

Innovation Heuristics

Experiments on Sequential Creativity in Intellectual Property

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Sequential Innovation

Creativity and Innovation are not static.

They emerge from previous ideas and inventions.

IP law is really Sequential Innovation Law

All IP doctrines are really about governing sequential innovation issues:

Who? – derivative works; doctrine of equivalents

When? – duration

How? – fair use; experimental use

The Borrow/Innovate Decision

When thinking about creating something in a field that is full of IP-protected ideas, people are faced with a choice:

- 1) Borrow from existing ideas and obtain a license
or
- 2) Innovate - “invent around” the existing ideas

Similar to the “**make or buy**” decision at the heart of Theory of the Firm.

see Buccafusco, Sprigman & Bechtold (draft)

The Borrow/Innovate Decision

How should they decide what to do?

- Borrowing is costly because it requires a license.
- But innovating is risky because it is hard to know how much “innovation space” is available.

The Borrow/Innovate Decision

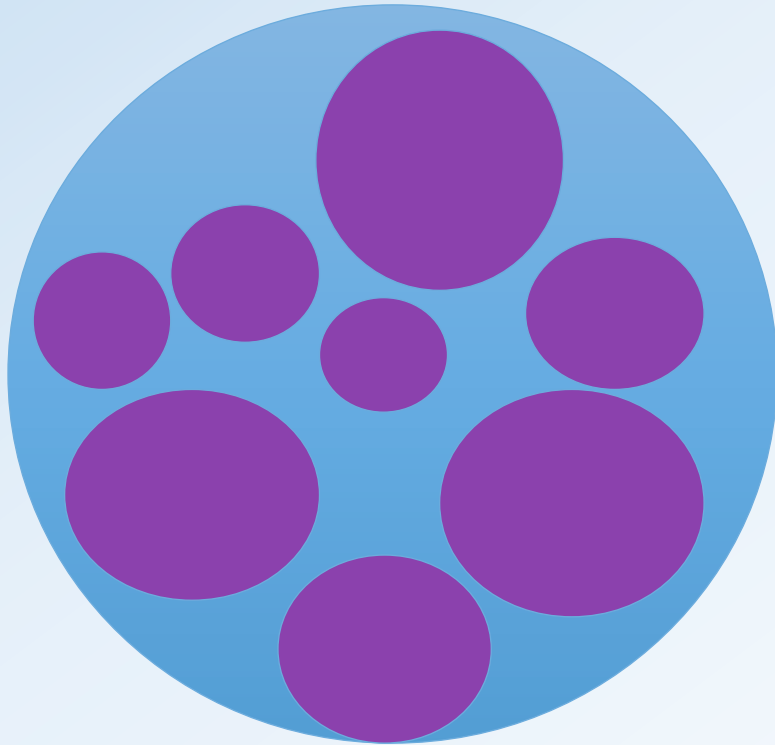
This generates two hypotheses:

- 1) *Creators will innovate more as the cost of licensing IP increases.*
- 2) *Creators will innovate less as the size of the innovation space shrinks.*

Innovation Space

Field

Patents/Copyrights



Our Experiments









How do creators actually make these sorts of decisions?

Are creators sensitive to changes in the costs of innovating and to changes in the scope of the innovation space?

Do they assess these changes accurately and rationally?

Wagon Task

In two experiments subjects play a *convergent thinking* creativity game based on the “knapsack problem.”

 Ammunition V = \$2 W = 3	 Bacon V = \$3 W = 4	 Elk Jerky V = \$6 W = 5	 Forged Iron V = \$9 W = 13
 Coffee V = \$4 W = 6	 Dried Fruit V = \$5 W = 3	 Guns V = \$6 W = 2	 Hard Tack V = \$5 W = 4

Items



Wagon

Weight limit = 14

Wagon Task

- Subjects are told that another subject has already played the game before them and that the other subject's performance may affect their own.
- Players will get 1 point for each % of the optimal solution value as their Submission Score (SS).
- Property rule:
 - 2 or fewer = Innovating
 - 3 or more = Borrowing
- Paid \$0.50 for participating and an additional \$0.03 per point scored.

Wagon Task

- This is an NP-hard problem that can be played within the time frame but is difficult to optimize.
- It requires heuristic cognition to solve.
- Multiple benefits from this game:
 - Allows objective scoring.
 - Easy to define a property rule.
 - Easy to measure the available innovation space.

Scrabble Task

Subjects were given a set of letters and told to create a list of six words using the letters.

Another subject had provided a list of words that could be borrowed. E.g. *zek, peak, pea, zap, key, aye*



Property Rule:

2- words = Innovating

3+ words = Borrowing

Paid \$0.50 for participating and an addition \$0.01 per point scored.

The Costs of Innovating

In the first two experiments we test the degree to which creators are sensitive to changes in the costs of innovating and borrowing.

Experiment 1: Wagon Bonuses

- Subjects are told that when they get to the game the items used in the other player's submission will be highlighted in yellow.
 - **NOT** told how good the provided solution is.
- Subjects are told that their own payment will be based on how many of the items from the other player's submission they use in their own submission based on the following formula:

Use 3 or more items	Use 2 or fewer items
SS	SS + bonus

- This creates an incentive to engage in innovation.

Experimental Variables

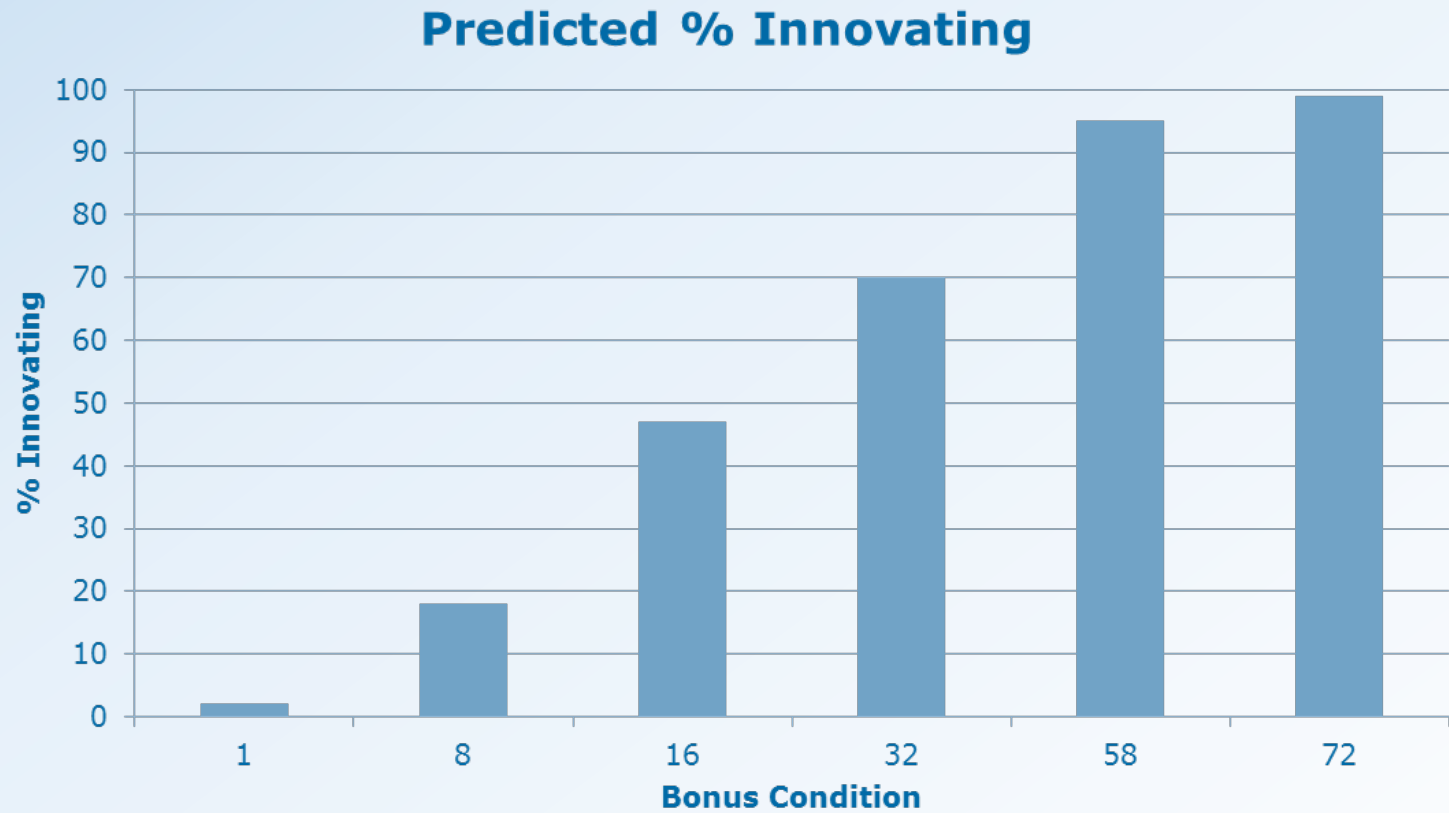
Subjects were randomly assigned to one of six bonus conditions:
+1, +8, +16, +32, +58, +72

We are able to estimate the *rational indifference point* for most subjects to be between 10 and 20 bonus points.

Thus, because innovating is more difficult than borrowing, very few subjects in the +1 condition should choose to innovate.

On the other hand, when the bonus is as high as +58 or +72, we should see almost all subjects innovating.

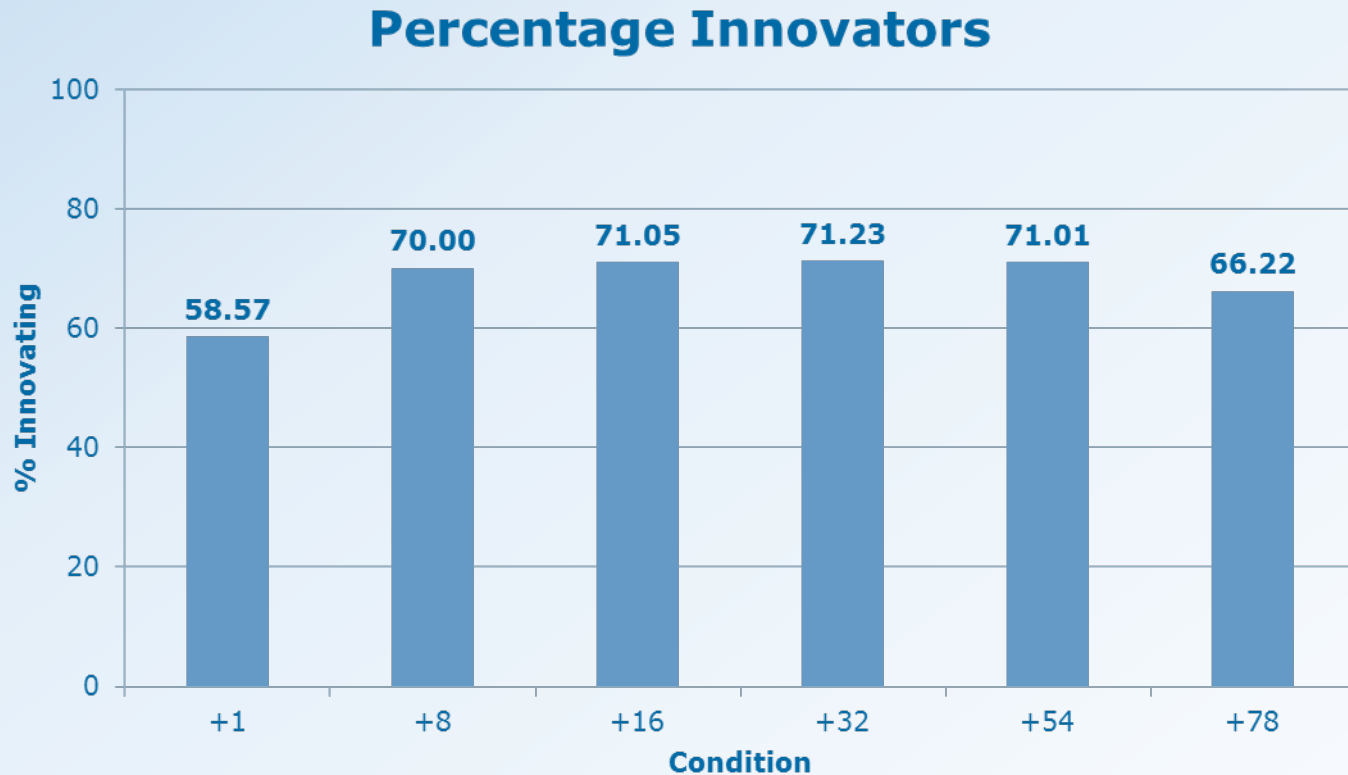
Expected Results



Experiment 1: Data

- We ran the experiment on Amazon Mechanical Turk using lay people as subjects.
- 598 subjects (58.8% male) played the game, answered comprehension questions, and answered demographic questions (including personality inventory).
- We removed 153 subjects who failed either an attention check or either of the comprehension questions.
- Created a dummy variable for Innovate/Borrow based on whether the subject used 2 or fewer items from the given solution.

Innovation by Condition



+1 vs. +8 Conditions:

One tailed t-test, $p = 0.079$; two-tailed t-test, $p = 0.159$.

All other comparisons non-significant.

Experiment 1: Results

There are three strange things about these results:

- 1) There is very little difference between the bonus conditions.
- 2) People in the +1 condition are borrowing at a suboptimal rate. Only ~41% borrow when it is rational.
- 3) People in the +58 and +72 conditions are innovating at a suboptimal rate. These numbers should be very close to 100%.

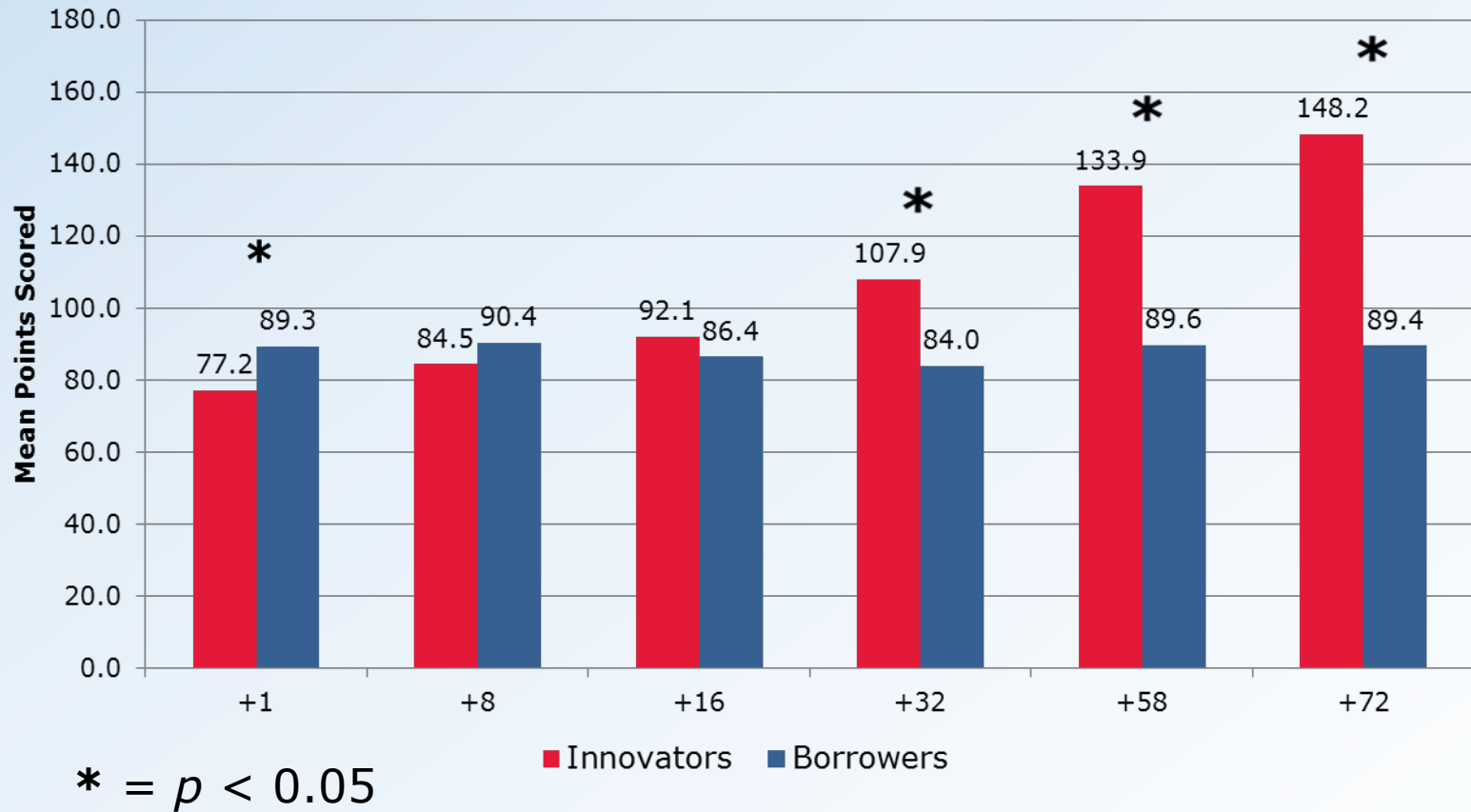
Due to #2 and #3, we see lost “welfare”

~8% decrease in +1 condition

~15% decrease in +72 condition

Suboptimal Behavior

Mean Scores of Innovators and Borrowers



What's Going On?

Maybe people are not trying or don't understand.

BUT, people's decisions appear to be based on some degree of rationality:

The easier they thought it was to innovate, the more likely they were to innovate.

*** Subjective beliefs matter more than objective values.

Experiment 2: Scrabble Bonuses

Subjects were given a set of letters and told to create a list of six words using the letters.

Another subject had provided a list of words that could be borrowed.



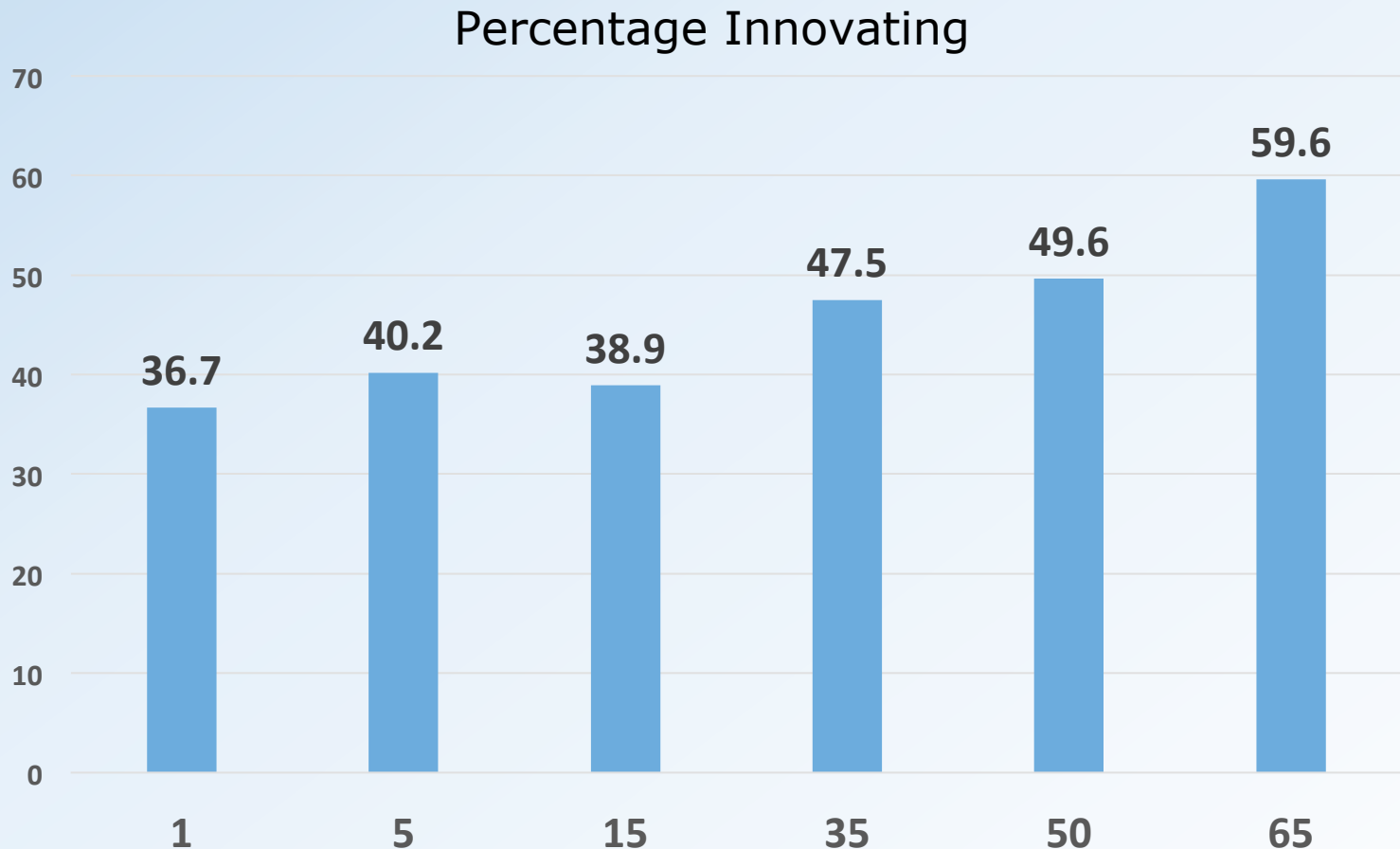
Other Player's Words:

zek, peak, pea, zap, key, aye

Bonus Conditions:

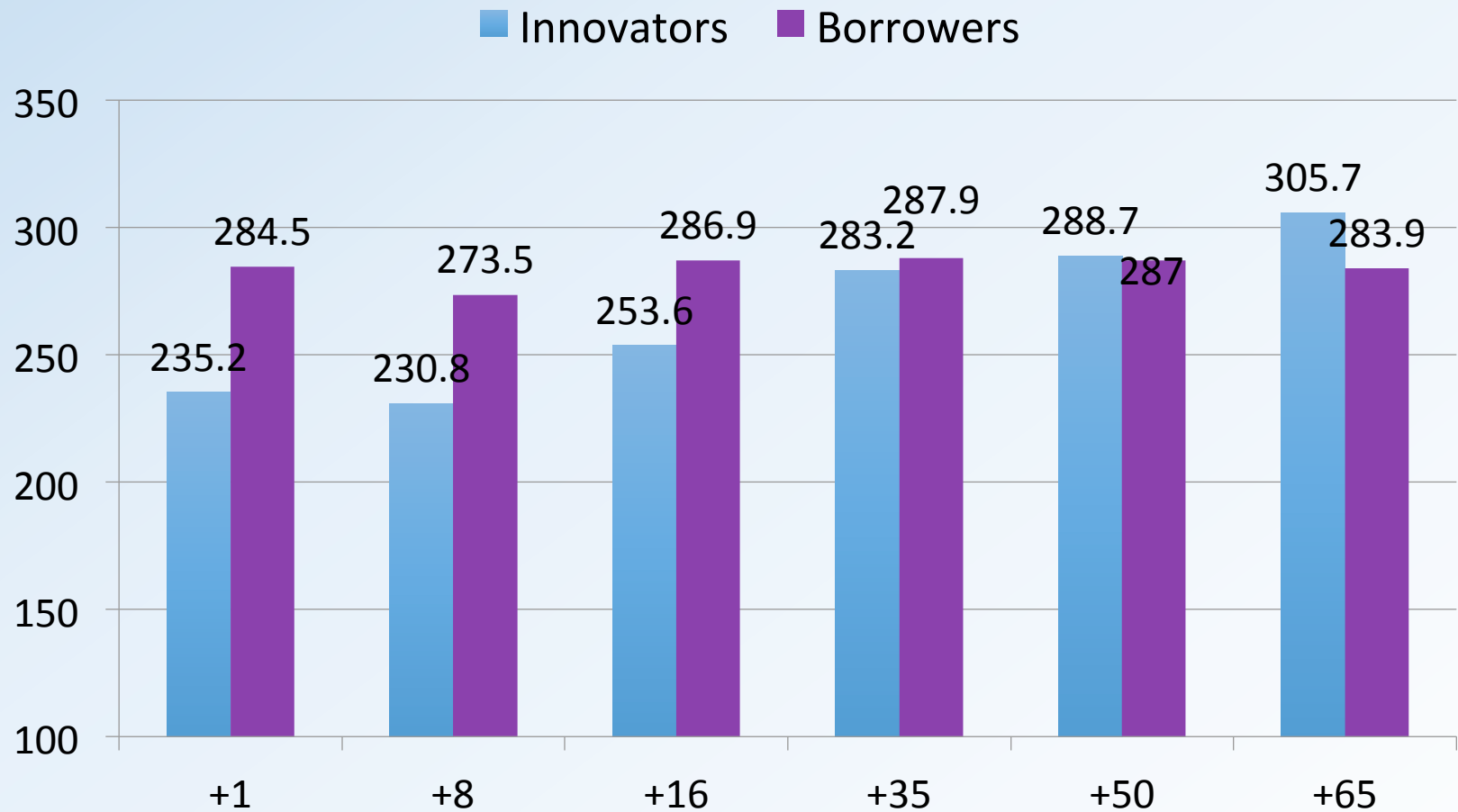
+1, +5, +15, +35, +50, +65

Experiment 2: Scrabble Results



Here, Bonus Size is a significant predictor of Innovation.
But there is still lots of suboptimal behavior.

Mean Scores Per Condition



Experiments 1 & 2: Interpretations

Our subjects were shockingly insensitive to large changes in the incentives associated with innovation.

In regression analyses of innovation behavior we do NOT see significant effects for:

Age, Gender, Risk Tolerance, Math/Verbal Ability, Education

Some, but limited, data on personality: openness to new experience

We DO see significant effects for self-reported ease of innovating.

This was enormously highly correlated with innovation.

Experiments 3 & 4: Innovation Space

The decision whether to innovate or borrow should also be based on the size of the available innovation space.

The easier it is to innovate, the more creators should do so.

But estimating the size of the innovation space is **hard**.

How well do creators do at it?

Experiment 3: Wagon Quality

The scope of the innovation space should affect people's innovate/borrow decisions.

The broader the scope of the existing ideas, the harder and more costly it is to innovate.

Here, we consider whether creators are responsive to changes in the **scope of innovation space** that arise from the quality of the underlying ideas.

Experiment 3 – Wagon Quality

HYPOTHESIS:

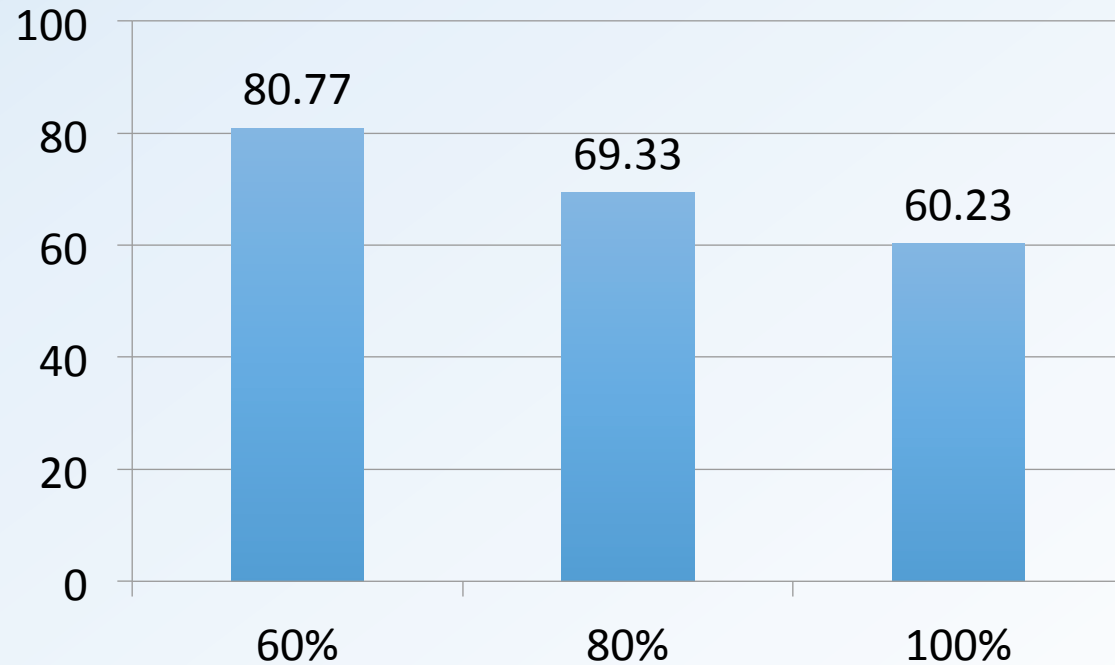
- As the scope of the innovation space decreases, the amount of innovating should also decrease.
- 3 Conditions varying the Quality of the Given Solution
 - All conditions are offered the same Innovation Bonus (+16)
 - 60% - expect high levels of innovation
 - 80% - expect intermediate level of innovation
 - 100% - expect low levels of innovation
- Subjects are not told how good the solutions are.

Exp. 3 – Data

- Recruited 303 subjects on Mturk
 - 59.3% male
 - 33.04 mean age
- Paid the same as in Experiment 1.
- Excluded 62 subjects who missed one or more of the comprehension or attention questions.

Exp. 3 – Innovation Behavior

% Innovating



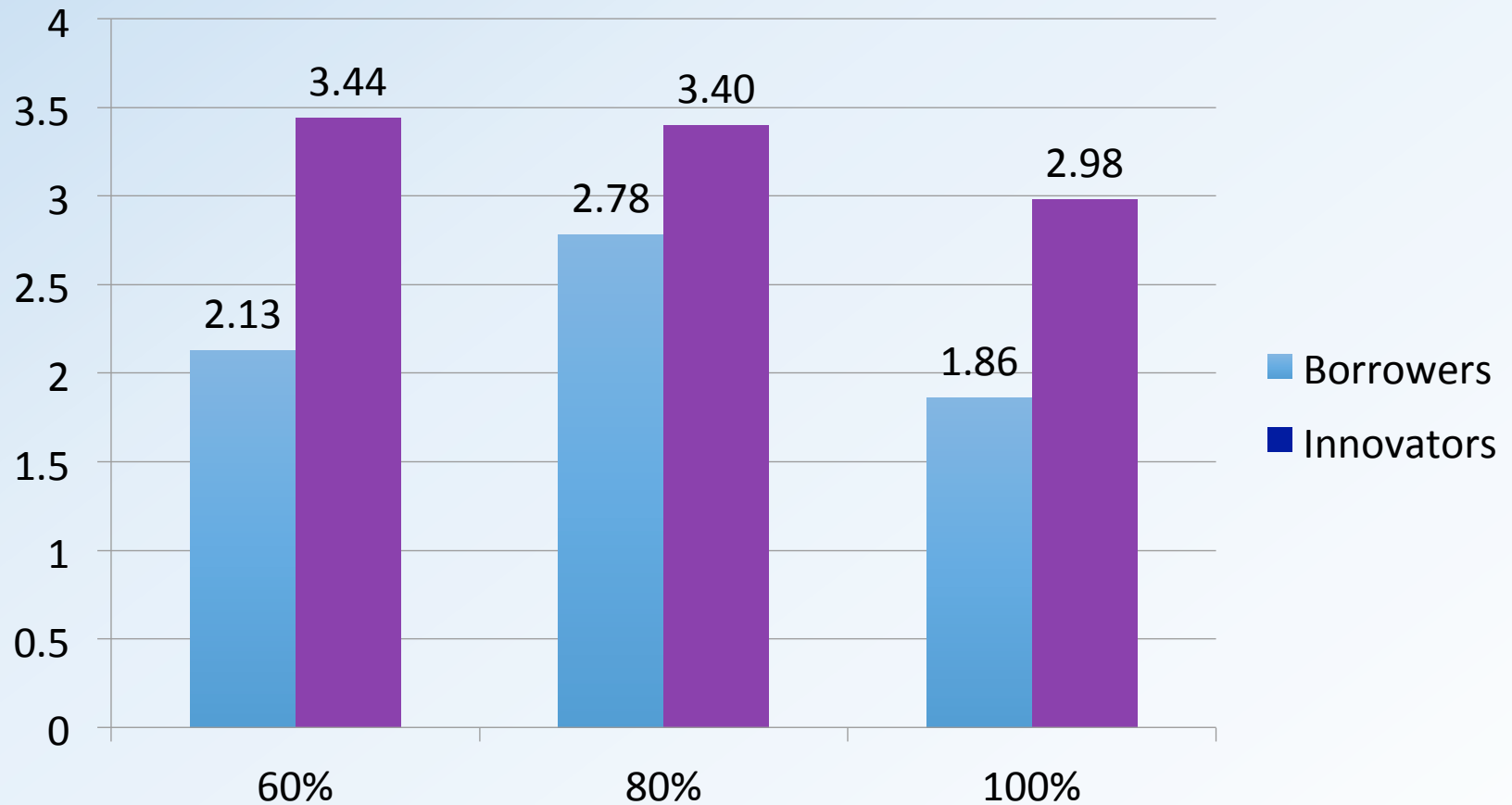
chi square tests

60 vs. 80: $p = 0.102$

60 vs. 100: $p = 0.004$

80 vs. 100: $p = 0.231$

Experiment 3: Ease of Innovating (1-6)



Exp. 3 – Findings

Here, we detect some sensitivity to the size of the innovation space.

The better the given solution, the less people innovate.

*** Surprisingly more sensitive to implicit values than explicit ones

But, again, subjective judgments of the innovation space appear to matter more than do objective characteristics.

Over- and under-confidence in innovating result in unexpected behaviors.

This can lead to suboptimal behavior.

In the 60% group, innovators scored better than borrowers (94.32 vs. 85.40).

Experiment 4: Scrabble Quality

Scrabble version of the Quality experiment

60% - zap, aye, kea, pay, key, pea

80% - zek, pay, zap, key, peak, yep

100% - zek, peaky, zap, kype, zea

+16 point bonus for innovating

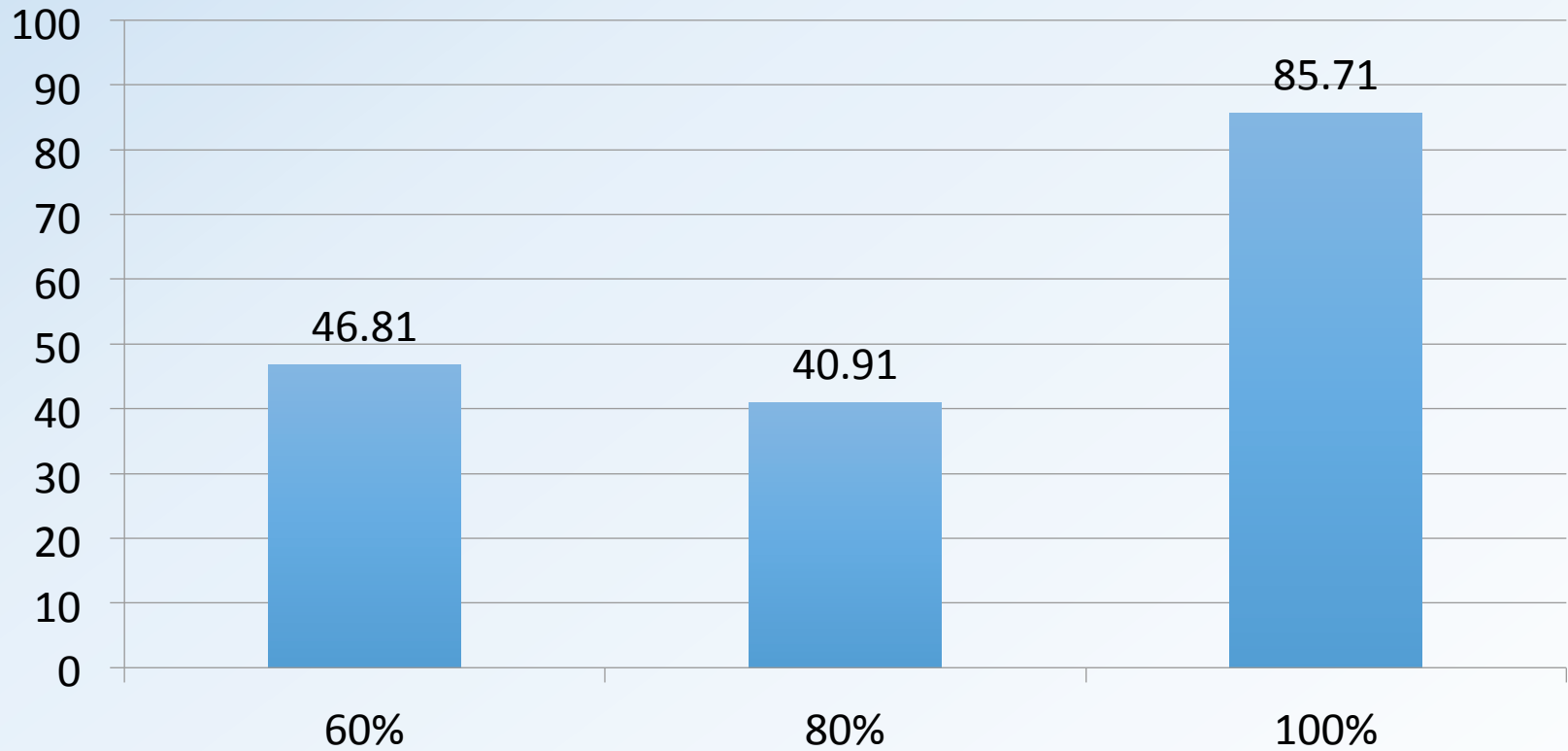
372 mturk subjects (46.9% female)

54 eliminated for opening a new browser

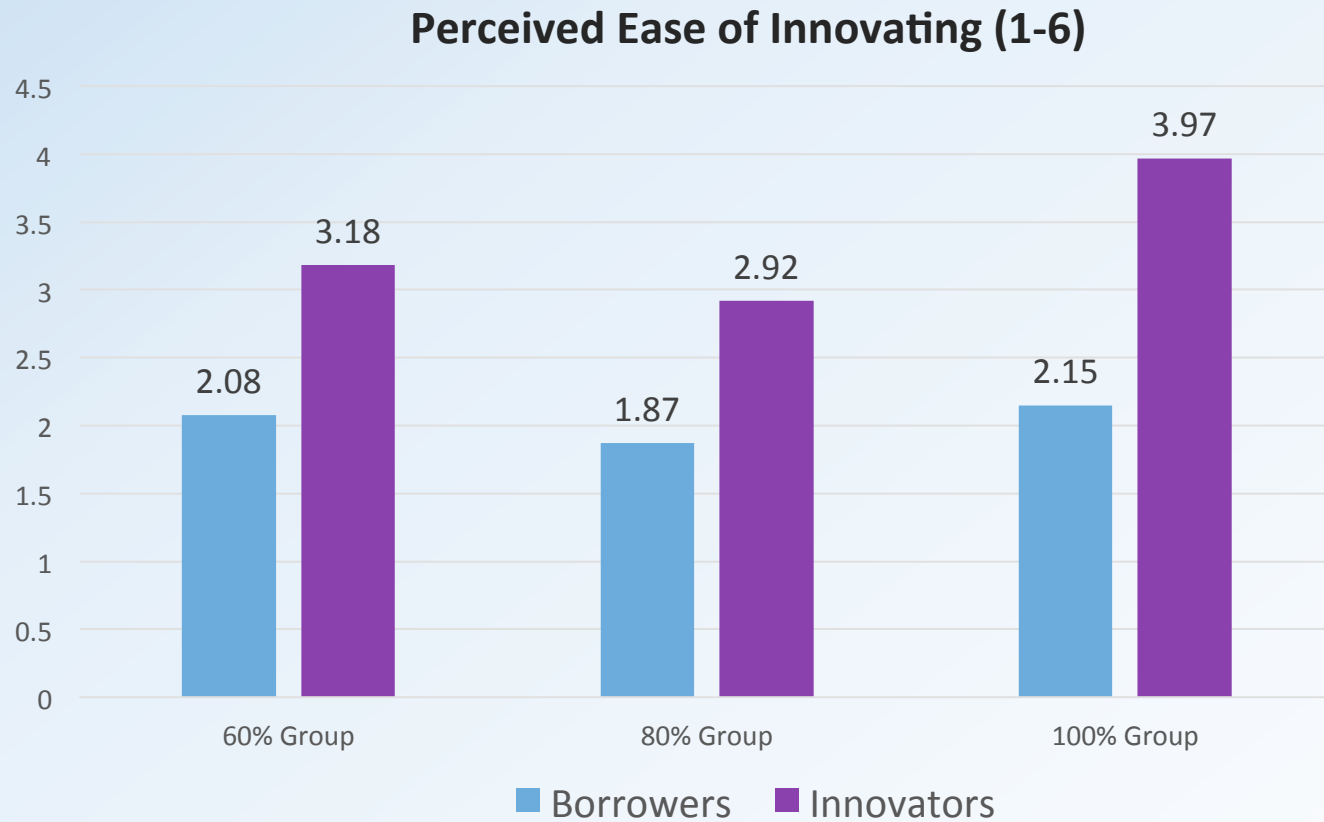
43 eliminated for failing comprehension question

Experiment 4: Results

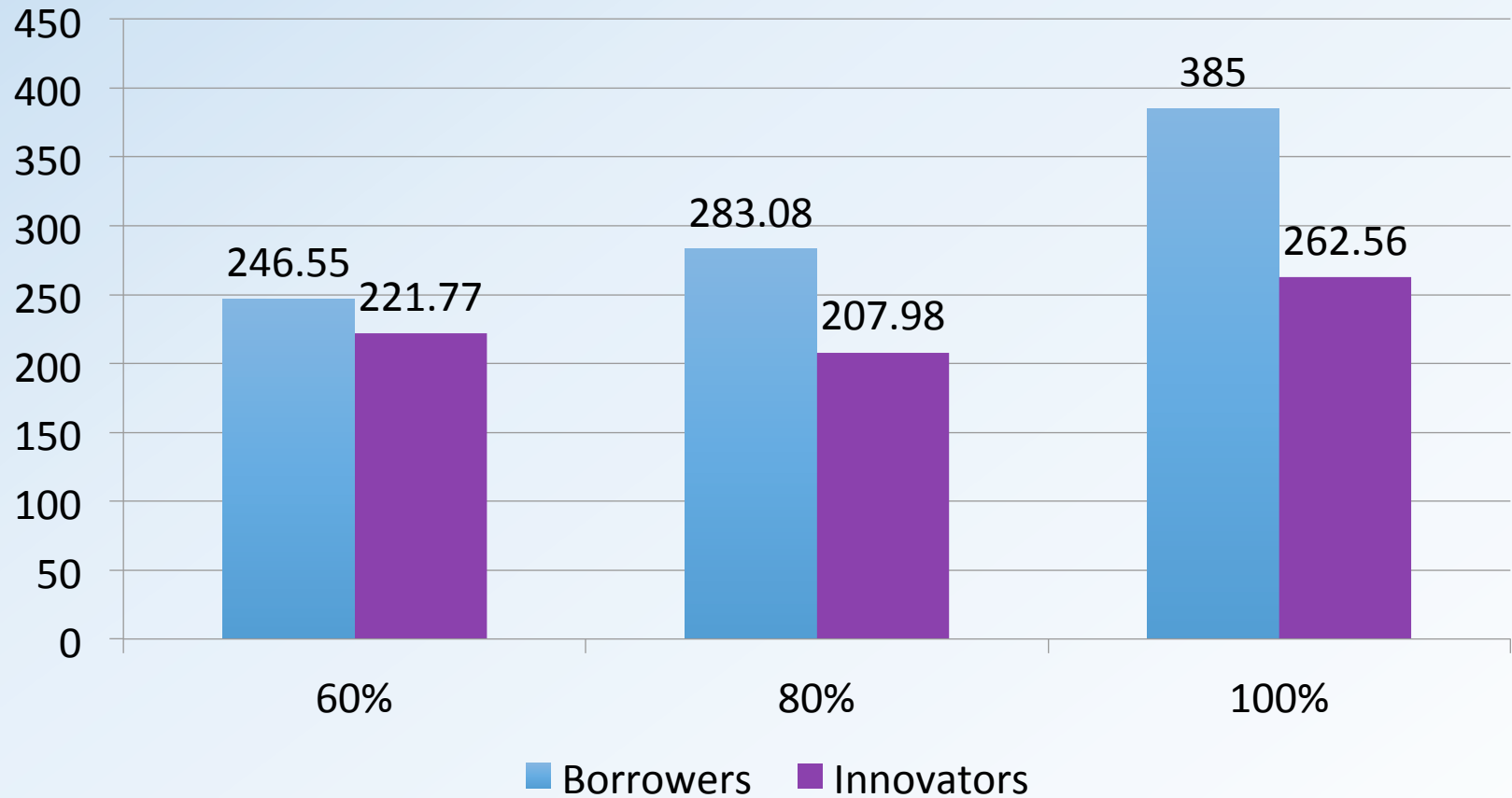
% Innovating



Exp. 4 – Ease of Innovating



Experiment 4 – Mean Points Scored



Exp. 4 – Innovation Heuristics

When creators contemplate I/B decisions they should consider both the ease of innovating and the benefits of innovating.

But this is a complicated question.

Instead, creators substitute an easier question (ease) for the harder question (ease + benefit).

They look at the 100% solution, and it looks easy to invent around.
But those words aren't valuable.

zek, peaky, zap, kype, zea

This Innovation Heuristic leads to big mistakes.

Limitations

- Lay people vs “real” creators (extrinsic vs intrinsic motivation)
 - MTurkers
 - But more lay creativity these days
- Individual vs Firm creativity
- Rapid cognition vs Lengthy gestation

Innovation Markets

- Ideally, in the absence of transaction costs, markets should efficiently distribute ideas to the highest valuing users.
- But the existence of Innovation Heuristics could keep this from happening.
 - This leads to sub-optimal innovation strategies.
- Although we're used to thinking of innovation as always valuable, we need to understand when it can be wasteful and costly.

Legal Implications

- IP law's goal is to provide innovation incentives.
 - But our experiments suggest that incentives can be pretty blunt instruments.
- Creators are not nearly as sensitive to the costs and benefits of innovating as we might hope.
- Because incentives are costly to provide, we need to be careful about how they're doled out.

Legal Implications

- Once we appreciate that innovating isn't always valuable, we need to question how the law incentivizes people to innovate.
- For example, copyright law is not very solicitous of borrowing.
 - The **Derivative Works** rules make it most costly to borrow from existing works.
 - In theory, by making the costs of borrowing greater, copyright law pushes people towards innovating.
- But our data suggest that some people may be unwilling to innovate even when doing so is wise.
 - Instead of becoming innovators, these people end up becoming infringers.

Thank You!

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