Online Experiment Platform

for Representations in Distributed Cognitive Tasks

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1. Introduction

In this semester, we replicated a series of experiments based on the paper of Zhang and Norman (published 1994) to understand how information is processed when conducting distributed cognitive tasks. The idea of our group was to use coins to create a similar experiment as Tower of Hanoi puzzle which Zhang and Norman did. In cognitive science, there are two kinds of rules. One refers to those that are defined clearly in a prompt while another is about those perceived by the player because of environmental constraints in real life setting. The goal is to evaluate the difference between an internal set of rules and an external set of rules in distributed cognitive tasks. In the original experiment, the study asked its subjects to play three isomorphic games with differing proportion of internal and external rules. All these experiments are conducted under the supervision of researchers and the number of subjects is limited.

In order to overcome the limitations and continue the exploration, I develop an complete online experiment platform for representations in distributed cognitive tasks. The biggest advantage is that online platform will collect large amount of detailed data easily and accurately. Besides that, this project is a great practice of combining and applying the design theories I have learnt in class. It involved a lot of user interface design for the web applications and also incorporated usability testing with real users.

In the following sections, I will firstly introduce about how we design our games and then the system flow chart for our website will be explained. After that, I will introduce my solutions to the problems I came across in design and implementation. Beside that, I will introduce my experiment by using Amazon Mechanical Turk . Finally, I will do a short summary and introduce some possible future work.

2. Methodology

Basically, in this project, I have developed an online experiment in which by asking our users to play one of our two kinds of games, at the same time the system will record how long it takes to solve the game. Our website (https://newpriceline.appspot.com/) is hosted in google cloud for free. Everybody could log in with their google account. In the chapter, we firstly introduce our games and then we will dive into the design of website logic. Finally we will talk about some implementation details on user interface design.

2.1 Games Introduction

Before we go into the details our website design, let's firstly understand our games. We design two kinds of games -- Coin Adventure and Tower of Hanoi Adventure. Although they have different appearance, they share the underlined rules.

2.1.1 Goin Adventure

Specific goal for Coin Game:

by following our three rules below,try to move all those three coins to one of the two empty blue plates.

Specific Rules For Coin Game:

- Player can only move a coin in one time -- **Internal Rule**
- The moved coin should be the biggest plate in its new stack -- **Internal Rule**
- Player can only move the biggest coin in a stack -- **Internal Rule**

Note: All three are internal rules (Already Deployed)

2. Hanoi Tower Adventure

Specific Rules for Hanoi Tower:

You need move the entire stack of disks from the first tower to one of the other two towers.

Specific Rules For Hanoi Tower:

- Player can only move a disk in one time -- **Internal Rule**
- The moved coin should be the biggest disk in its new stack -- **Internal Rule**
- Player can only move the biggest disk in a stack -- **External Rule**

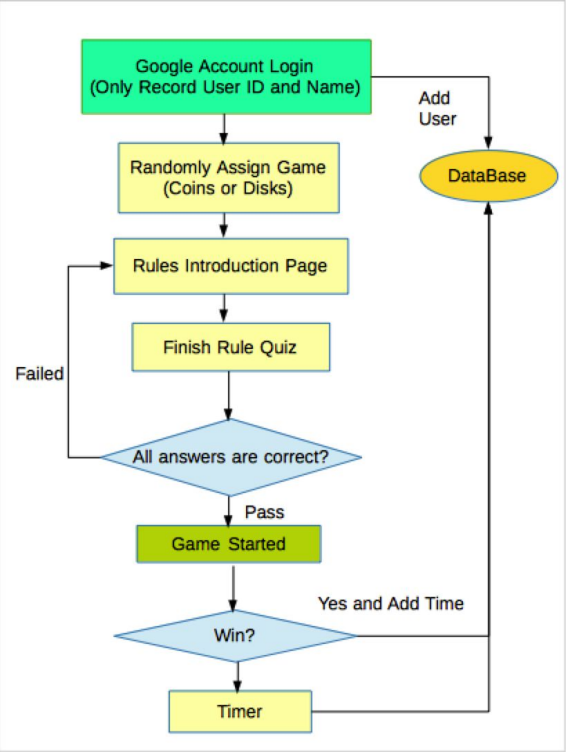
Note: Two internal rules and one external rules

2.2 System Flow Chart

Firstly, user need to log in with a google account, in which system will store google account id in database and if the user Id is already in database, it will not add it. Once user login system with google account, it will randomly get game between coin games and disk games. After that, we will go to introduction of game rules. Considering there is a process to ensure tester understand the rules completely, it is also beneficial to do the rule understanding check before user start. So I add a rule quiz page there. Only when users answers all the questions correctly could they be allowed to start the games.

After the game starts, the timer will start timing from 0 seconds. User could use mouse to manipulate the position of disks or coins and if all the coins or disks are moved to a new circle bar, it will stop the timer automatically, and then send the Time and user ID to database. If the user want to continue the game, they could click play again button and play as many times as they want.

Notes:The website will not record your email, but only record your google ID and your name



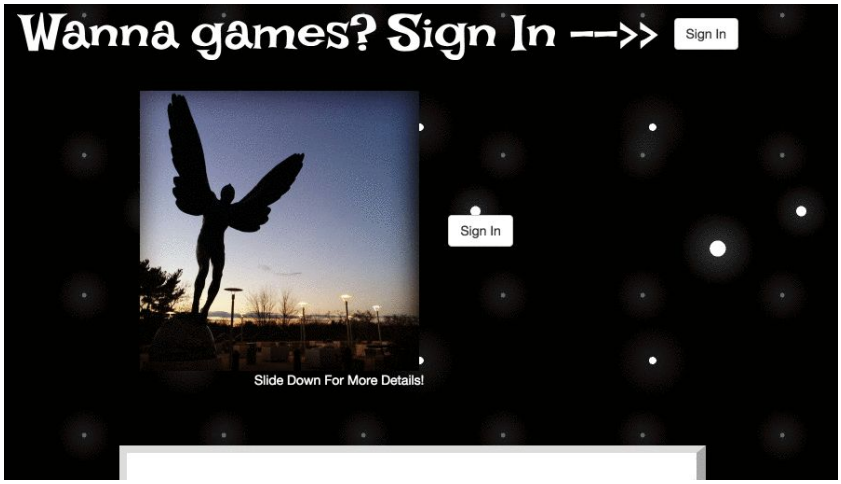
2.3 Important Details in implementation

In this projects, I practice some concepts that were introduced in our class. There are a lot of thinking behind the scenes. In the following content, I will list some practice examples involved in my project.

Practice 1: Use gif image to explain game rules

In order to help our users easily understand our rules,instead of simply using text to explain rules, I also add gif image to dynamically show how the rule is applied. Animation could easily catch the attention of users.

Practice 2: Use small hit to guide users



- Add “-->>” and encourage users to sign in
- Add hover effect on image and tell user that the image is clickable, which also link to sign page.
- Add “Slide down for more details” to guide those who need more information.

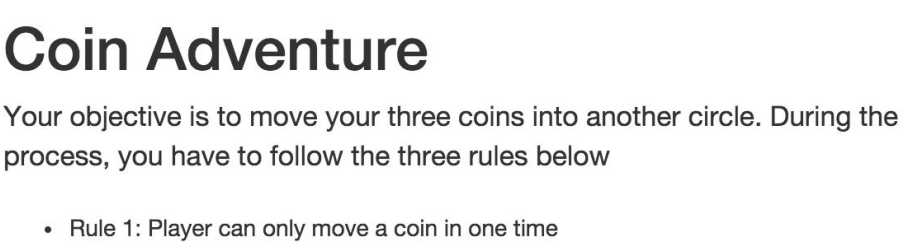
In the practice, hints are used and give user a sense of control.

Practice 3: Use more readable font

Compare with two different fonts below, Font-B is more readable. Even though Font-A looks fancier, from the perspective of usage, Font-B is better.

Font-A:

Font-B:



Practice 4: Do usability testing

Do usability test before launching officially and obtain valuable feedbacks from initial users. I got a lot of valuable feedback about the usage of website. For example, at the beginning, one user dissatisfied about font I used originally. And also one user suggested me a new sentence to explain one rule. Here is the real example below.

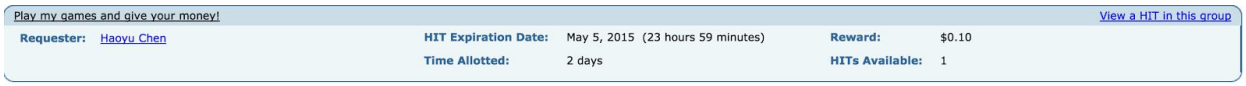
Original Sentence:Your goal is simple - follwing our three rules below, try to move all those three coins to move one of two empty blue circles

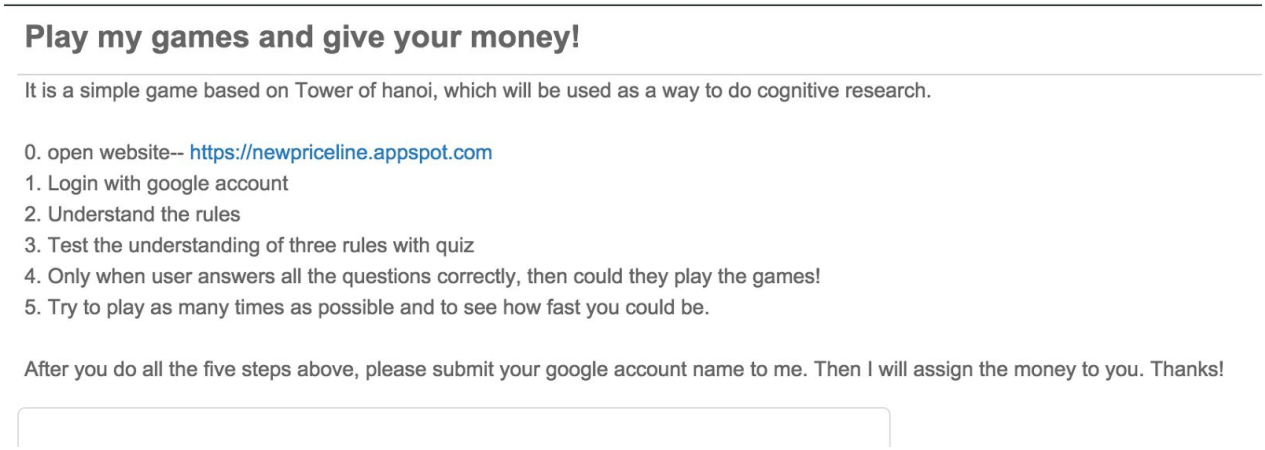
Revised Sentence: Your goal is simple - by following our three rules below,try to move all those three coins to one of the two empty blue plates.

3. Experiment

Besides asking my friends to do the practice, it also used amazon mechanical turk and publish an experiment there. I paid 0.1 dollar for each experiment. Maybe because it is my first time to use amazon mechanical turk, the number of response is not so much. After I published my hit, 8 hours later, I received 15 users and 5 of them play the games more than 8 times.

Experiment designed in Amazon Mechanical Turk:





The approved hits in my experiments:

Worker ID	Result	Submission Date	Approval Date
ACIZKR30ALBE5	80charlesc@gmail.com	May 4 2015, 10:47 PM PDT	May 4 2015, 11:16 PM PDT
A9ZUPULJTZ61S	alcatraz.max01@gmail.com	May 5 2015, 12:21 AM PDT	May 5 2015, 06:08 AM PDT
A1UURQF07IOXBO	tim.lyden	May 5 2015, 12:30 AM PDT	May 5 2015, 06:09 AM PDT
A14ZS4XY2AXKXA	sankaranprasath@gmail.com	May 5 2015, 06:06 AM PDT	May 5 2015, 06:09 AM PDT
A3B2O3SOMXJ2OF	deepuinuganti@gmail.com	May 5 2015, 06:29 AM PDT	May 5 2015, 07:43 AM PDT

But although I didn’t collect enough data for a formal experiment, it proves the functionality and stability to collect the data accurately.

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ID/Name	name	registerDate	userid	experiments.date	experiments.time	experiments.userid	experiments.gameId
id=5750085036015616	crtclmaas	2015-05-05 13:56:48.218730	101571105889869558862	[datetime.datetime(2015, 5, 5, 13, 58, 42, 762550), datetime.datetime(2015, 5, 5, 13, 59, 4, 466510), datetime.datetime(2015, 5, 5, 13, 59, 20, 296110), datetime.datetime(2015, 5, 5, 13, 59, 45, 255020), datetime.datetime(2015, 5, 5, 13, 59, 59, 5...	["00:28.900", "00:17.360", "00:12.677", "00:11.603", "00:11.992", "00:19.673", "00:15.530", "00:07.688"]	["101571105889869558862", "101571105889869558862", "101571105889869558862", "101571105889869558862", "101571105889869558862", "101571105889869558862", "101571105889869558862", "101571105889869558862"]	["True", "True", "True", "True", "True", "True", "True", "True"]
id=5757334940811264	tim.lyden	2015-05-05 07:18:57.917600	103076698777037978317	[datetime.datetime(2015, 5, 5, 7, 25, 9, 191090), datetime.datetime(2015, 5, 5, 7, 25, 31, 764710), datetime.datetime(2015, 5, 5, 7, 25, 42, 454640), datetime.datetime(2015, 5, 5, 7, 25, 53, 793920), datetime.datetime(2015, 5, 5, 7, 26, 7, 88360),...	["00:19.791", "00:15.161", "00:08.651", "01:07.123", "00:09.324", "00:08.900", "00:06.288", "00:07.588", "00:07.661", "00:08.750", "00:08.141", "00:06.299", "00:06.585", "00:11.893", "00:08.103", "00:06.161", "00:08.085"]	["103076698777037978317", "103076698777037978317", "103076698777037978317", "103076698777037978317", "103076698777037978317", "103076698777037978317", "103076698777037978317", "103076698777037978317", "103076698777037978317", "10307669877703797831...	["False", "False", "False", "False", "False", "False", "False", "False", "False", "False", "False", "False", "False", "False", "False", "False", "False"]

Note:

- **UserId** is user’s google account ID
- **Name** is the nickname of user’s google account
- Experiment store the data for each experiment
    - **experiment.date** -- the time when the experiment was performed
    - **experiment.time** -- the time which user took to finish one game
    - **experiment.gameid** -- true means the game type is coin adventure while false means the game type is Tower of hanoi adventure.

4. Summary and future work

In summary, I have designed and implemented an online experiment platform for representations in distributed cognitive tasks. It can run the experiment online and record the detailed data for each experiment. During this process, I practice various kinds of design rules in user interface design. And also I tried to use amazon mechanical turk to attract more users to play the games. It proves the usability of the website and collects useful data.

But it is still not complete. For example, the only measure we are currently using is time, but it can’t measure the user’s performance comprehensively. It is better to include other measures, such as the number of moves user takes to finish game. So in the future step, more measures should be incorporated. Besides that, with the help of this experiment platform, a larger scale of experiments could be implemented. Then we could do some research about how quickly people improve their speed to solve the same puzzle under the different representations of the same game. The collected data will help us to answer the question that how external and internal representation influence the speed of learning.

References:

- Demo Website: https://newpriceline.appspot.com/
- Zhang and Norman's Paper: Zhang, J., & Norman, D. A. (1995). A representational analysis of numeration systems. Cognition, 57(3), 271-295.
- Google APP Engine: https://cloud.google.com/appengine/docs
- Amazon Mechanical Turk: https://requester.mturk.com/