

Reward processing, timing, and impulsivity

Kimberly Kirkpatrick
Kansas State University

The Marshmallow Test

“The Marshmallow Test”

Smaller-Sooner



4-yr old child

Larger-Later



= higher SAT scores
better social skills
better coping skills

Mischel, Shoda & Rodriguez (1989)

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“Impulsive”

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“Self-control”

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“Self-control”



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Impulsivity as a trait variable

- Kirby (2009) – tested impulsive choice in 100 undergraduate students and then retested again 5 weeks later and 1 year later
 - Test-retest reliability of .77 at 5 weeks
 - Test-retest reliability of .63 at 1 year
 - Similar to personality traits
- Mischel, Shoda & Rodriguez (1989)
“marshmallow test” results are also consistent with impulsivity as a trait variable
- Two main factors in determining trait variables
 - Genetics
 - Environment

Impulsivity and drug abuse

- Impulsivity is correlated with drug abuse in humans (e.g., Businelle et al., 2010; Diergaarde et al., 2008)
- Exposure to cocaine has been associated with increased impulsive choice (e.g., Simon, Mendez, & Setlow, 2007)
- Impulsivity predicts self-administration of cocaine in rats (Perry et al., 2005)
- Some have argued in favor of screening for impulsivity as a part of drug abuse prevention efforts (e.g., Kreek et al., 2005)

Smaller-sooner (SS) vs. Larger-later (LL) choice paradigm

- Smaller-sooner choice (SS)



- Larger-later choice (LL)

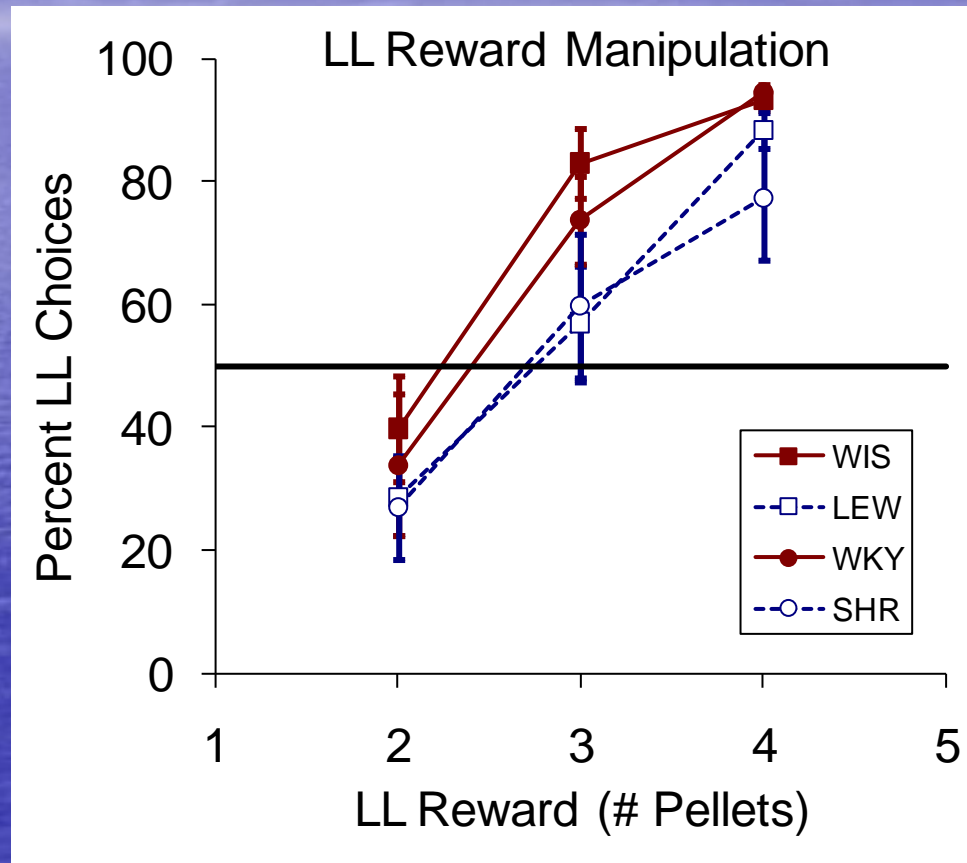


- Intermixture of free choice and forced choice trials
- Vary SS delay and/or LL amount
- Add occasional peak trials for SS and LL to test their timing of the expected food delivery

Experiment 1: Genetic factors

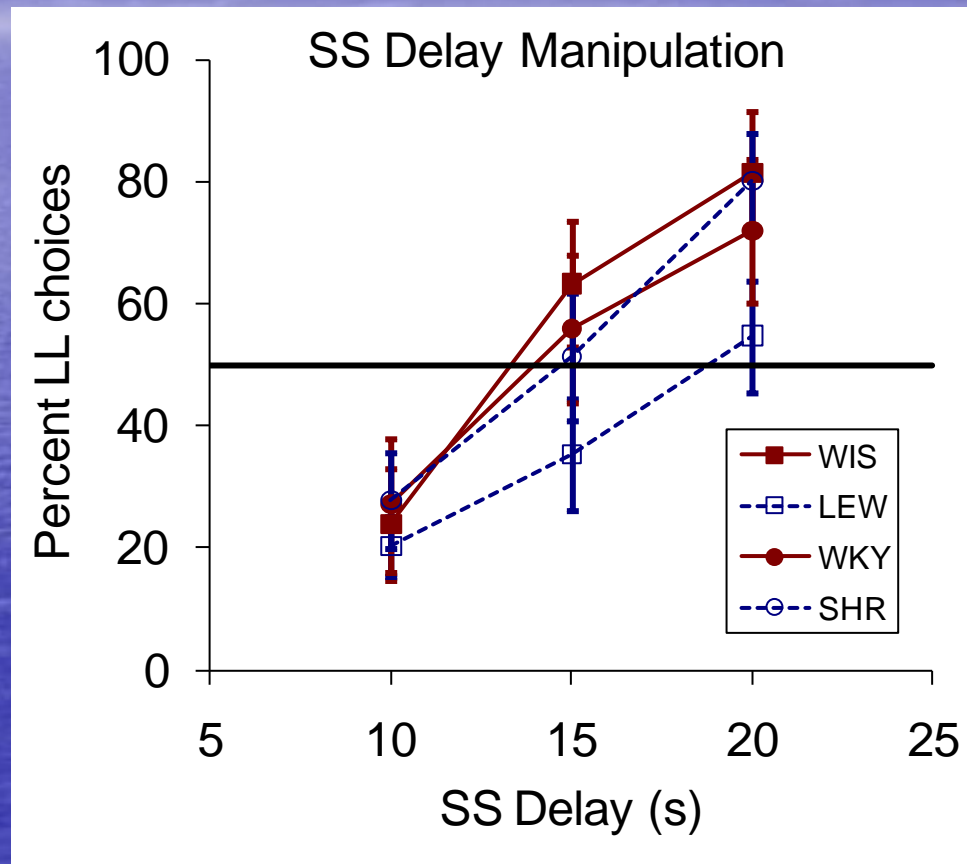
- Four strains:
 - Spontaneously hypertensive rats (SHR) – model of ADHD
 - Wistar Kyoto (WKY) – Control for SHR
 - Lewis (LEW) – Reported to show impulsive choice
 - Wistar (WIS) – Control for LEW
- SS vs. LL choice procedure
 - Mixture of forced choice, free choice, and peak trials
- Baseline: 10 s 1 pellet (SS) vs. 30 s 2 pellets (LL)
- SS delay change: SS increased to 15 s, then to 20 s
- LL amount change: LL increased to 3 pellets, then to 4 pellets

Experiment 1 Results: Reward Magnitude Manipulation



Garcia (2011) Master's thesis

Experiment 1 Results: Timing Manipulation



Summary

- SHR rats did not exhibit impulsive choice in either the magnitude or delay condition
 - May not be a good model for studying impulsivity and addiction
- LEW may be a potential model of impulsivity
 - But, only for delay manipulations
 - See also Madden et al. (2008)
 - LEW may have trouble integrating delay information into their decision-making

Experiment 2: Environmental factors

Impoverished (n = 9)

- 30 days
- Minimal handling
- Individual housing with no novel objects



Enriched (n = 9)

- 30 days
- Daily handling
- Group housing with daily toy changes



Experiment 2: Environmental factors

Phase

1

2

3

Delay discounting

SS: 10 s, 1 pellet

LL: 30 s, 2 pellets

Reward sensitivity

SS: 30 s, 1 pellet

LL: 30 s, 2 pellets

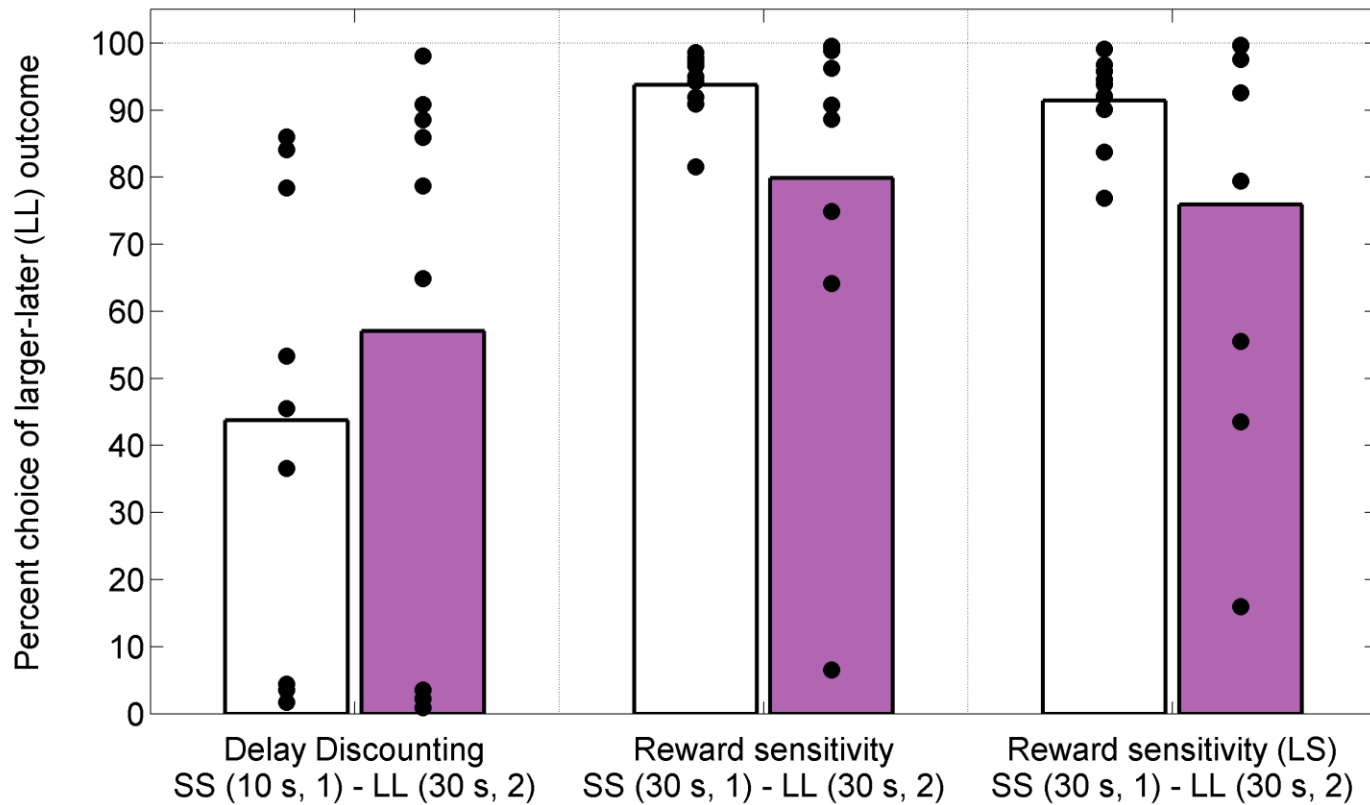
Reward sensitivity

SS: 30 s, 1 pellet

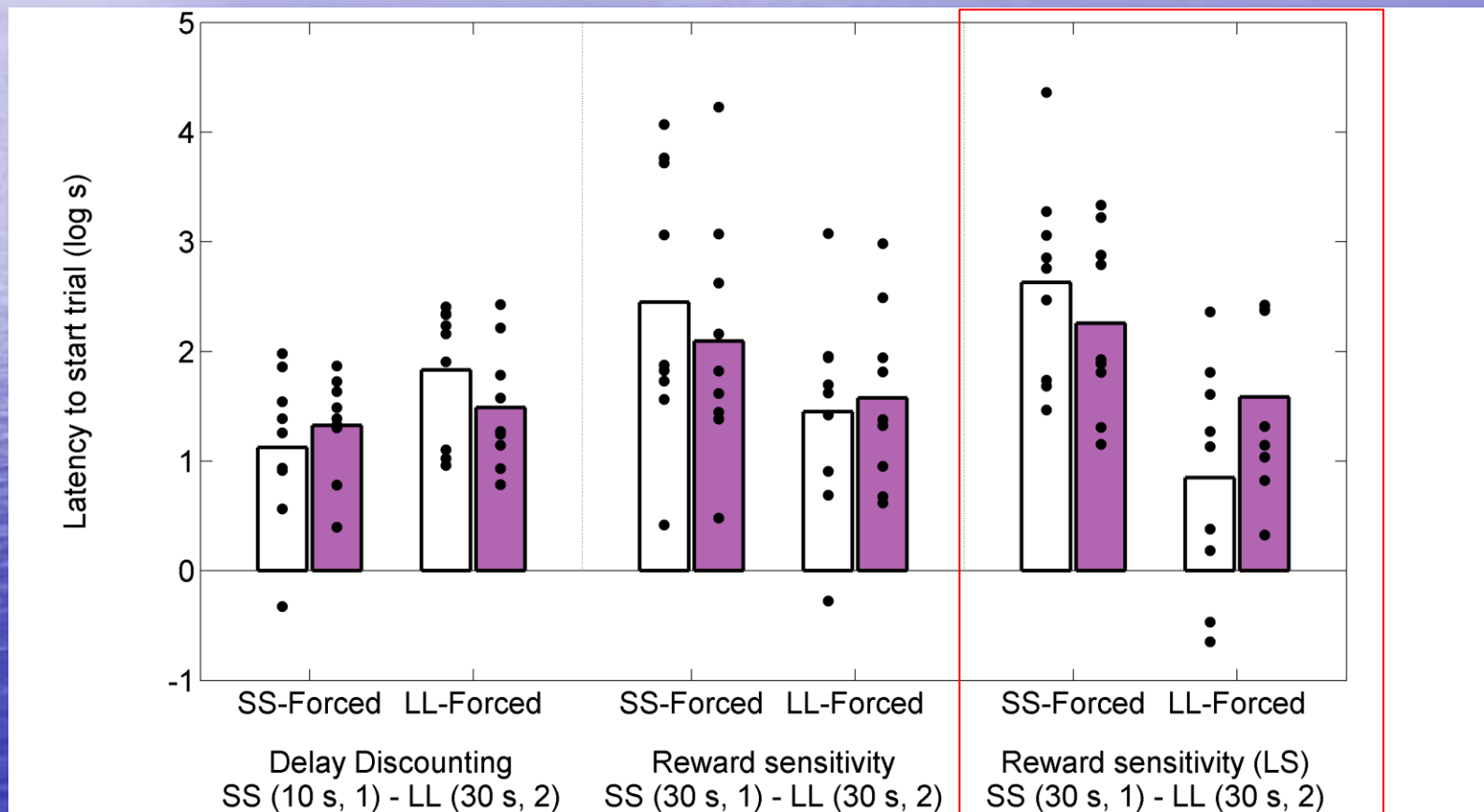
LL: 30 s, 2 pellets

(Lever swap)

Experiment 2 Results



Experiment 2 Results



Summary

- Environmental enrichment did not produce any effects on basic impulsive choice, but it did produce decreases in reward discrimination
- There may be a general downward modulation of the sensitivity to rewards that could provide a protective effect against drug taking and abuse

Acknowledgements

- Genetic effects on impulsivity
 - Ana Garcia
- Environmental effects on impulsivity
 - Andrew Marshall, Jacob Clark, Angela Crumer and Mary Cain

The background is a smooth blue gradient, transitioning from a lighter blue at the top to a darker blue at the bottom. On the left side, there is a bright, glowing area that resembles a sun or moon reflecting on water, creating a shimmering effect. The overall appearance is clean and professional.

Questions?