Individual Differences in Delay Discounting

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Delay discounting refers to the decrease in value of a reward the longer it takes to arrive. Choosing between a smaller sooner and a larger later reward depends on delay discounting.

Delay discounting deficits are evident in addiction and gambling disorders with individuals producing impulsive choice behavior.

Delay discounting is a combination of two factors; time taken to receive reward – reward delay and size of reward – reward magnitude.

Deficits in delay discounting can be a result of deficits in timing reward delay or reward magnitude deficits.
Background

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Delay discounting is a combination of two factors; time taken to receive reward – reward delay and size of reward – reward magnitude.

Deficits in delay discounting can be a result of deficits in timing reward delay or sensitivity to reward magnitude.
SSLL Delay Discounting

Choice between:

**Response A** –
*Short delay Small magnitude*

**Response B** –
*Long delay Large magnitude*

**Between phase manipulations**

<table>
<thead>
<tr>
<th>Reward delay (SS)</th>
<th>SS 1 pellet</th>
<th>v</th>
<th>LL 2 pellet</th>
</tr>
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<tbody>
<tr>
<td>2.5s</td>
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**SSLL Delay Discounting**

Choice between:
- **Response A** – **S**hort delay **S**mall magnitude
- **Response B** – **L**ong delay **L**arge magnitude

**Between phase manipulations**

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**SSLL Delay Discounting**

**Choice between:**
- **Response A** – Short delay Small magnitude
- **Response B** – Long delay Large magnitude

**Percent LL choice**

- 2.5s < 5s+ 5s < 30s 10s < 15s+ 1p < 2p+ 2p < 3p
Individual Differences in Reward Delay and Magnitude

Measure **reward timing** while keeping reward magnitude constant

**Temporal discrimination** (Bisection)

Measure **reward magnitude** sensitivity while keeping reward delay constant

**Reward contrast**

Correlate these measures to choice behavior
Individual Differences in Reward Delay and Magnitude

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**Reward contrast**

Correlate these measures to choice behavior
Reward Delay Sensitivity

Temporal Discrimination

Signal  4s (Short) or 12s (Long)

Short – Response A – 1 pellet
Long  – Response B – 1 pellet

Test with intermediate durations
Reward Delay Sensitivity

Temporal Discrimination

Signal  4s (Short) or 12s (Long)

Short – Response A – 1 pellet
Long – Response B – 1 pellet

Test with intermediate durations
Reward Delay Sensitivity

Temporal Discrimination

Signal  4s (Short) or 12s (Long)

Short – Response A – 1 pellet
Long – Response B – 1 pellet

Test with intermediate durations

Test duration

Proportion of Long Responses

PSE v 3 Pellet

R² = 0.4039

Percentage LL Choice

PSE

R² = 0.2185

app sig

DL v 5s

DL

R² = 0.2185
Reward Magnitude Sensitivity

Reward Contrast
Discrete trials: Small : Lever A inserted
Large : Lever B inserted

Small Large
Baseline Phase – VI30 1 pellet VI30 1 pellet
Contrast Phase – VI30 1 pellet VI30 4 pellet
Reward Magnitude Sensitivity

Reward Contrast
Discrete trials: Small: Lever A inserted
Large: Lever B inserted

Small
Baseline Phase – VI30 1 pellet
Contrast Phase – VI30 1 pellet

Large
VI30 1 pellet
VI30 4 pellet

Discrimination Ratio – Baseline v Contrast

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<tr>
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<tr>
<td>0.4</td>
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<td></td>
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</tr>
<tr>
<td>0.9</td>
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**Reward Magnitude Sensitivity**

**Reward Contrast**

**Discrete trials:**
- **Small:** Lever A inserted
- **Large:** Lever B inserted

**Small**
- Baseline Phase – VI30 1 pellet
- Contrast Phase – VI30 1 pellet

**Large**
- Baseline Phase – VI30 1 pellet
- Contrast Phase – VI30 4 pellet

**Discrimination Ratio**

- Small v 2 Pellet
- Small v 3 Pellet
- Large v 2 Pellet
- Large v 3 Pellet

**R²** values:
- Small v 2 Pellet: 0.7996
- Small v 3 Pellet: 0.3939
- Large v 2 Pellet: 0.6216
- Large v 3 Pellet: 0.3494
Conclusions

Large individual differences in choice behavior in a standard population

Delay discounting is correlated to sensitivity to both reward delay and reward magnitude

Determining where the individual deficit lies – sensitivity to reward delay or reward magnitude - can be used as both a predictor of individual choice behavior and to develop intervention therapy for impulsive choice disorders