Response Time</i> | | | |
|--|-----------------------|-----------------------|-----------------------|
| | (1) | (2) | (3) |
| valueDiff | -0.162** (0.063) | -0.083 (0.081) | -0.156** (0.063) |
| congruency | -0.342 (0.460) | 0.593 (0.763) | |
| interaction | | -0.198 (0.129) | |
| Constant | 9.048*** (0.441) | 8.632*** (0.517) | 8.882*** (0.380) |
| Observations | 489 | 489 | 489 |
| R ² | 0.014 | 0.018 | 0.012 |
| Adjusted R ² | 0.010 | 0.012 | 0.010 |
| F Statistic | 3.351** (df = 2; 486) | 3.026** (df = 3; 485) | 6.153** (df = 1; 487) |

Note:

*p<0.1; **p<0.05; ***p<0.01