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**These research papers are written by undergraduate students as part of the capstone requirement for the Cognitive Science major.**
Casual Illusion
Alexis Baird

Frequently, when induced percepts are evoked in human perception, there tends to be some sort of perceptual time involved (Chen, Y., & Scholl, B. J., 2016). For example, when a person comes across a bitten sandwich, they assume that someone took a bite, and that it does not typically appear that way, such that they are making some sort of causal history to the sandwich. However, how this is done through the visual system, if at all, is what researches are trying to identify. Further, experimenters took this into account, such that they were interested in identifying how humans can tell causal history, based upon the appearance of objects (Chen, Y., & Scholl, B. J., 2016). Therefore, the experimenters took two shapes, imposed and intruded, to see if participants perceive a gradual shape change, or sudden shape change, when the frames were altered (Chen, Y., & Scholl, B. J., 2016). The gradual change had one extra frame in between, whereas the sudden change had no frame (Chen, Y., & Scholl, B. J., 2016). When the shape is imposed, there must be a sudden change, on the other hand, when the shape is intruded there is an illusion to perceive a gradual change even though it is suddenly changing (Chen, Y., & Scholl, B. J., 2016). The researchers went on to hypothesize that the intruded shape was an illusion perceived, therefore, the intruded shape could involve casual history (Chen, Y., & Scholl, B. J., 2016). Based on their results, when participants were shown the gradual change for both conditions, imposed and intruded shapes, they perceived this as gradual change (Chen, Y., & Scholl, B. J., 2016). On the contrary, when the participants were shown the objects in the sudden frame, for the imposed condition, they perceived it more sudden, however, when the participants were in the intruded condition they perceived it more gradual (Chen, Y., & Scholl, B. J., 2016). These results give evidence to suggest that the intruded condition is not only an illusion, but rather supports the researcher’s hypothesis.
Apparent motion has been defined as the reconstruction process of motion (Shiffrar, M., & Freyd, J., 1990). Therefore, some other researchers were interested in understanding how apparent motion can alter prior “knowledge of object-appropriate transformations” (Shiffrar, M., & Freyd, J., 1990). Such that, if you were shown a photograph of an arm raised, then based on apparent motion, you will automatically be biased to think that their next movement will be to put their arms down (Shiffrar, M., & Freyd, J., 1990). This suggests that there must be some reconstruction done within the motion, or apparent motion, within a non-moving figure. Knowing if apparent motion plays a role within non-moving figures, can help future researchers understand different visual illusions within the perceptual system. The researchers hypothesized that having apparent motion within the visual system would be taken over by background knowledge, when participants look at static figures (Shiffrar, M., & Freyd, J., 1990). The researchers were more interested in using biological motion, because it is more familiar across humans (Shiffrar, M., & Freyd, J., 1990). Therefore, the researchers used photographs of people posed in different positions (Shiffrar, M., & Freyd, J., 1990). To test their hypothesis, the researchers showed participants photographs of a person that was demonstrated different bodily positions (Shiffrar, M., & Freyd, J., 1990). Their research indicated that “joint constraints influenced apparent motion” such that, the participants were more likely to suggest that “paths of motion” were in tune with direction (Shiffrar, M., & Freyd, J., 1990). Therefore, this suggests that there is evidence of an illusion, within the visual system, that apparent motion reconstructs biological motion of non-moving figures.

On the other hand, some researchers wanted to identify if the visual perception had apparent motion, specific human movements, compared with inanimate objects in the world (Heptulla Chatterjee, et, al, 1996). Further, the researchers sought to identify “shortest path of
apparent motion”, in which the researchers hypothesized that sensitivity to human movements goes beyond the percept of “human movement relative to the outside world” (Heptulla Chatterjee, et, al, 1996). Moreover, the researchers suggested that humans may perceive apparent motion, in the visual system, only paths that are only directed towards themselves (Heptulla Chatterjee, et, al, 1996). Further, the researchers hypothesized that participants would be able to perceive apparent motion that are in line to biological movement “with respect to non-biological objects” (Heptulla Chatterjee, et, al, 1996). To test their hypothesis, the researchers showed images to participants that consisted of a person who was either holding the front of their knee, or the person was matching the body part consistent with an object (Heptulla Chatterjee, et, al, 1996). The results gave rise to evidence that, the visual system is general in terms of biological movements, but it also includes how biological movements are moving “in respect to inanimate objects” (Heptulla Chatterjee, et, al, 1996).

However, since the previously stated research did not involve looking at biological motion within causal history, current researchers sought out to identify this further. Therefore, the current researchers wanted to identify whether or not goal-directed actions entailed causality. Such that, if a non-moving frame of a human posture could not only imply a future motion, but also a past motion. In addition, the researcher wanted to understand if human movement can evoke a meaningful interaction. For example, if you see your friend throwing a ball towards your direction, you will move your arms up to catch the ball. This is an example of a meaningful interaction, because the individual actions of throwing a ball causes the person to move their arms up to catch the ball. Thus, the perceptual system may be sensitive to individual actions that allows for a meaningful actions to take place. The research question consisted of understanding the human sensitivity to individual actions, such that if an individual action can provide
information about the causal history. Such that, when a participant is presented with two static frames, the prediction of the participant will be to perceive the limb moving towards a second location, which is an illusion. Further, the researcher wanted to investigate whether a certain interaction between two people will causes a participant to suggest that an interaction will facilitate their apparent motion illusion. Therefore, the researcher hypothesized that human causal interactions can cause a perception of motion between two different interactions. To test their hypothesis, the researcher created different interactions between two different stimuli, the stimuli could be presented as interacting (faced towards each other), inverted (upside down), and non-interactive (faced away) to evoke a meaningful interaction. To continue to facilitate a meaningful interaction, the researcher had to actors presented to the participant throughout the duration of the experiment, one actor was known as the thrower and was depicted as throwing an imaginary object, and the other actor was known as the catcher and was depicted as catching the imaginary object. However, the thrower was depicted in a green color and was always presented first, and was shown through the entire experiment, on the other hand, the catcher was depicted in a red color, was presented very briefly after the green, and did not consistently demonstrate the same posture like the green one did. Thus, when the red actor was presented it could either demonstrate a sudden or gradual posture change. The sudden posture change consisted of two static frames, whereas as the gradual posture change had multiple frames and appeared smoother. Therefore, through the series of interactions between the thrower and the catcher, the researcher predicted that the participant will perceive a gradual motion between the two different posture changes. The results indicated that when the participants were in the interaction condition, the participants responded as gradual change of posture, rather than sudden. Nevertheless, when the subjects were in the non-interactive and inverted conditions, the participants responded to a
gradual posture change, correctly. The results supported the hypothesis, in which the experiment did induce an apparent motion illusion, therefore, participants are more likely to perceive gradual posture changes when the interactions between the figures are congruent with interpretations of the two figures.

Method

Participants

Nineteen undergraduate students (six males, and 13 females), ranging in ages 18-27 who were currently enrolled at the University of California, Los Angeles (UCLA). Subjects were selected based upon their enrollment through SONA online; therefore, participants were compensated with one participation credit.

Materials and Apparatus

The stimuli used was created through MATLAB, and consisted of having a red figure and a green figure. The red figure was perceived as a catcher, and was briefly presented, whereas, the green figure was the thrower on an inanimate object. Moreover, the catcher, or target, was shown very briefly at approximately eight frames presented for 16 m/s. During the sudden condition, the two static frames were induced for 4 frames (96, 96, 96, 96, 98, 98, 98, 98, etc.) and the gradual condition was a series of postures (96, 96, 98, 98, 100, 100, 102, 102). Further, directions of the experiment were provided, and orally presented by the research assistant. Following instructions, a practice stimuli was provided to ensure accuracy before starting the experiment. During the experiment, and practice, two figures were either shown inverted, or upside down, interacting, or facing each other, and non-interacting, or facing away. The participants were also directed to
place their chin on a chin rest, to ensure correct viewing distance. Moreover, all lights were shut off during the practice and actual experiment.

**Procedure**

Participants were asked to enter a room, and were later directed to sit down in front of a computer. First, the research assistant opened up a PowerPoint slide, which provided detailed instructions. The instructions suggested that the participant would be viewing two actors shown in different colors, one green and one red. However, although both shown through the duration of the experiment, the red actor would be briefly presented. During the briefly presented time, the red actor was going to demonstrate a change of posture. Moreover, the participant was directed to pay attention to both actors, but only respond to the red actor. However, the research assistant told the participant that although they will be responding to the red actor, the green actor will help with their judgment, and they should pay attention to the movements of both actors. Such that the red actor could either be suddenly changing postures, or gradually changing postures. Further, sudden posture change was defined the red actor jumping from one posture to another, however, the gradual change was defined as the red actor quickly moving to a posture. The research assistant went on to show the participant two videos which showed the difference. Then, the participant was directed to press the left arrow button when they perceived the posture change as sudden, and the right arrow button when they perceive the posture change as gradual. Further, the participant was told that there would be two practice blocks, in which they would be given feedback of a correct answer, given by a beep. Lastly, the participant was also told to fixate on a central cross, and judge the posture change via peripheral vision. After the research assistant closed the PowerPoint slides, the participant’s information (age, initials, and gender) were put in MATLAB, the practice portion of the experiment began. During the time, the
research assistant stood in the room to ensure no further questions or information would be needed. After the practice, the participant began the experiment and was given one participation point through SONA afterwards.

**Results**

The results indicated that when the participants were in the interacting condition, for a sudden posture change ($M=0.195$, $SD = 0.1398$), however, when there was a gradual posture change, ($M=0.8837$, $SD = 0.0803$). When participants where in the non-interacting condition, for a sudden posture change ($M = 0.138$, $SD = 0.096$), but when there was a gradual posture change ($M=0.872$, $SD = 0.0889$). Lastly, when participants were in the inverted condition, for a sudden posture change ($M=0.1162$, $SD = 0.094$), whereas the gradual posture change ($M=0.839$, $SD = 0.129$).

**Discussion**

Although our effect size was small, estimation of 5%, the sudden posture change, in the interacting condition, was significantly higher than the other two conditions. Consistent with what was expected, our results indicated that in the interacting-sudden, and non-interacting sudden condition, that when the two figures were interacting during a sudden posture change, the participants were more likely to say that it was a gradual posture change. Although this is incorrect, it is expected because it represents apparent motion illusion. Further, in the interacting gradual condition, the participants correctly identified that the posture change was gradual. Several versions were attempted to recreate this effect, therefore, in version seven, we altered the practice, such that during the first practice only the red actor was shown with correct or incorrect feedback, however, during the second practice both red and green actors were shown without
feedback. Since the results of version seven were not consistent with the previous version, there may have been a bias response for the participant to respond with sudden change, since they were only provided feedback on just the red actor. In addition, more alterations were made and version eight consisted of a color change in the middle of the stimulus, such that the during the experiment the green actor would either change from green to blue, very briefly, before the red actor appeared, or would not change demonstrated a color change. Therefore, in addition to the participant responding to the posture change of the red actor, the participant was asked to respond color change, or no color change regarding the green actor. The color change task was added as an additional way to ensure that the participant was fixating on the central cross, thus not directly looking directly at the actors. The results were again not significant, this may be due to the overwhelming task of responding to a color change task, following a posture change on a briefly presented actor. Additionally, the participant’s performance could have declined, because it was hard for the participant to remember if the green actor showed a color change, and what posture change the red actor made, since the experiment moves quickly. Although this quarter’s results were inconclusive, due to the unsuccessful attempts at replicating previous results, a next step forward would be to possibly include the red actor throughout the duration of the experiment, instead of briefly presenting it, and halfway through show a change of posture. This would ensure that the participant would be exposed to the red actor. Lastly, to avoid any biases built up from the practice, all future practices should allow feedback to the participant.
Figure 1. Results suggest during the interaction condition, responses highest during gradual change of posture, rather than sudden. Nevertheless, in the non-interactive and inverted conditions, responses more towards gradual posture change, correctly.

Figure 2. The first scene is an example of an interaction, the second scene is an example of non-interaction, and the last is an example of an inverted scene.
1.83 s

Sudden change

Catcher

Gradual change
Works Cited


**Perceiving Directions of Motion**

*Ana Heatherman*

Motion processing in the brain has been found to occur predominantly in the middle temporal visual area and the single striate cortex (T. D. Albright, 1984, Pg.1). This processing allows for humans and animals to perceive the direction and type of motion an object is moving in (left, right etc). This paper will discuss “Seeing multiple directions of motion—physiology and psychophysics” by Stefan Treue, Karel Hol and Hans-Jürgen Rauber and relate it to work being conducted in the Zili Lab at UCLA by Andy Silva.

There were two main parts to the study in Stefan Treue, Karel Hol and Hans-Jürgen Rauber’s article. The first was an experiment involving Macaques, which served to gain insight into the physiology of motion perception in the brain. The second involved human subjects and served to study the psychophysics of perception or reveal insight into the relationship between physical stimuli presented and mental phenomena. In the first experiment, direction selective neurons (neurons which respond only to a particular subset of directions and speeds of motion within its receptive field) in the MT area of the brain of the Macaques were tested for population response when presented with stimuli of either one or two directions. The second experiment asked humans to report the upward direction component in patterns that they were presented. Both of these experiments were designed to test the hypothesis that the response to a transparent stimulus is simply the scaled sum of the activities evoked by the individual components (Stefan Treue, Karel Hol and Hans-Jürgen Rauber, 2000, Pg. 270-271). These way researchers hope to create a computer program able to generate a hypothetical curve for population activity in response to movement in two directions.
Andy Silva conducts research that is highly psychophysical and focused on visual motion perception as is the main article discussed in this paper. Through presenting some stimuli with a lot of moving dots and asking participants to perform a task, such as judge the direction of the dots he is trying to learn about the actual way the brain’s neurons work to create a percept of movement. By seeing how subtle changes in the motion stimulus changes performance in the task, Andy hopes to isolate the important parts of a stimulus that are critical for motion perception in the brain.

Analysis of the results proved that neuronal groups that are direction selective could in fact be activated by stimuli that are no of a “true” right or left direction. Experimenters found that for a person to perceive multidirectional motion, they do not necessarily need to have distinct peaks in neural population activity. Key to this understanding are direction metamers and the fact that they are stimuli that can appear to be indistinguishable even though they can consist of differing direction components (Stefan Treue, Karel Hol and Hans-Jürgen Rauber, 2000, Pg. 273). These results were noted in the studies on Macaques and in the studies involving human subjects, it was shown that participants gradually chose lines that were closer to the perceived motion and not the distinct motion components.

The findings overall give experimenters insight into two main aspects of creating a computer model. The first is the coding of mult-valued sensory signals and the second were the creation of the models’ constraints. In the study run in the Zili Lab, dots are used to measure a person’s ability to detect motion in a certain direction. Discussed in this paper is the response of MT direction selective neurons in a particular direction and how individual motion components elicit a similar response in these neurons. The model that the experimenters found to be the most fitting was one with a “winner-take-all approach” which predicts the perceived direction as the
direction that most of the active neurons prefer. This model contradicts or replaces a previously proposed model that operates off the idea of vector averaging. The difference here is that in vector averaging, direction components would be averaged and lead to an incorrectly predicted direction of motion instead of a direction favored by the majority of motion neurons activated.

In summary, perceiving multi-directional motion does not depend on different peaks in activity profiles in direction selective MT area neurons. The overall shape of the population response dictates the perceived direction of motion. The neural population activity profiles for transparent motion changed according to the angle that the components of motion are at (acute versus larger angles).

Moving forward with experiments done in the Zili Lab at UCLA seem to lead toward the hope of gaining more insight into whether certain types of dot motion are perceived as truly moving in the direction that they were coded to move. There may be findings that show that even if the true direction of a stimulus is in multiple directions, the human brain is only able to perceive that motion in one way. From what I have been able to observe, it is fairly difficult for participants in these types of studies to distinguish different types of motion to each other. There are factors such as individual differences in people’s vision, to reaction times, to understanding of the task that I feel really affect the results and cause a varied response during the studies.
References


This paper is a summary of the ongoing research of using different inputs to the Bayesian Analogy with Relational Transformation (BART) model. The BART model by Lu, Chen, and Holyoak in 2012, is a computational-level model that learns first-order comparative relations from various non-relational inputs. Specifically, the BART model learns representations for animal concepts like larger and smaller based on empirical priors from the non-relational inputs. After the model is trained, the next step is to show the transformative power by using the learned representations to evaluate higher order analogy problems. An example analogy is one that follows the form smaller is to larger as meeker is to fiercer. One benefit of being able to use different sets of model inputs is to be able to learn more about the model as well as the nature of the input.

In the paper, the Lu et al. evaluated different model inputs with considerable success for each. The three different sets of inputs were animal ratings on four different magnitudes (i.e. size, speed, fierceness, and intelligence) (p. 622), Leuven inputs, and outputs from the topics model. The preliminary research covered in this paper is a comparison of BART model performance when using the topics model output by Griffiths, Steyvers, and Tenenbaum (2007) and the word2vec output by Mikolov, Sutskever, Chen, Corrado, and Dean (2013). In summary, preliminary tests show that BART model improves in performance in the generalization task when using word2vec feature vectors as input. Further research is required for hyper-parameter tuning and to explore performance changes for the analogy test.

The topics model has three goals: predicting associated words in a given context, identifying the meanings of words, and extracting the gist. To clarify, gist extraction means to
capture the semantic context and relationships between a set of words. To accomplish these goals 
the topics model uses a generative model to build probability distributions for words for each 
document given a word-document co-occurrence matrix. This can then be decomposed into two 
separate components, a probability distribution of words given a topic and a probability 
distribution of topics for each document.

The approach taken by Griffiths et al. is to run the topics model on the Touchstone 
Applied Science Associates (TASA) corpus, “a collection of passages excerpted from 
educational texts used in curricula from the first year of school to the first year of college.” (p. 
215). After preprocessing the data and deciding on lower bounds frequency counts for tokens it 
resulted in 26,243 unique words from 37,651 documents. The total amount of words across the 
documents sums to 4.2 million words. Lu et al. uses the output and processed them into feature 
vectors for animals as BART model input. This is notable because of the differences when 
compared to corpus used by word2vec as highlighted below.

Word2vec takes a different approach than the topics model instead using a neural 
network at its core. There are two model architectures for word2vec: the continuous bag-of- 
words (CBOW) and the skip-gram model. The CBOW architecture is designed to predict the 
word given a context of other words. The skip-gram model is the reverse; designed to predict 
surrounding words, or a window of a certain length, given a word. Available to train the model 
are two methods. The first is hierarchical softmax, which is a more computationally efficient 
version of full softmax (Mikolov et al, 2013b). The second is negative sampling. The feature 
vectors made available by Mikolov et al. were done with the skip-gram architecture using 
negative sampling to train. The feature vectors were trained on a corpus of 100 billion words 
resulting in 3 million words and phrase vectors in 300-dimensional space.
Mikolov et al. (2013b) showed that the outputs from word2vec capture semantic and syntactic relationships. This is thought to be the result from using a window of words that are predicted in the skip-gram model. As word2vec gets trained it encodes probabilities of surrounding words not only just words in that document. One noticeable benefit over the topics model is that, “if ‘Volga River’ appears frequently in the same sentence together with the words ‘Russian’ and ‘river’, the sum of these two word vectors will result in such a feature vector that is close to the vector of “Volga River” (p. 7). If the occurrences of the words ‘Russian’ ‘river’ and the phrase ‘Volga river’ may have a low frequency count given a document and may be filtered out from the topics of a document. It is also interesting that the resulting word vectors can be manipulated to discover analogous semantic relationships. Finding the nearest word vector representation when computing vector $X = \text{vector(“biggest”) - vector(“big”)} + \text{vector(“small”) results in the vector(“smallest”).}$ This also holds for other relationships as well such as country-capital pairs.

As mentioned previously using word2vec animal feature vectors as BART input has shown considerable performance improvements. Without the tuning of hyper parameters the BART model was able to perform around 90-93% accuracy on the generalization task when using 100 positive training pairs. There are improvements of more than 10% as compared to using topics model input. The topics input generalization performance improved by 3% after tuning hyperpriors, so it would be expected to have 3% as an improvement floor when using word2vec input. It is also expected that this accuracy would hold when using a lesser amount of training pairs. While further work is required to understand this improvement, it is thought that word2vec captures the semantic relationships for the animal concepts better than topics model.
There are two immediate differences between the topics model output and word2vec output. The first being the corpus used to generate the animal feature vectors. Comparing the size of the data set, the Google news corpus used to train word2vec has two orders of magnitude more data than the TASA corpus. Also from the surface descriptions of the corpuses, they appear to differ in terms of content and syntax. The TASA corpus contains passages from educational texts for educational material for children in their first year of school to first year college students. So, it would not be unreasonable to expect core differences. Although topics model does not take into account the syntax of documents, it does generate the gists of documents, so it would be possible that the gists of more basic documents for elementary readings could interfere with the topics for those at the college level. The second immediate difference between the two is the qualities captured in the outputs, mainly the semantic and syntactic relationships. One hypothesis is that because word2vec using the skip-gram architecture predicts other words and phrases within a window, that it captures more meaningful semantic relationships than the topics model, as it captures only the probability distribution of a word co-occurring with another in a given document or topic. By capturing these relationships for animal feature vectors, word2vec encodes better innate properties that are useful for generalization task in the BART model.

Another fundamental difference between the two is how the feature vectors were prepared. In word2vec the feature vectors did not require any further preprocessing whereas topics model output did. The output from the topics model trained on the TASA corpus outputted 24 samples of 300 topics each. Because the animal feature vectors were essentially split across these 24 samples, steps were taken to unify them into single feature vectors for each of the 77 animals. The methods taken are available in Lu et al. (p. 636-637). The results of the preprocessing steps were single feature vectors achieved by averaging feature vectors across all
samples. The feature vectors were sparse in nature, and so only the top 50 dimensions were used in BART when using topics model input. When using word2vec input, all 300 dimensions were used since a word2vec feature vector resembled an entity in vector space.

In summary, input taken from word2vec trained on the Google news corpus provides a performance improvement over topics model input. We expect to see improvements for BART when also doing the analogy task for reasons provided above. The difference in corpus would be worth examining. Would it be possible to get similar results from the topics model if it were trained on the Google news corpus, or vice versa, would we expect to see similar model performance if word2vec trained on the TASA corpus. I would argue that the topics model provides a distributed representation for the various animal names and regardless of corpus used, would result in lower performance than word2vec.
References


**Self-recognition in point-light displays of actions**

*Aya Strauss*

**Background:** The perception of biological motion is essential to human social interaction. Perceiving subtle cues such as body language, posture, and mannerisms aid humans in identifying, interacting with, and imitating others. Generally, humans have a wealth of visual experience perceiving the movement of others, however humans are still more adept at recognizing their own actions from point-light displays than at recognizing others’ (Loula et al., 2015), suggesting that both visual and motor experience contribute to self-recognition.

Due to enhanced recognition performance for self, the neural basis of self-recognition is theorized to reside in the mirror neuron system (MNS). Mirror neurons discharge both when perceiving others’ actions and when performing the motor movements (Iacoboni 2009). In this regard, since humans have a paucity of visual information perceiving the actions of others, enhanced self-recognition may be characterized by a unique coupling of perceptual and motor systems for the same action representations (Prinz 1997). The MNS is thought to enable higher-order social actions and perceptions, such as imitation, empathy, and recognition. Deficits within the MNS can result in a wide range of neurological disorders, including autism spectrum disorder (ASD), characterized by focus on low-level details at the expense of global perception, and a lack of social awareness and social interaction skills, and Schizotypal Personality Disorder (SPD) (Boxtel and Lu, 2013). In the van Boxtel and Lu study, subjects with ASD did not show greater distraction from a visual task by point-light displays of human figures performing actions vs. point-light displays with random dots. This shows that on a pre-conscious processing level, subjects with ASD do not pick up global motor and visual information, and implies that people...
with ASD may use compensatory low-level details in order to extract global movement and social information from visual and motor information.

Schizotypal Personality Disorder is also characterized by impairment in self-recognition and awareness, including impairments in the perception of one’s own face (Lee et al., 2007). In this regard, self-recognition from dynamic actions can serve as a potential tool to assess the ability of self-awareness with objective measures for individuals with Autism or Schizophrenia. Finally, since ASD and SPD affect perception in multiple modalities, it is hypothesized that since self-recognition appears to stem from multimodal experience, self-recognition performance will be affected by the presence of these disorders.

Within Dr. Hongjing Lu’s biological motion perception lab, I assisted graduate student Akila Kadambi with her research study on self-recognition from point-light displays of actions. The study’s goal was to determine how well people can identify themselves from point-light displays between simple and complex actions. Based on our lab’s pilot results, subjects demonstrated enhanced recognition performance for complex actions (characterized by their overall variability), specifically due the unique movement signatures encoded in complex actions and increased motor planning. Thus, in the present study, we utilized simple (e.g. wave) and complex actions (e.g. dance) to determine whether self-recognition performance depends on action complexity. Specifically, we aimed to understand how well subjects can recognize their own actions, solely from the kinematics of their body movements and to identify the extent to which motor and visual experience characterizes self-recognition performance. We also assessed correlations between scores on the AQ (autistic quotient) and SPQ (Schizotypal Personality Quotient), which measure the degree of relative Autistic and Schiztoypal traits respectively.
Design and method: Around 35 subjects were recruited from the UCLA Psychology SONA pool. The study was conducted in two parts. Participants signed up for two slots on the SONA website, separated by 2-3 months in order to minimize memory effects.

During the first part of the study, participants were instructed to perform an action, while their movements were captured by an Xbox Kinect, which extracts 3-D joint information and translates their motions into point-light displays. 9 simple actions and 9 complex actions were displayed in sequence on a PowerPoint display (e.g. “to wave”, “to get attention”), and the participants were asked to perform each action according to their own interpretation. The participants performed actions by first holding a neutral position with arms down, then holding a “T” position with arms outstretched, then performing the action, then holding the “T” position and then the neutral position again. This was to obtain a uniform starting point for the point-light recordings so that the displays could later be edited to eliminate as much confounding identifying information (such as posture, actions performed before the recorded action) as possible. The participants were then presented with 9 videos of 3-dimensional figures performing actions, without being told what the actions were. The participants were then asked to imitate each action to the best of their ability. The imitation actions were performed twice, due to the difficulty of imitating the displays and the complexity of some of the imitation actions. After completing the motion-capture part of the experiment, the participants filled out the AQ and a motor imagery questionnaire (VMIQ-2). The motor imagery questionnaire asked subjects to imagine themselves performing actions in three ways: kinesthetically, as if they physically performing the action; visually from their own perspective, as if they were looking out from their own eyes at their body performing the action; and visually from an outside perspective, as if they were watching
themselves perform the action from a third person point of view. The subjects then rated how vividly they imagined each action from each viewpoint.

During the second part of the study, participants were shown displays of actions in the form of multiple choice questions. Four point-displays were shown, one of which was the participant performing the action from the first part of the study. The other three options were distractors, showing other subjects or the researchers performing the action. The distractor displays were controlled for gender - the male participants only saw distractor actions performed by male subjects or researchers, and vice versa for female participants. This controlled for extraneous postural and gender information, unrelated to the action itself. The participants were instructed to watch the displays and select their own action. After each action display, the participants were asked to rate how confident they were in their choice on a scale from 1 to 5, 1 being the most confident. After this set of questions, the participants completed the SPQ. A subgroup of participants, around 10 people, were given a control task, which asked participants to determine whether the displays showed actions that they performed in the first part of the study (e.g. “to wave”), or a new action that they did not perform in the first part of the study (e.g. “to water plants”). This control task controlled for action description recognition, as opposed to recognition based on kinematics.

Expected results: We expect that participants will perform better on self-recognition for complex actions (e.g. “to play baseball”), rather than simple actions (e.g. “to punch”). This is due to both the effect of unique body movements that provide identifying information when performing more complex actions, and to the involvement of more motor planning when performing more complex actions.
We hypothesize that subjects will show low confidence on their self-recognition choices (based on our lab’s pilot results), despite also being hypothesized to perform above chance on the task. This may suggest that self-recognition primarily happens on a lower, pre-reflective level, rather than being the product of conscious thought.

According to previous research on MNS and correlations between social cognition disorders such as autism spectrum disorder, we also hypothesize that participants with higher scores on the AQ and SPQ would show lower performance than participants with low scores. While the AQ and SPQ alone do not serve as clinical diagnoses of autism spectrum disorder or schizotypal personality disorder, the presence of autism spectrum-related and/or schizotypal-related traits may indicate underlying neurological differences from neurotypical subjects. This part of the study served as a pilot for further studies into the correlation between self-recognition performance on visual and motor tasks and ASD and SPD. We aim to run the experiment a second time in spring, in order to have stronger correlations with a larger sample size (N = 60).

Discussion: This study examines how visual and motor experience are cognitively linked and contribute to the process of self-recognition as opposed to recognition of others. Currently, there are a dearth of studies that examine the distinction between these two types of recognition; therefore, this study will fill this gap in the literature. If a strong correlation exists between AQ and SPQ scores and performance on self-recognition tasks, then this provides evidence that self-recognition performance is adversely affected by autism spectrum and schizotypal personality disorder. This would also provide further evidence that self-recognition and recognition of others is an important part of the social perception and cognition that is affected by these disorders. This evidence could lead to further studies identifying and finding causal links in between cognitive processes of self-recognition, the MNS, and ASD and SPD. Further research in this
area may examine what other forms of visual and motor perception are linked to the motor system, and how these in turn are linked to higher-level social recognition, imitation, and interaction.
References


Psycholinguistics Verbal and Visual

Cristian Ramos

The abstract nature of time has made it a difficult concept for the human mind to understand without putting it in the context of more easily understood concepts such as space and motion. When referring to time, we often refer to it as if it exists in a physical space that is capable of moving in different directions. This association constructed between space and time is the product of the human mind using metaphors to talk about abstract domains such as time in order to give them form and make them easier to understand (Lakoff & Johnson, 1980; Broditsky, 2000). For example, when referring to a point in time in the future, we usually associate it with a preposition that denotes a physical space such as “in a month”, “at noon”, or “in the distant future”. These spatial linguistic expressions are used as metaphors to refer to time.

Previous studies have been done on the relationship between these spatial linguistic expressions and our perception of time. Claims have been made that speakers of different languages perceive time in different manners. A study by Boroditsky (2001) was conducted to establish whether or not language shapes our thoughts. Using spatial scenarios, Boroditsky found that not only is language a powerful tool in shaping thoughts on abstract concepts such as time but that a person’s native language is important in how one tends to think about these concepts. Boroditsky found differences in the way that English speakers and Mandarin speakers perceive time. English speakers tend to think of time on a horizontal axis, while Mandarin speakers tend to think of time on a vertical axis (Boroditsky, 2001; Boroditsky, Fuhrman, & McCormick, 2011).

This present study seeks to refute the claim made by Boroditsky, that is that there are no significant differences in the way that English and Mandarin speakers perceive time and that
both speakers can adapt quickly to either axis. In order to test this, we used motion and animations rather than linguistic expressions because they have been proven to facilitate analogical transfer (Kubricht, Lu, & Holyoak, 2015) and because it has been shown that visual-spatial stimuli are effective in riddle solving (Stamenkovic, 2015). We expect there to be very subtle differences between the perception of time in speakers of different languages.

**Method**

**Participants**

The participants for this study were 65 undergraduate students (16 male, 47 female, 1 undeclared, 1 gender-fluid) enrolled at the University of California, Los Angeles. All participants were college aged students, mean age was 20.28. Out of the 65 participants: 23 participants spoke English only, 22 participants were bilingual in English and Mandarin, and the remaining 20 participants were bilingual in English and another language that was not Mandarin. All participants signed up for the experiment using the SONA system and received SONA credit for their participation in the experiment.

**Materials**

The stimuli used in this study were 40 Adobe Flash animations depicting horizontal movements from left to right and right to left, vertical movements from top to bottom and bottom to top, and diagonal movements towards each of the four corners of the screen. Each movement and direction had five different positions. The stimuli were presented on a computer in a preparatory trial followed by two main trials. The computer was connected to a remote control which the participant used to answer left or right. The Eyelink II was also used in this experiment, and was used to track the participants pupil and corneal reflection in the right eye during the experiment. A second computer was used to calibrate the eye tracker and to monitor
the participants eye movement during the experiment, as well as to manually advance the
participant from trial to trial. A pretest containing questions similar to the ones asked during the
experiment was also used in this experiment to assess the participants timeline preferences. A
consent form and a set of instructions were also required in this experiment.

Instructions

Instructions that were presented to the participants at the beginning of the experiment:
The subjects received the following instructions: “A meeting had been scheduled for February,
but eventually got postponed. Each of the following simple animations depicts the shift of the
meeting from February to another (later) month in the same calendar year. Your task is to choose
the more likely ‘new month’ of the meeting. Two options will be offered after each animation.
Please choose one by pressing the button (Left or Right button on the joypad) as quickly as
possible after the animation has finished. Please choose the more likely one even when neither of
them seems to be completely accurate. There will be one test trial (6 animations), and two main
trials (40 animations each).”

Procedure

Participants were first asked to fill out a consent form and a pretest before starting the
main experiment. The pretest was used to determine the participants timeline preferences when
associating time with space. The experiment itself determined how they performed despite their
preferences. Participants were then taken into the testing room and were asked to be seated in
front of the computer screen with the animations. The set of instructions were then presented to
them on the screen. After confirming that they have read the instructions by pressing a button on
the control, the Eyelink II was then placed on their head and then adjusted so that their pupil and
corneal reflection in their right eye was detectable. Several calibrations and validations were then
performed to ensure optimal eye tracking data. Once the Eyelink II was calibrated, the participants began the experiment. All participants completed a test trial (six animations) followed by two main trials (40 animations each). In between each animation was a dot fixated on the screen that participants were asked to stare at before proceeding to the next animation. Each trial was preceded by a set of instructions. Participant’s responses, reaction times, accuracy and eye tracking data were all recorded and collected for analysis.

**Results and Discussion**

ANOVAS and paired sample t-test were used to compare mean reaction times and accuracy across each of the different conditions. The pretest used to collect the timeline preferences for each participant found that a majority of the three groups (English monolinguals, English-Mandarin bilinguals and English-other bilinguals) had a preference of a horizontal axis. Vertical axis preference was found to be slightly higher in the English-Mandarin bilingual groups than the rest of the groups, but the amount was significant less than the amount of English-Mandarin bilinguals that had horizontal preferences. Based off previous claims, we would have expected a larger preference for vertical axes than horizontal axes in English-Mandarin speakers.

When comparing the performances of all the different groups in this experiment on both the horizontal and the vertical axes, we found that there were no significant differences in reaction time between the groups. Based off previous studies, we would have expected to find that English speakers to perform better on horizontal axes and English-Mandarin bilinguals to perform better on vertical axes. Instead we found almost the same results. All three groups fixated more on the left option than the right option, but this finding is not relevant towards the
aim of this study. Instead we found that the group of English-other bilinguals performed better than the other two groups.

The results of this study show that there is no sufficient nor significant evidence that indicate that English and Mandarin speakers think or perceive time in different ways. Instead it is thought that when we talk about time, a small adaptation of a general spatial mechanism occurs. Due to the nature of the experiment, the adaptation time must be relatively short which shows that time perception based off spatial linguistics is not a world-view.
References


Hierarchical Biological Motion Perception: Behavioral Oscillations

Derek Khaothong

Background

Biological motion is defined as the movement of a living organism. Studying biological motion perception in psychology, researchers attempt to understand how humans can perceive animate humans provided an impoverished stimulus (e.g. a point light display) (Johansson, 1973; 1976). The ability to perceive and recognize the motions of living organisms accurately is an essential skill for survival. Visual motion plays a major role in identifying another living creature and can inform the observer about its actions and intentions. Human infants as young as three months of age can perceive biological motion (Fox & McDaniel 1982), as can non-human mammals (Blake 1993). In Figure 1, a hierarchical motion structure for a walking action is represented with a point-light display, where different colors represent a cluster of joints assigned into the same motion component.

For our studies, we used an experimental design that involves the use of rhythmic or repetitive neural activity in the brain, called neuronal oscillations and a priming paradigm. Huang, Chen, and Luo, (2015) used a priming paradigm to establish a relationship between behavioral response time (RT) and perceptual predictions which are triggered by feed forward prime events. In their study, they presented a left-, or right-pointing arrow in a rectangle as the prime and a left- or right-pointing hollow arrow as the probe stimulus. In the priming experiment, the prime and probe are either congruent (pointing in the same direction) or incongruent (pointing in a different direction). Similarly, in our study, we employed the use of the priming paradigm with a target action preceded by different types of prime motion components. A priming paradigm with the use of neuronal oscillations typically leads to
facilitation effects, which are associated with faster and/or more accurate responses to the same stimulus, or an adaptation effect, which can result in slow and/or less accurate responses to the same stimulus. We ran three experiments with this cuing paradigm based on the assumption that if the motion prime stimulus matches with the observers’ middle-level motion components in the hierarchical representation of an action for Figure 1, it would facilitate the later judgment of the walking direction of the probe stimulus and provide facilitation effects.

**Design and Methods**

For experiment one, University of California, Los Angeles (UCLA) undergraduates (N = 36; 14 males and 22 females) ranging from 18 to 27 years old (M = 20.78, SD = 2.24) were recruited via UCLA’s SONA system. For experiment two, UCLA undergraduates (N = 28; 10 males and 18 females) ranging from 18 to 27 years old (M = 20.96, SD = 2.62) were recruited via UCLA’s SONA system. A computer running MATLAB was used to run the experiment in a dark room. Printed instructions of the task were read by the research assistant to the participants. In the practice trial, feedback was given via an audible beep if participants made a correct response and no audible beep if participants made an incorrect response. Participants were stressed that their responses would only count as correct when the response was both correct and fast. Figure 2 depicts the priming paradigm used in our study. For each trial in both experiments, participants first viewed a walking action (S1) presented in Figure 3 as either the whole-body motion, or as subparts of body movements (bipedal leg movements, bilateral arm-leg movements with the same motion direction, and unilateral arm-leg movements with the opponent motions). The S1 stimuli were presented in the forms of red point-light or red skeleton walkers for either a short duration (100 ms) or a long duration (500 ms). After the presentation of S1, a black point-light whole-body walker was shown briefly as the second stimulus (S2) for 200 ms.
Participants were asked to judge the facing direction of the black walker in S2 by clicking left arrow or right arrow on the keyboard. In experiment one, S1 was presented as whole-body motion, bipedal leg movements, and bilateral arm-leg movements with the same motion direction. For experiment two, S1 was presented as bipedal leg movements, bilateral arm-leg movements with the same motion direction, and unilateral arm-leg movements with the opponent motions. In addition, the S1 stimuli was presented for only a short duration (100 ms) in experiment two. The S1 stimuli and S2 stimuli priming paradigm were either congruent (facing direction of prime and probe were the same) or incongruent (facing direction of prime different from target). For both experiments, there were 32 trials per condition (e.g. 100 ms, skeleton, whole-body) in which 16 trials were congruent and 16 were incongruent.

**Results**

The results of experiment one are depicted in Figure 4, which depicted congruent trials and incongruent trials. Results showed that with a short duration of S1 (100 ms), whole-body motion, bipedal leg movements, and bilateral arm-leg movements for skeleton and point light displays elicited a robust priming effect but with different facilitation magnitudes. When the S1 stimulus was presented for a long duration (500 ms), the whole-body skeleton display yielded an adaptation effect. However, the adaptation effect was not found in any subpart conditions or when S1 was presented as a point-light display for a long duration, suggesting that a priming effect occurred when the duration of the prime was short, whereas an adaptation effect occurred when the duration of the prime was increased. The results of experiment two are illustrated in Figure 5, which showed that bipedal feet movements, bilateral arm-leg movements, and unilateral arm-leg movements all elicited a robust priming effect for whole-body skeleton primes. However, bipedal feet movements and bilateral arm-leg movements led to stronger
priming effects than unilateral arm-leg movements, suggesting that some subparts of body movements may be encoded in the hierarchical representation of actions. Figure 6 displays the response times for the priming paradigm task when the duration of the prime was presented from 100 to 600 ms. Priming effects (faster RTs) occurred when the duration of the prime was presented for a shorter duration (100 to 200ms), where as facilitation effects (slower RTs) occurred when the duration of the prime was presented for a longer duration (300 to 600ms).

**Discussion**

Overall, experiment one’s results suggest that duration is a prerequisite for eliciting a priming or adaption effect. The results of experiment 2 seem to imply that stimuli with bilateral properties lead to stronger priming effects than unilateral arm-leg movements. Experiment 3 confirmed our hypothesis that when the duration of the prime increased for the whole-body skeleton primes in 100ms increments, there was a transition from priming effects to adaptation effects. This suggests that priming duration cannot be randomly chosen for our future oscillation experiments otherwise we could obtain opposite perceptual effects than we intended. The current and ongoing oscillation experiment systematically varies the SOA to measure the temporal dynamics of RTs over time.
Figure 1. An illustration of the Hierarchical Model of a walking action. Different colors in the figure represent a cluster of joints assigned into the same motion component. Gray circles indicate the absence in any motion components for a particular layer.

Figure 2. Initial Experiment Paradigm.
Figure 3. Prime stimuli, from left to right: bipedal leg, bilateral arm-leg movements, whole-body

Figure 4. Response Times for Skeletal Primes and Point-light Primes presented at 100 ms or 500 ms.
Figure 5. Response Times for Skeletal Primes and Point-light Primes.
Figure 6. Prime Duration (ms) & Adaptation Effects.
References


Physiological Evidence in the Brain When Experiencing Persuasion

Drew Watanabe

The act of persuasion is a concept that has been studied over and over for years. It is clear that there are certain things a person can do to influence another individual, but what exactly are the physiological mechanisms in the brain that are associated with persuasion? Are there even brain regions that can be associated with persuasion? This review highlights a few experiments that do indeed show there are regions in the brain that are activated when one engages in the act of persuasion as the influencer, and some of these regions are reliable enough to make predictions of an individual’s behavior days before it happens.

The first experiment is from Dietvorst et al. (2008) where they test persuasion in the context of how a salesperson and their sales performance can be associated with the temporopariteal junction (TPJ) and the medial prefrontal cortex (MPFC). They investigated the idea of interpersonal mentalization, which is defined as how well the salesperson can “read the minds” of customers in regards to their intent by looking at non-verbal cues, as well as adjusting their own speech and non-verbal cues accordingly. Dietvorst et al. hypothesized that higher interpersonal mentalization leads to greater sales performance. They experiment was conducted by recruiting participants by sending a survey to sales managers and those that agreed to be part of the study were randomly selected. This idea was tested by reading stories to the participants that required “theory of mind” to understand how and why characters acted a certain way. After the story was completed, the participants were asked a question to answer silently to themselves. All participants were undergoing fMRI for approximately 10-15 minutes while listening and responding to a total of 15 stories. The results from the study confirmed Dietvorst et al. hypothesis, the group that scored higher on the mentalizing task did have better sales
performance. The study also revealed that the brain regions that were active for the higher mentalizing participants were the bilateral TPJ and the MPC. These findings demonstrate that persuasion for a salesperson can be associated with activation of two brain regions: the TPJ and MPFC.

In another experiment conducted by Falk, Morelli, Welborn, Dambacher, and Lieberman, 2012, the idea of social influence was investigated by setting up a paradigm that allowed for the experimenter to observe the brain activation when one is attempting to persuade another individual. First participants were randomly assigned to a situation where they were either an intern trying to pitch an idea for a television pilot show, or a producer evaluating the idea. The interns were scanned in an fMRI machine while they were rating ideas given by the experimenters. Then following the fMRI scan, the interns were videotaped giving responses that evaluated each of the ideas presented previously. The task of the producer was to watch the clips of the interns give their evaluations for each television pilot idea and for the producer to then decide whether or not they wanted to further recommend the idea. Finally the producer rated each intern on how much interest they could generate about the show. The results of the study provide evidence that there was more activation in the TPJ in interns that were more successful in convincing others that the shows they liked were more interesting. Since the TPJ has been highlighted as the activated region, it can suggest that the interns with the most success in conveying their interests are better at mentalizing (Falk et al., 2012). Similar to the first experiment, the TPJ seems to be a region that indicates how well a person is at interpersonal mentalizing and allows the individual to have “theory of mind” to be more successful at persuading or influencing another individual.
An experiment by Falk et al. (2010b), studied to see how persuasive messages would differ among cultures when analyzing brain activation. The participants selected for the first study were American and the participants for the second study were Korean. The requirements needed for Korean participants was that they need to have born in Korea, to have spent at least half of their life in Korea, and their first language needed to be Korean. Both the first and second study followed the same procedure, with the only difference being what language the text was given in. The American group was given English and the Korean group was given Korean. To begin, the participants were shown groups of sentences and after reading all the groups of sentences, they were asked to rate the persuasiveness of each group on a 4-point scale. The results from this study showed that the dorsal medial prefrontal cortex (DMPFC), bilateral posterior superior temporal sulcus (pSTS), and the bilateral temporal poles (TP) were more active during the messages that participants rated as more persuasive. However, the interesting part is that the American and Korean groups had remarkably similar results, suggesting that across cultures persuasion activates the same parts of the brain. In other words, there were unidentifiable differences with both results.

The prior experiments mentioned have demonstrated that the act of influencing or persuading another individual activates certain regions in the brain that do suggest there is physiological evidence in the brain. The next experiment takes this idea one step further and has presented the notion of being able to predict a behavior change due to persuasion by looking at brain. The study by Falk, Berkman, Mann, Harrison, and Lieberman, 2010a, aimed to observe MPFC activation of participants while they viewed persuasive messages. To start, the participants filled out surveys that asked them questions about their thoughts on sunscreen use. The main questions were how much sunscreen have they used the past week, how much they
planned to use in the coming week, and what their attitudes were on sunscreen in general. Next, participants were shown slides that included words and images being presented by expert sources about using sunscreen. After all the slides were viewed, the participant was given another survey asking about their current intentions to use sunscreen and attitudes toward sunscreen use. One week after the experiment, an email was sent to the participants asking about their sunscreen use in the week that followed the experiment. The participant was also not aware there would be a follow up email. Results from the experiment by Falk et al. (2010a) showed that MPFC activation was significantly related to whether or not the participant changed their behavior. Furthermore, the experiment used this data to test a behavior prediction model and the analysis they found suggests that the predictive model has significance. Not only does this experiment provide evidence that specific regions of the brain are activated during persuasion, but certain activation patterns when viewing persuasive messages can actually predict a person’s behavior. However, the method used to determine whether behavior did change was self-report so there remains an unknown of if there was a self-report bias. Despite this fact, the prediction model presented was able to foresee behavior change in an individual even if the individuals themselves could not see it. Based on the self-reports given on the day of the experiment, it turned out that the prediction model was better than using self-reported behavior change intentions.

Overall, all of the experiments mentioned previously have provided evidence that there are certain regions in the brain that are associated with persuasion, like the TPJ and MPFC. These regions being consistently activated during persuasive experiences suggest that persuasion causes physiological changes or activations in the brain. Furthermore, the ability to predict behavioral change just from studying the brain activation patterns from an individual can lead to very exciting implications in the future for the field of social cognitive neuroscience.
References


Differences of Infant Looking Behavior Across the Development of Self-Awareness

Frances Yang

Introduction

During the first years of life, infants seem to experience different stages of cognitive development in order to reach higher levels of self-awareness. Especially important in the development of self-awareness is a child’s social-cognitive abilities (Lewis, 2012). Past studies have suggested that the capacity for secondary representation is necessary for self-recognition to occur (Asendorpf, Warkentin, & Baudonniere, 1996). According to such conclusions, self-recognition as well as the recognition of another being requires that a child construct a mental model of oneself. The majority of research on the development of self-recognition and self-awareness supports this perspective. However, recent studies suggest that there is more to a child’s ability to recognize herself than previously thought. Recent studies have used the mirror mark task to assess a child’s ability to understand the idea that he or she is “an objectified entity among other entities” (Rochat, Broesch, & Jayne, 2012). The mirror mark test is passed when a child demonstrates self-orientation, touch, and removal of a mark that was placed on his or her forehead after recognizing himself or herself in the mirror. Passing this task suggests that an infant has reached the capacity to form an internal representation of themselves. In a study by Rochat, Broesch, and Jayne (2012), the researchers explored the role that social factors might have on the emergence of an objectified idea of self and a sense of being. Specifically, they aimed to discover whether or not passing the mirror mark test depends on a child’s awareness of the social context. The experiment consisted of two conditions: the Classical and Norm conditions. In the first condition, the child was the only one in the room to have a mark on his or her forehead, while in the latter condition, the child and everyone else in the room also had a
mark on their forehead. Based on video recordings of their reactions, the researchers measured self-referential behavior (e.g. touching) while looking in the mirror and hesitation. Hesitation was considered any of the actions that occurred after the child touched the mark while looking in the mirror. The results showed that between the two conditions, there was no difference in the children’s ability to complete the task. There was, however, a significant difference in the amount of hesitation displayed by the subjects. The children in the Norm condition showed significantly more hesitation while removing the mark, while in the Classic condition, only one child showed any hesitation. These findings suggest that there is more to the development of explicit self-awareness in children than previously thought. There appears to be a social component to a child’s ability to express self-recognition.

According to a study by Amsterdam (1971) on the mirror self-image reactions of children between 3 and 24 months of age, there appears to be an age-related sequence of mirror behavior. Amsterdam found that infants between 6 and 12 months of age treated their reflection as if it were a “playmate.” This was contrasted by a shift in behavior in the second year of life. Specifically, Amsterdam observed that starting at around 14 months, the majority exhibited self-admiring and embarrassed behavior towards their reflections. Between 20 to 24 months of age, a little more than half of the subjects demonstrated the capability to recognize their mirror images. The present study hopes to build upon these findings by studying the 13- to 20-month-old age range.

The current study hopes to contribute to this social-cognitive perspective of self-recognition. There has been minimal research investigating the manner by which infants’ looking patterns develop through the different stages of cognitive development. Specifically, this study explores whether or not a child’s attention differs when looking at themselves versus another
child. For example, when presented with a video or picture of herself, does she prefer looking at certain facial areas? Are these looking preferences the same or different when compared to a video or picture of another child?

**Methods**

*Participants*

Thus far, the current study has tested 8 13- to 20-month-old infants ($M = 15.6$ months; $SD = 0.222$; two males). Participants who expressed interest in participating in studies through mail-in cards were recruited by telephone.

*Design*

The present study is a between-subjects, exploratory study with one condition. The participant is essentially comparing himself or herself to another infant of similar gender, age, ethnicity, and facial features.

*Procedure*

Prior to the participant’s arrival, researchers placed a laptop on top of a stool and then positioned a video camera on a tripod in front the stool. The camera was below the level of the laptop and slanted upwards. Once the infant and parent arrived, they were both given a plain white shirt to wear as well as an eye tracking sticker for the child to place on their forehead. The child sat on the parent’s lap in a chair facing the laptop and camera. The researchers stood behind the camera. A children’s cartoon was played on the laptop. During the video, researchers took a three-minute recording of the child. The experimenters and the parent were permitted to speak to the child if the child needed help redirecting his or her attention to the video. After recording, the participants left the experimentation room and returned to the waiting area to fill out the remaining consent forms.
In the meantime, the researchers edited the stimuli. After loading the three-minute video of the child into Final Cut Pro, researchers found four different five-second clips during which the baby was looking at the camera. The parent was cut out of the frame as much as possible so that the child’s face was the main focus. Each clip was scaled to 142% magnification. All four video clips had a resolution of 1024 by 768 and a rate of 30 frames per second. In addition to the video clips, researchers created a screenshot of the video using Adobe Photoshop. The screenshot image was resized to fit the specific dimensions of an image template in order to ensure that all images were the same size. The movie files were converted to AVI files using Xillisoft Video Converter. The converted videos and the screenshot image were then downloaded onto a flash drive to be used in the main eye-tracking study. The video clips and image of the child were loaded into the experiment file and used as the stimuli in the study. This constituted the Self condition. This child’s videos and image were then presented with another child’s videos and images who had previously participated in the same study, also known as the Other condition. Researchers tried to choose a child for the Other condition who most closely resembled the child in the Self condition.

Once the stimuli had been loaded into the experiment file, the parent and infant were invited back into the experimentation room to participate in the eye-tracking portion of the experiment. The child sat on his or her parent’s lap in a chair that faced a television monitor. Below the television monitor was the eye-tracking device and a video camera. Subjects were sat at a distance of approximately 550-650 mm from the eye tracker. The study commenced after the infant’s eye was calibrated using the EyeLink computer program. In each trial, one video frame was shown on the screen. The video was either from the Self or the Other condition. One of the four video files were randomly chosen to be presented for each trial. On the final trial, the
screenshot image of the participant was shown next to the image of the infant in the other condition. Eye movements were recorded throughout all trials.

Data Analysis Procedure

Each of the 150 frames in the four videos were coded for areas of interest (AOIs). Four AOIs were coded for: forehead sticker, eyes, nose, and mouth. Adobe Photoshop was used to set the locations of all four AOIs. Data was analyzed based on what AOI the subject was looking at.

Results

Preliminary analysis of the data has revealed that overall infants do look longer at the infant in the Other condition. Although these preliminary results did not reach significance, they did show a trend towards significance. Due to the exploratory nature of the study, there is a wide range of possibilities in terms of data analysis. The researchers hope to find significant results with more data from more participants.

Discussion

The analysis of data thus far show that subjects’ looking times were longer on average for the videos and images of the child in the Other condition than they were for the videos and images of themselves. These preliminary results suggest the emergence of meta-self-awareness during this age. With further analysis of the looking times of specific facial features (e.g. mouth, nose, eyes), researchers hope to explain what features subjects are looking at to differentiate between Self and Other. More recent studies on self-recognition have found cultural differences in self-recognition (Ross et al., 2016). Considering the diversity in cultures among participants, it would be interesting to explore the role that culture plays in the development of self-awareness and recognition.
References


Object Integration Across Space and Time

Golbahar Azizi

The visual system often receives information about objects in fragments scattered across time and space. This information has to be integrated for us to be able to successfully perceive the object as a whole, and ultimately view the world as unified instead of bits and pieces. There is still much to be learned about the mechanisms and processes behind this integration. A lot of effort has been devoted to cases where parts of the object are separated in space. Few examples of such cases are occluded objects in which an object is covered by another object, or illusory figures, which are figures that prompt the visual system to see unified surfaces even when they are not fully visible. Not as much time has been spent investigating what exactly occurs in perception where parts of objects are separated in time, which is the element of interest in the current study.

To better understand the possible underlying mechanisms to temporal integration brain functions and perceptions in general need to be studied. In a recent review VanRullen (2016) argues that brain functions involve occupations at various frequencies. This idea gave rise to the notion of rhythmic perception that is processing of sensory input is rhythmically modulated such that our sensory, cognitive, and motor processing abilities fluctuate rhythmically. Additionally,
these oscillatory cycles directly affect perceptual abilities because a particular phase of each oscillatory cycle gives rise to more efficient neuronal, sensory, perceptual, or cognitive processing, whereas the same process is less efficient at the opposite phase. Several findings from studies in vision imply that for several visual functions there is a succession of more efficient and less efficient phases. These findings point to the existence of two well-separated peaks that typically occur at frequencies of 7Hz and 11Hz. The peak at 7Hz tends to involve visual attention whereas the peak at 11 Hz relates more directly to sensory aspects of visual perception.

To tap into the visual functions discussed above, we used a paradigm similar to Chen & Tyler (2002) and Lev and Polat (2011). Visual performance can be modified for a target when other stimuli are presented at different locations on the retina. This modification is modulated by orientation and the distance of the flankers. When the flankers are in the same orientation as the target, facilitation occurs such that discrimination of the orientation of the target flanker becomes easier. However, when the flankers are perpendicular to the target there is complete loss of this facilitation. A possible underlying mechanism for this facilitation or lack thereof is that detectors responsive to neighboring elements would facilitate with each other if they are in a similar orientation and they would inhibit each other if the orientation is different. Facilitation also depends on the contrast level of the target Gabor patch, such that flanker facilitation occurs in low contrasts and flanker suppression occurs in high contrasts. These studies by Chen & Tyler (2002) and Lev and Polat (2011) aided us not only in choosing our paradigm but also in configuring the distance and the contrast so we can better apply principles such as rhythmic perception.
In order to determine the 75% threshold for the contrast level of a Gabor patch for which a horizontal or vertical orientation could be identified, interleaved adaptive staircases were ran for using the QUEST procedure. In other words, interleaved staircases were used to determine how bright the Gabor patch has to be for orientation responses to reach accuracy of 75%. We then used this value to test orientation discrimination of the patch when it was surrounded by flankers. The flankers could either be parallel to the target Gabor or perpendicular. Parallel flanker meant that all three Gabor patches were oriented either vertically (||) or horizontally (---). Perpendicular flanker meant that the orientation of the middle Gabor patch was different than the other two patches (-|- or |-|). In addition to manipulating the orientation congruency between the target and flankers, we also manipulated the time between the appearance of the flankers and the target. In each trial, the participant saw a fixation spot alone for 1 sec, the flankers alone for 400 ms, and then, after a variable interval, the target for 200 ms, after which the participant had to report the orientation of the target patch. The time between the disappearance of the flankers and the onset of the target ranged from 16:67 ms to 550 ms (in steps of 33.33 ms).

Data gathered from a pilot testing with myself as the participant was analyzed. My proportion correct are shown in Figure 1. A 50ms moving window (average every 3 points together) was applied to smooth the data. There is a notable difference between the parallel and perpendicular conditions. For the parallel condition, my data show a slow downward trend; as the time between the flankers and the target increases, the flankers have less and less of an effect. This is in stark contrast to the effect of perpendicular flankers which cause drastic reductions and improvements in performance as a function of SOA (time between flankers and target). A Fourier transform to put these data in to the frequency domain (figure 2) shows that the perpendicular accuracy fluctuates at roughly 9 Hz, shown in the chart as the orange peak.
There are two main characteristics we wanted to look at in the data. First, the overall change in performance over time and second, oscillation in performance over time.

In the parallel condition, performance starts high and drops off fairly quickly until it stagnates at around 75%, which is the performance threshold that we aimed to achieve using the staircase procedure in the first part of the experiment. It’s difficult to accurately tell whether performance bottoms out at 500+ ms or not. To avoid this issue, it might be good to go out a little further in time so that we can show that performance plateaus, in future experiments. The plateau point of performance can indicate the time when the flankers no longer have any effect on the perception of the target. From the pilot data, it seems that the performance plateau occurs around 500 ms. This might mean that the integration window (the time over which one stimulus affects another) can be as large as 500 ms. This integration window seems rather large, possibly because my performance was improving over the course of the experiment. Therefore, while the contrast setting we used might have corresponded to 75% accuracy at the start of the experiment, it may be up to 80% at the end. When running the experiment in the future, a few trials (approximately 20 or 40) could be added at the end of the experiment that just show the target alone and accuracy is measured on those trials. We then use that point as the "plateau" point. It's more difficult to find where the plateau point in the perpendicular condition is because of the fluctuation in the data.

The perpendicular data show a pretty clear, huge oscillation, but the parallel data don’t, the small fluctuations are likely just noise. This is incredibly interesting. When facilitation in target orientation perception due to parallel flankers occurs we can think of as a feed-forward excitatory signal whereas suppression from perpendicular flankers may be thought of as some sort of feedback or recurrent inhibitory signal. Similar results were seen in another experiment
conducted in the Human Perception lab; This experiment employed the fat/thin method devised by Ringach and Shapley (1996). In this method, the participant makes a forced choice as to whether the stimuli (a Kanizsa square) is wider at its middle than at its top and bottom (fat) or is thinner in the middle (thin). In the fat/thin experiment, we ultimately found an effect for the global mask, which was also a feedback/inhibitory type signal, but not for the local mask, which was meant to interfere with feedforward processing / in a feedforward manner. Peak oscillation for the global condition in those experiment was also around 7.5 Hz which is rather close to the signal in this experiment. Taken together, these results suggest that maybe we are observing a feedback/inhibitory perceptual signal. Our findings are also in agreement with neurophysiological studies discussed in the Van Rullen (2016) review that have found feedback from higher to lower visual areas in the alpha frequency range (7-11 Hz).
Figure 1

Figure 2
References


Human Judgment in Substance Dynamics

Jennica De Guzman

Abstract

Scientists have been trying to understand how humans infer future states of perceived physical situations. There is ubiquitous evidence of fluid dynamics in everyday life that humans can reason about and interact with effectively. In this experiment, we hoped to determine how successful humans are at being able to predict (1) the resting geometry of sand pouring from a funnel and (2) the dynamics of three substances—liquid, sand, and rigid balls—flowing past obstacles into two separate basins. Participants’ judgments show that human reasoning about future states of physical situations are strongly and consistently correlated with cognitive model based on approximate probabilistic simulator with noisy inputs. The model and results reported herein extends previous work that human physical understanding of substance dynamics are based on simulation and demonstrate human proficiency in predicting the dynamics of a substance less common that liquid or rigid objects; the dynamics of sand.
Human Judgment in Substance Dynamics

When it comes to inferring how liquids or solid substances will interact in a given environment, humans can do very well. Whether it is liquid flowing into a glass, or the collision of rigid balls, humans are able to make complex physical judgments so effectively and so quickly about everyday objects (Bates et al., 2015). How humans, even infants, reason about and manipulate substance dynamics have been supported by a growing body of evidence demonstrating that human predictions do agree with Newtonian physics, or the “noisy Newton Hypothesis” (Bates et al., 2015; Smith & Vul, 2013). The hypothesis suggests that humans have a sophisticated implicit knowledge of many aspects of everyday physics that help them infer the value of physical variables through a system of probabilistic reasoning to make predictions about future states. To do this, initial locations, motions, and physical attributes of a physical scene need to be sampled from noisy distributions to make predictions according to approximated physical principles.

The purpose of this study was to gain a deeper understanding of whether human predictions about the future states of multiple substances, including rigid balls, liquid, and sand, can be consistently modeled using approximated, probabilistic simulation. Since sand is not as commonly seen in daily life than liquid, are humans able to accurately predict how it will interact with obstacles and surfaces? The present study explored the characteristics of the representation of different substances and their physical properties, and examined how human judgments and model predictions change with each different substance. Experiment 1 looked at the human ability to predict the resting composition of sand after pouring from a funnel. In Experiment 2, participants predicted how liquid, sand, and rigid balls will flow through obstacles into two separate basins using a similar design to that in Bates et al.’s (2015) study.
In the study by Bates et al. (2015), the noisy Newton framework was extended to liquid dynamics using an intuitive fluid engine (IFE). In the present study however, participants’ judgments for each experiment were correlated with computational results from our intuitive substance engine (ISE), which used a Material Point Method (MPM) simulator with noisy inputs. According to the study by Smith and Vul (2013), human judgments cannot be captured by simple heuristics and must incorporate noisy dynamics. They also suggested that people use prior expectations on object destinations to compensate for uncertainty about their physical models (Smith & Vul, 2013).

**Computational Models**

**MPM Physical Simulator**

The Material Point Method (MPM) used computer graphics to simulate the behavior of solids and fluids and produced physically accurate and visually realistic simulations of the dynamics of liquid, sand, and stiff elastic objects.

**Intuitive Substance Engine**

Although the MPM simulator is accurate in producing visually realistic dynamics for liquid, sand, and rigid balls, it remains very deterministic. As such, it does not take into account that human judgments in different various intuitive physics task vary, that noisy inputs must be incorporated (Smith & Vul, 2013). Following after the implementations of the noisy Newton framework (Bases et al., 2015), the MPM simulator was thus combined with noisy inputs resulting in an Intuitive Substance Engine (ISE) that accounts for the uncertainty in human perception and reasoning in physical situations that involve the three substances used within this study.
In addition, two data-driven models were constructed as competing models—the
generalized linear model (GLM) and Extreme Gradient Boosting (XGBoost). Both are machine-
learning methods based on statistical learning.

Experiment 1

Method.

Participants

Participants consisted of (N=108; 81 females) undergraduate students (M age=20.2)
recruited from the University of California, Los Angeles (UCLA), Department of Psychology
subject pool and were compensated with course credit. The participants had normal, or corrected
to normal vision and were able to understand, read, and write English.

Design

The first experiment was designed to determine whether humans are able to predict the
resting configuration of sand after it is poured from a funnel and onto a surface, and whether
dynamic visualizations of pouring facilitate mental simulation of sand-surface interactions.
Participants were assigned to one of two conditions: Static or Dynamic. Participants assigned to
the Static Condition (N=43) viewed a static image (zoomed out) where a funnel was positioned
at a particular height. According to the study by Schwartz and Black (1999), motor activity, even
when imagined, plays a role in drawing inferences. Participants in the Dynamic Condition
(N=65) viewed a video (zoomed in and out; looped three times; 35 sec duration) of sand pouring
from a funnel that was positioned at different heights above the surface. In the Dynamic
Condition, an area where the sand fell was occluded by a gray rectangle.

Materials and Procedure
All participants first viewed a demonstration video of sand falling from a funnel suspended 10 cm above a level surface (zoomed in and out; looped three times; 29 sec duration). After the demonstration video, participants then viewed a stimulus video based on their assigned conditions with a sand-filled funnel suspended ½, 1, 2, and 4 cm above the surface in a randomized order. Participants were then asked to indicate which of four sand piles would be produced from the sand pouring from the funnel at the indicated height. For each trial, the stimulus images (for the Static Condition) and final video frames (Dynamic Condition) remained on the screen until they responded. The pile choices were shown from the zoomed-in perspective and represented the ground-truth resting configurations resulting from each situation. There were 4 trials in total.

**Results and Discussion**

Human results were compared with results from model simulations. In the human results, there was no difference between the Dynamic and Static Conditions when it came to choosing a sand pile. This suggested that dynamic visualizations of sand pouring from the funnel did not affect how participants inferred the sand’s resting configuration. However, there was an effect of height such that pile choices did vary across different heights, revealing that funnel height influenced their predictions about the resting shape of falling sand. Figure 1 depicts the model results of the ISE, XGBoost, and GLM compared to human results. In the model comparisons, human responses and ISE predictions for the 4 judgment trials were strongly correlated in both Static and Dynamic Conditions. Overall, the ISE provided a better fit to human judgments compared to the two-data driven models about the resting configuration of falling sand.
Experiment 2

Method

Participants

Participants consisted of (N=90; 66 females) undergraduate students (M age=20.9) recruited from the University of California, Los Angeles (UCLA), Department of Psychology subject pool and were compensated with course credit. The participants had normal, or corrected to normal vision and were able to understand, read, and write English.

Design

The results from the first experiment showed that humans are able to predict the resting geometry of sand piles, even though they may not have much experience interacting with sand in daily life. Experiment 2 seeks to determine 1) whether humans can infer interactions between sand and obstacles, and 2) whether their predictions about the resting state of sand in a new situation will be different from their predictions about liquid and rigid balls. The study employed a between subjects experimental design where participants were assigned to the liquid, sand, or rigid balls condition. Thirty participants were assigned to each condition.

Materials and Procedures

Using a similar design in Bates et al.’s (2015) experiment, participants viewed a volume of a substance suspended in the air above obstacles and were asked to predict the what fraction of a substance would fall in each basin separated by a vertical divider. However, instead of reasoning about just liquid, the present experiment differed from previous work in that participants were asked to infer the resting states of three substances: liquid, sand, and rigid balls. The study also used circular obstacles varying in size instead of polygonal ones.
For each substance, forty testing trials (10 trials with 2, 3, 4, and 5 obstacles) were chosen such that the ground-truth proportion of substance in the left basin was approximately uniform across trials. The testing trials were the same for each substance. Before testing, participants completed five practice trials with two obstacles in each situation in a randomized order. Participants were then asked two questions: 1) which basin will majority of the substance fall into and 2) what do you expect would be the proportion that would fall in the indicated basin? After answering, participants viewed a video (13 sec duration) of the situation unfolding and were told the resulting proportion according to the ground truth simulation. After the practice trials, participants then completed 40 testing trials in a randomized order by answering the same two questions in each trial. No feedback was given for each testing trial.

Results and Discussions

The results from the testing conditions were strongly correlated with ground-truth predictions for all three conditions. The deviation for each trial also indicated that the differences between human prediction and the ground-truth status varied according to the substance type. We also found that the response proportions showed significant differences depending on substance type ($F(2) = 8.43, p < 0.01$) by using a random factor ANOVA for a chosen set of trials. To examine whether our ISE and two-data driven models can capture the differences in human performance between the three substances, human judgment and model results were compared, as shown in Figure 2. Similar to experiment 1, human responses showed very high consistency with ISE predictions ($r = 0.93$ for liquid; $r = 0.93$ for sand; $r = 0.93$ for rigid balls). This showed that probabilistic simulation consistently accounts for human judgments across a range of substances and performs better than a ground-truth physical model. In comparison, GLM and XGBoost predictions were less correlated with human judgments. It is also important
to note that the ISE used only ⅓ of the training samples that XGBoost and GLM needed, demonstrating that a generative physical model with noisy perceptual inputs is capable of learning with a smaller number of samples than data-driven methods.

**General Discussion**

The results from both experiments provide evidence that humans are able to predict outcomes of novel and uncommon physical situations by using approximate spatial representations forward in time using mental simulation. This goes against previous research suggesting that human physical predictions do not follow ground-truth physics and instead relies on heuristics (Klopfer et al., 1983). Our ISE has shown that the noisy Newton framework outperformed both ground-truth and data-driven models in both experiments, further confirming the role of perceptual noise and physical dynamics in human intuitive physical predictions as discussed in the study by Smith and Vul (2013). Although our ISE accounted for perceptual uncertainty in each situation, the simulations themselves closely approximated normative physical principles. As in the study by Smith and Vul (2013), adding “stochastic noise” to physical dynamics, however, has been shown to increase model performance when predicting human responses in simple physical situations. Thus, future computational work could explore methods for adding dynamic uncertainty in complex physical situations while maintaining their accuracy and stability. Overall, the results from the present study demonstrate that human predictions about the motions of substances can be accurately predicted by simulation methods with physical uncertainty in perceptual variables and substance attributes.

However, previous work based on Newtonian principles has shown that people tend to show more accurate physical knowledge when tested in more natural perceptual or interactive sensorimotor tasks (Smith & Vul, 2013). As such, a follow up study is underway to explore how
human ability to predict the resting composition of sand in virtual versus real-life settings. The study will be designed similar to Experiment 1, but participants will be presented videos of the simulation using real sand from the beach, a glass funnel to hold the sand, and a stand to suspend the funnel placed on a table. A ruler will also be placed alongside the stand to indicate height, as shown in the setup in Figure 3. The purpose of this is to measure resulting pile widths for different funnel heights so we can determine the parameters for simulated sand that match that of real sand. Thus, when comparing participant performance across a real and artificial sand task, the sand they will be reasoning about will be the same in terms of movement, friction, and viscosity.

Participants will be shown the same exact stimuli (i.e. the initial funnel configuration will have sand suspended X cm above the surface), but one image has realistic texture cues, which inform people’s inferences about the sand’s attributes. Thus, if performance differs between the two groups, it could be due to the realistic-stimuli group having a better understanding of the sand’s properties. In addition, participants will also be shown videos of the sand pouring behind an occluder. It may not be easy to perceive how fast the sand is moving using artificial stimuli, but we expect the visual motion cues to be more pronounced in the real world-stimuli. As previously stated, we believe that such motion cues could lead to superior performance in the real-world stimuli group, which is what we want to determine.

We are currently working on collecting preliminary data for the experiment. We want to record measurements (videos and pile width measurements) of how real sand behaves to create virtual sand that is the same. Thus, if humans had direct access to the properties of the real and artificial sand, their performance in the two conditions would be the same. Since humans initially do not have direct access to that information (i.e. in using ambiguous perceptual information to
infer the attributes), we expect performance will differ, where humans will do worse in the virtual world. The goal of the follow up study is to determine if virtual stimuli are actually comparable to real-world stimuli in intuitive physics. Specifically, we want to know whether it is a good idea to use virtual stimuli if performance on virtual situations differs greatly in comparison to real cases.
References


Figure 1. Results from the model simulations compared to human judgment. (Upper) Static Condition. (Lower) Dynamic Condition. Each bar, 1, 2, 3, 4, corresponds to testing trials with funnel height $\frac{1}{2}$, 1, 2, and 4 cm, respectively.
Figure 2. Human judgments compared to model prediction results. From left to right: ISE, GLM, and XGBoost.
Figure 3. A sample setup of the materials to be used for the real-life simulation. We will use real sand from the beach, a glass funnel to hold the sand, and a stand to suspend the funnel, next to a ruler to indicate height.
Negative Examples in Contrast

Jennica De Guzman

How we come to learn a language is a difficult feat that children undertake in everyday life. Whether it is making sounds, forming syllables, knowing words, using phrases, or creating sentences, children come into the world prepared to learn language. The number of words that a child knows, for instance, is a great indication of their semantic development; children are able to learn new words at increasing rates despite few opportunities to learn the word and a fragmented and incomplete understanding (Bjorklund, 2012). In fact, children are also able to learn new words even more so for objects that they can recognize rather than what they can produce (Bjorklund, 2012). More importantly, a huge topic of interest in semantic development is how children are able to associate words spoken by others to objects and form categories. Studies have shown that comparison and contrast provide different information about categories and have reported mixed results regarding the efficiency of each process. Particularly, some studies suggest that comparing objects of the same category can help children discover underlying high order commonalities (Gentner & Markman, 1994), others suggest that contrast leads to greater category learning than comparison (Andrews et al., 2005), and that contrast helps with word learning and category formation for colors as well as shapes (Ankowski et al., 2013). The present study seeks to provide further research regarding the efficiency of comparison and contrast in children’s semantic development, specifically whether negative examples in contrast benefit generalization and if contrast will result in the most learning.

Previous research have suggested that lexical constraints on word learning exist, such that children do not consider all possibilities whenever they hear a new word (Bjorklund, 2012). A well-known example of this is when a child sees a white long-eared object hopping in a field of
grass and her father points to it and says “See the rabbit,” the child seems to know that he is referring to the whole animal, not the color, the long ears, or the act of hopping by way of trial-and-error in acquiring the meaning of words (Bjorklund, 2012). This phenomenon can be explained by the whole-object assumption, an example of a lexical constraint in which children assume that a new word refers to the object as a whole and not some part of that object (Bjorklund, 2012). One can also argue that this word association is due to another lexical constraint, taxonomic assumption, in which children would assume that words would refer to things that are similar (Bjorklund, 2012). In this case, after the child learns to associate the word “rabbit” with a white long-eared object that hops, the child could assume that a similar-looking grey animal at a pet store also goes by the same name (Bjorklund, 2012).

A study by Gentner and Markman (1994) investigated the theory of similarity further by exploring comparison, and how comparing objects of the same category can help children discover an underlying commonality. The study assumed the view that mental representations consist of hierarchical systems that encode objects, attributes of objects, relations between objects, and relations between relations (Gentner & Markman, 1994). They found that more differences related to the common structure could be found for high-similarity pairs, which are likely to be important to other cognitive processes linked in early development such as the association of words to objects (Gentner & Markman, 1994). What makes a rabbit a rabbit? It’s not the just the ears, the color, or the texture of a rabbit. The shared feature could be the underlying shape of a rabbit. In essence, comparison highlights the shared features to help children discover the underlying higher order commonality, e.g. the rabbit-like features that are necessary for it to be called “rabbit”.
Another study addressed the idea of comparison versus contrast and how it may lead to greater learning than comparison (Andrews et al., 2005). The study by Andrews et al. (2005) investigated the role of stimulus juxtaposition in learning categories by presenting target items in the context of a coordinated triad paradigm that allow learners to 1) compare the evaluation of within-category examples; 2) contrast the evaluation of between-category examples; or 3) both. Where comparison is seeing multiple examples of the same category, and contrast is seeing one example of the category alongside examples of non-category members. They found that success in learning categories can be affected by how the items are presented in the triples paradigm during training, which also suggested that learners are able to benefit most from such triads when each item is a member of a different category (Andrews et al., 2005). In other words, they found support that contrast leads to greater learning than comparison in promoting categorization.

Similarly, the study by Ankowski et al. (2013) also addressed the idea of comparison versus contrast with a focus on color categories. They examined how specific aspects of a categorization task affect performance by systematically manipulating feature variation and category structure in a category extension task performed by 3-year-old and 4-year-old children. They suggested that it is not that contrast is inherently more effective than comparison when it comes to promoting categorization; rather that task context may have an effect on children’s ability to use comparison and contrast (Ankowski et al., 2013). The category extension task manipulated the category structure by presenting children with either high-density or low-density categories, where the categories to-be-learned were defined by the lightness or darkness or hue of color, i.e. dark, medium, or light (Ankowski et al., 2013). Because comparison facilitates attention to the similarities and differences between examples, as proposed by Gentner and Markman (1994), their study explains that lower density categories, with items that do not have
much in common, may benefit most from comparison learning whereas high-density categories may benefit most from contrast learning (Ankowski et al., 2013).

As such, the current study seeks to test how information about category membership can be used to teach children new words. Research assistants created an array of strange and unfamiliar objects controlling for prior knowledge, such that the object cannot be named based on what it looks like. To effectively create abstract objects, everyday items such as bird feeders, bouquet holders, and mini-travel massagers were textured with items such as beans, gems, and couscous, and were then painted with varying colors where shape, texture, and color are manipulated to control for possible categories that the objects can be matched on. The objects will be matched to a particular nonsense word (e.g. wug, dax, flip, blicket, etc.) on the shape category. The abstract objects will ultimately be used to teach children new words to track the learning, retention, and recall of object labels.

Children will be put in one of three categories: comparison, contrast, and one-example. Children in the comparison condition will be shown multiple objects with one kind of shape, where the information about category membership can be identified by looking at a bunch of differently textured and colored objects of the same shape. For instance, comparison is one wug, plus two other wugs. Based on the theories posed in the study by Gentner and Markman (1994), the comparison of similar objects highlight the shared features that may help children discover the underlying higher-order commonality, which in this case is shape. The contrast condition on the other hand, is why it is necessary to have many objects that have different shapes–children will be given information about what makes one category stand out from other objects. Contrast is one wug, along with two other non-wugs. The current study extends from previous research by Andrews et al. (2005) in that a similar triad paradigm will be used to investigate how children
form categories. Lastly, children in the one-example condition will only be shown one wug to serve as the control. The current study will seek to identify whether comparison, contrast, or one-example will result in the most learning of the novel words associated with the strange and unfamiliar object. The present study hypothesizes that contrast will result in the most learning because of the prior research previously described.

Overall, in addition to providing more research on the efficiency of comparison and contrast when it comes to category learning, another aim of the present study is to better understand contrast. What is so special about contrast? Why does it benefit learning, and in this case, language learning over and above comparison? Specifically, the present study seeks to identify whether negative examples in contrast benefit generalization.
References


The role of pregnenolone in the body has been a topic of interest among the scientific community for decades. Pregnenolone is a hormone produced by many bodily tissues, including the adrenal glands, the brain and skin. Due to the high concentration of pregnenolone in the brain, the scientific community have categorized this hormone as a neurosteroid (FDA, 1996).

Early experiments conducted by Weinberg and Wright (1950) demonstrated that when individuals under high levels of stress were administered pregnenolone, they showed improvements in learning, memory and psychomotor performance. Although the Weinberg and Wright findings were of great interest, their experiment was not conducted under clinical conditions, leading many to question the reliability of these findings. It wasn’t until much later the effects of pregnenolone were the subject of clinical studies.

One of these early clinical studies was conducted by Melchior and Ritzmann (1994) on mice. Melchior and Ritzmann (1994) were interested in how different dosages of pregnenolone affected the anxiolytic effect of ethanol. The researchers found that while low doses of pregnenolone without ethanol produced an anxiolytic response, high doses of pregnenolone had the opposite effect. When administered with ethanol, high and low dosages of pregnenolone blocked the antianxiety effect of ethanol.

Meiraran and Reus (2004) were interested in the use of pregnenolone as a benzodiazepine attenuator in humans. Their study found that participants who received pregnenolone prior to diazepam experienced significantly reduced sedation effects of diazepam compared to the participants that did not receive pregnenolone. The Meiraran and Reus (2004) study supports the
current body of research on pregnenolone; pregnenolone blocks GABA receptors, an inhibitory neurotransmitter.

Continuing research on the interaction between ethanol and hormones, Pierucci-Lagha and Jonathan (2005) conducted an experiment that measured the changes in steroid hormone concentrations in humans after ingesting large quantities of alcohol. This experiment revealed not only that alcohol consumption significantly increased pregnenolone production and hence the blood concentration of pregnenolone, it also found that “endogenous neurosteroids mediate some of the subjective effects of alcohol” (Pierucci-Lagha & Jonathan, 2005).

Interested in developing more effective treatments of alcoholism, Wolkowitz and Reus designed the “Neurosteroids and Acute Alcohol Intoxication in Humans Study.” The purpose of this study was to study the effects of pregnenolone and alcohol on a self-assessment of intoxication, a self-assessment of sleepiness and several independent measures of memory.

**Method**

The experimenters of the “Neurosteroids and Acute Alcohol Intoxication in Humans Study” conducted a mixed factorial within subjects design. Participants came to the lab five different occasions, one week between each visit. The first visit was an introduction visit to explain what would occur during the course of the experiment and to accustom the participants to the entire process. On the subsequent visits, participants were given a combination of pregnenolone or placebo and alcohol or placebo. Participants were asked how intoxicated and sleepy they felt at the zero minute mark, 75 minute mark and 150 minute mark after alcohol/placebo and Pregnenolone/placebo consumption. Participants also completed a Weingartner test, a verbal memory test, and a Brief Visuospatial Memory Test (BVMT) during each visit.
Analysis

When I joined the project to aid in data analysis, we first ran a two-way within subjects ANOVA on the subjective ratings. Although running ANOVAs was an excellent preliminary analysis, the main goal was to eventually run a multilevel regression on the data. To run an ANOVA, all data points of the variables of interest must be available for each participant for every visit. When data points are missing, the statistical software being used, regardless of brand, will exclude the entire visit. Too much data is lost due to missing entries when running ANOVAs, hence the end goal of multilevel analysis.

After finding that implementing a multilevel model for the data took more time than anticipated, we decided to temporarily put that approach aside and instead analyzed the data using an ANCOVA approach to better understand the relationship between our dependent variables (level of intoxication, level of sleepiness, Weingartner test results and BVMT results), our independent variables (Alcohol and Pregnenolone) and our covariates (age, gender, alcohol dosage and weight).

After running several ANCOVAs, I realized that there were far more alcohol condition entries than placebo condition entries. While exploring the data, I realized that the missing data in the weight category was causing a lot of data to be lost. This issue had not occurred during the ANOVA phase because weight was not included in the analysis. To address this issue, I replaced the missing values with the average weight entries for that participant. Due to the relatively short duration of the experiment (around two months), participant weight would not have varied by much during the course of the experiment. I also converted the alcohol condition from two levels (alcohol, placebo) to three levels (alcohol high-dose, alcohol low-dose, placebo).
Due to the subjective nature of the self-assessment results, we focused on the analysis of the independent memory measurements. I ran several ANCOVAs with different Weingartner memory test scores as the dependent variable, with the alcohol condition, pregnenolone condition and participant gender as the independent variables and age and weight as covariates. I also ran several ANCOVAs with different BVMT results as the dependent variable. Of the Weingartner measures identified as of high priority by the primary researcher, only one analysis showed promise. The CORR FR (Total number of words from List 1 reported during free recall – Number of words not appearing on List 1 reported during free recall) ANCOVA revealed a nearly significant interaction between alcohol and pregnenolone (p = .066), such that the average CORR FR score was much higher in participants given pregnenolone and no alcohol compared to when they were given pregnenolone and alcohol. Because the interaction was trending very closely to significant, it is possible that a different analysis method may yield significance. However, it is also possible that since only this interaction was even trending towards significance, that it is a Type I error. There was no significant main effect of the pregnenolone condition. There was also no significant effect of the alcohol condition. There was a significant effect of gender. Figure 1 below illustrates the interaction effect of alcohol and pregnenolone.
Returning to the subjective measures, the self-assessed level of intoxication at time 150 ANCOVA appears to be very interesting. The main effect of alcohol is significant and the main effect of pregnenolone approaches significance with a p-value of .057. Not only this, but the finds seem to be opposite of what was predicted. In this analysis, the presence of pregnenolone increased the general feeling of intoxication as shown in Figure 2 below.

*Figure 1. Interaction effect of alcohol and pregnenolone on the CORR FR results.*
As of now, more research must be done in order to apply multilevel regression analysis to our data. Our current plan is to reanalyze the Weingartner data as a repeated measures ANOVA because we are dealing with repeated measures data.

**Conclusion**

When analyzing data with a plethora of variables, it is often difficult to know which variables should be included in the model and which variables are depleting our degrees of freedom. It is also difficult to know whether two variables can coexist in the same model due to the nature of their relationship. The role I play in this project is three fold: clean up the data prior to analysis, decide the best model to use when analyzing the data, and to create that model. Currently, the first goal has been completed. Many trials have been executed to decide upon the best model to use when modeling the data. Unfortunately, none have proved adequate. I will continue researching data analysis methods.
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Primbing and Adaptation Effects on the Hierarchical Processing of Biological Motion

Jiangyan Du

Continuous integration of inputs from a constantly changing environment is a necessary skill when making motion predictions. This is especially useful in dynamic settings where previous inputs can contradict upcoming stimuli. It is also especially advantageous to be able to perceive an animate object given degraded visual inputs. Previous studies provide evidence that these skills are innate; infants as young as three months of age are able to perceive biological motion and show preference towards biological motion patterns (Fox and McDaniel, 1982). These inborn behaviors likely have evolutionary advantages in survival and also in social coordination.

Other studies also support the model of coordinating multiple perceptions to form a motion prediction. Huang, Chen, and Luo (2015) used a timed behavioral approach and found that multiple inputs are continuously processed in an oscillatory manner. Analysis of the detrended reaction time time course data showed a periodic reaction time pattern for both congruent and incongruent conditions, where the prime either matched or mismatched the probe’s motion direction for each respective condition. Their data revealed an out-of-phase oscillatory pattern, supporting the model of rhythmic brain activity. Song, Meng, Chen, Zhou, and Luo’s study results in 2014 also support that varying patterns of neural oscillations that correspond to attention and perception processes also strongly correlate to human behavior.

There is also evidence that perception in one sensory modality can be influenced by input from a different sensory system. Fiebelkorn et. al.’s study in 2011 revealed that target detection in vision is heavily influenced by audio inputs; this behavior is also characterized by a periodic rhythm based on audiovisual congruence.
The actual processing of these various dynamic biological motion stimuli appears to be organized hierarchically. Watanabe and Kikuchi in 2006 demonstrated that motion integration processes depend on locally integrated motions over separate individual motions. These implications of hierarchical motion processing are further supported by Takano, Imagawa, and Nakamura, whose study is 2016 showed that motions symbols are encoded in a “tree” according to spatial organization. Processing these organized encodings with temporal data extracted from varying motion transitions allows for quick and accurate predictions about motion patterns and upcoming stimuli.

Our study consists of three experiments and our predictions are based on the hierarchical processing model of motion perception. It links the first level of processing to the overall motion of the moving body and dedicate significant attention to individual subparts. The next level is dedicated to the movements of individual limbs, while the third and final level focuses on joint movements, the highest level of detail. The first of our experiments analyzed the extent of priming effect on response time across varying prime durations; this revealed an adaptation effect if the prime was relayed for an extended period of time, which we addressed in Experiment 3. Our second experiment tested for the amount of priming effect on response time across different body subparts used for the prime. Experiment 3 analyzed the transition from priming effect to adaptation effect across extended prime durations to choose an optimal prime duration to use in future studies. We expected different response times to different body subparts in Experiment 2, to support the hierarchical model, and we were also interested to see if there would be a smooth transition from prime to adaptation effect over prime duration in Experiment 3.
Method

Participants

We collected data from 36 participants for Experiment 1 (14 men, 22 women, $M_{age}=20.78$ years), 28 participants for Experiment 2 (10 men, 18 women, $M_{age}=20.96$ years), and 41 participants in Experiment 3 (27 females, 14 females, $M_{age}=20.56$ years). Participants were recruited through the SONA system at the University of California, Los Angeles. Subjects were granted online course credit as compensation.

Design

There were three subparts to this study. The timings of the stimuli were standardized by a computer program and recorded RT data were averaged before analysis.

Experiment 1 tested the overall effect of prime duration and body composition on response time (RT). The prime was composed of one of the following: bipedal leg movements (spatial coherent prime), bilateral arm-leg movements (motion coherent prime), or whole body movements (whole body prime). There were a total of 32 trials, with 16 congruent trials where the motion direction of the prime matched the direction of the probe, and 16 incongruent trials where the motion direction of the prime opposed the direction of the probe. Each motion was displayed with a point light and a skeletal representation, with a prime duration of either 100 ms or 500 ms. Thus, there were a total of $32 \times 3 \times 2 \times 2 = 384$ trials in this experiment.

Experiment 2 utilized only 100 ms prime stimuli and compared the response times of different body subpart conditions. Similarly to Experiment 1, there were 16 congruent and 16 incongruent trials, and a point light and skeletal representation for each display. Thus, there was a total of $32 \times 3 \times 2 = 192$ trials.
Experiment 3 tested for the transition between priming and adaptation effects over 6 prime durations. Primes lasted for 100 ms, 200 ms, 300 ms, 400 ms, 500 ms, or 600 ms. It also compared the effect of prime duration on this transition between congruent and incongruent trials. Again, the average data was taken before analysis.

**Materials**

The experiments were run through MATLAB 2007 on the same computer to keep processing time and display settings consistent. To track participants while maintaining anonymity, each participant was assigned a seed number. For all experiments, the subject was presented with a sequence of 500 ms of fixation time on a central cross, the prime stimulus, a 150 ms stimulus-onset asynchrony (SOA), 200 ms of the probe stimulus, and a 500 ms response time window to take in the participant’s response to the probe’s direction. The prime durations were 100 ms or 500 ms for Experiment 1, 100 ms for Experiment 2, and 100-600 ms for Experiment 3, depending on each trial.

Point-light representations were shown in black for the probe stimuli. Meanwhile, the point-light and skeletal prime stimuli were presented in red shortly before the probe stimuli.

**Procedure**

The same procedure was used to run subjects through all experiments. Participants were first asked to document their initials, age, seed number, and gender into the program. The experimenter then instructed each participant to pay attention to both the red prime and black probe stimuli, but to only respond to the probe, and relayed the importance of both timing and accuracy. The participant pressed the left arrow key if the probe was moving towards the left and the right key if the probe was moving towards the right. A practice run was conducted before each experiment to familiarize participants with the program. Short breaks were conducted
throughout each experiment before the program automatically continued when prompted by the participant.

**Results**

Figure 1 shows the results from Experiment 1. There was no significant difference between the 100 ms primes as all led to a similar decreases in RT in congruent conditions. However, when prime durations increased to 500 ms, response times were similar across most congruent and incongruent conditions. The exception was the whole-body skeletal prime, where there was a significant decrease in response time with the incongruent condition over the congruent condition.

Figure 2 details Experiment 2’s data. All conditions yielded significant priming effects, with the spatial coherent and the bilateral (arm-leg opposite) primes giving greater effects than the unilateral, motion coherent prime.

Figure 3 shows the data for Experiment 3. As the duration of the prime presentation increased, there is an overall increase in RT in the congruent condition and a decrease in RT in the incongruent condition. It shows that there are opposing perceptual effects of the same prime stimulus across different durations; thus, our data implies that priming and adaptation perceptual effects are processed through two different neural systems. Of the 6 prime durations that we used, the 100 ms duration yielded the largest RT difference between the congruent and incongruent conditions (an average of around 445 ms and 465 ms for each respective condition).

**Discussion**

Experiment 2 supports the hierarchical processing of biological motion. Specifically, it provides evidence that bilateral body subparts may have preferential processing, as an arm and leg on opposite sides of the body yielded lower response times than unilateral body subpart
primes. Higher effects were also shown for spatial coherent primes. Meanwhile, Experiment 3 expands on Experiment 1’s implication that there was a shift from priming effects towards adaptation effects with increasing prime durations for congruent conditions. Furthermore, since the evidence shows that the same prime stimulus elicits opposing perceptual effects with different durations, it supports the idea that priming and adaptation effects are processed through two different neural systems. Since the 100 ms condition proved to have the largest RT difference between congruent and incongruent conditions, we decided to utilize the 100 ms duration for future studies as it would have the highest signal-to-noise ratio. It would not have a huge overlap between priming and adaptation effects; in other words, the two effects would not cancel each other out when analyzing RT patterns.

Using the optimal prime duration from Experiment 3, we can conduct future studies that vary SOA times within subjects to see if there is an oscillatory RT pattern in the brain during motion processing, as Huang, Chen, and Luo’s study had implied. These studies would study coordinations in motion predictions in a dynamic setting; to do so, it would test both congruent and incongruent priming conditions to see if there is an effect on RT when previous inputs contradict upcoming inputs. We could also test RT patterns for each level of the motion processing hierarchy. For instance, if initial studies support an oscillatory pattern, then it would show that neural networks process incoming stimuli and store perceptions in a periodic fashion. These periodic patterns may be further influenced by the type of biological motion; as such, it is possible that finer details like joints in the third level of the hierarchy would show a different oscillation frequency than a higher level of motion, such as bilateral arm movements.
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Figure 1. Data for Experiment 1. Average response times in judging the facing direction of the probe stimulus, with variations in priming.
Figure 2. Data for Experiment 2. Average response time to probe stimulus with 100 ms prime.
Figure 3. Data for Experiment 3. Average response times for congruent and incongruent conditions across 6 prime durations.
Psycholinguistic Verbal and Visual Study

Jocelyn Reyes

Introduction

People use spatial metaphors to understand abstract concepts such as time. For instance, we may talk about time as 'moving forward' when referring to the future and express that we are ‘looking back in time’ when reminiscing about the past. Studies show that many cultures use spatial metaphors to understand temporal elements (e.g., Boroditsky 2000; Nuñez & Sweetser 2006; Torralbo, Santiago, & Lupiañez 2006). Some researchers have proposed that metaphors, such as those used to understand time, actually structure our thinking and are therefore critical to language. (John Benjamins, 2005). In cognitive linguistics, the connection between time and space domains is commonly examined via the space is time metaphor. Among researchers in this field, Boroditsky’s studies have been some of the most influential.

Lera Boroditsky (2001) claimed that visuo-spatial metaphors in our language shape how we think about time. In her study, she tested 20 native Mandarin speakers and 26 native English speakers. They were shown prime space questions followed by questions about time (all written in English). The spatial questions were either vertical or horizontal and the time questions were before or after statements. Data showed that Mandarin speakers answered time questions faster after vertical primes compared to horizontal primes, while English speakers answered time questions faster after horizontal primes compared to vertical primes. Boroditsky claimed that Mandarin speakers predominantly talk and think about time vertically whereas English speakers think about time horizontally (2001). Furthermore, she concluded that language could shape abstract thoughts (such as time). Multiple researchers, including Chen (2007), January and Kako (2007), have replicated this study, but failed to get the same results. This brings into question the
validity of Boroditsky’s claim that our perception of time is shaped by visuo-spatial metaphors in language.

Last quarter, we gathered data supporting the claim that language does not shape our perception of time. This quarter, our purpose was to gather stronger evidence to support our claim by adding another element to our design: an Eyelink II eye-tracker. Similar to last quarter, we used computer-based animations depicting time motion in different axes with different directionality and measured their reaction times. We also used an eye tracker to record eye-motion patterns and measure the amount of fixations a subject made during each decision trial. In our study we tested four groups: English only speakers, English-Mandarin bilinguals, and bilinguals that speak English and another language. We predicted to see no significant effect of language on reaction times and furthermore hypothesized that people would quickly adapt to different directions, axes and rules of spatiality. Our results confirmed that time perception differences are subtle cross-linguistic distinctions rather than differences in our worldviews.

Methods

Subjects

Sixty-five undergraduate students at UCLA (16 male, 47 female, 1 undeclared, 1 gender fluid) participated in the study for school credit. Their mean age was 20.28. Twenty-three subjects spoke English only, twenty-two spoke English and Mandarin and twenty spoke English and another language.

Materials

The experiment room contained two desks, two chairs, two computers and an eye-tracking device. One computer screen displayed the instructions for the task and ran the animation program. The animations depicted motion on different axes and different directions.
There were a total of 40 Adobe flash animations including the depiction of horizontal left to right motion (visa versa), vertical bottom to top motion (visa versa), and diagonal upward movement towards left or right corner and diagonal downward movement towards left or right corner. The second computer monitor served as the CRT screen. There was a chair by each computer, one for the participant and one for the person running the experiment. Materials also included the Eyelink II head-mounted eye tracker and a box of tissues for the sake of sanitary use of the eye tracker. There was also a pre-test in which subjects provided basic information about themselves (age, gender, major, native language/second language), and their timeline preferences by completing 14 short date movement tasks.

Instructions presented on the computer screen in the experiment room:

“A meeting had been scheduled for February, but eventually got postponed. Each of the following simple animations depicts the shift of the meeting from February to another (later) month in the same calendar year. Your task is to choose the more likely ‘new month’ of the meeting. Two options will be offered after each animation. Please choose one by pressing the button (Left or Right button on the joy pad) as quickly as possible after the animation has finished. Please choose the more likely one even when neither of them seems to be completely accurate. There will be one test trial (6 animations), and two main trials (40 animations each).”

Design

We conducted a one-way ANOVA between subjects group design experiment. The independent variable was the language(s) the participant could speak. There were three levels: English only, Mandarin and English bilinguals, bilinguals in English and another language (i.e. Spanish, Korean, Hebrew, etc.). The dependent variable measured accuracy and reaction–times.
Specifically, we measured the amount of time it took the participant to respond after seeing the animation.

**Procedure**

We first preset the two computer monitors prior to the arrival of the participants. On one monitor we set up the animation program and created a file for the incoming participant. On the other monitor we set up the Eyelink II program. As participants arrived to the lab, we had them sign a contract agreement to participate in the research. After completing this form, we handed them a couple of stapled pages, which contained the pretest. We then led them to the experiment room and asked them to take a seat by the computer and read the instructions. Once we confirmed that they had read and understood the instructions we asked the participant to take a tissue, fold it horizontally and place it on their foreheads so that their skin would not make contact with the eye tracker headband. We then took the eye-tracker and carefully placed it on their foreheads. We adjusted the knobs so that the tracker was placed securely on their heads. We then adjusted the camera pointing towards the right eye, so that it was at the required angle. We had to make sure that the camera was properly grasping the markers, pupil, and corneal reflection. After adjusting the camera, we turned to the monitor with the Eyelink II program and automatically set the pupil threshold. If the image of the eye was set properly we could calibrate the camera. To calibrate, we asked participants to follow the displayed dots on the screen. This computed the correspondence between pupil position in the eye camera image and the gaze position on the monitor (SR Research Ltd., 2005-2009). If calibration was successful, we could then validate it and begin the experiment. Subjects were presented with the judgment task that involved the computer-based animation program. Each set of animations showed a picture of a fictional meeting moving to a different day. There were two options in months and the program
asked which option was the more likely new date of the meeting based on the animation. There were two main sections each containing 40 trials. Experiment lasted approximately 30 to 40 minutes. After the first section, we checked that the camera was still properly calibrated. After participants completed all the trials, we carefully removed the eye-tracker and told the participant they were free to go.

Learning how to properly use the eye tracker was a bit challenging. It was difficult to successfully calibrate the eye tracker. Prior to running participants we met with someone who had experience using the eye tracker and we practiced setting up the eye tracker on each other. However, calibrating on an actual participant is much more nerve wrecking than practicing on each other. For one of the sessions, Dusan had to go out of town and he kindly asked us if we could run the experiment by ourselves. Running the experiment by myself was challenging but rewarding. It forced me to really learn how to use the eye tracker without depending on Dusan being present to help me. I was able to successfully calibrate the eye tracker for all the participants except for one. Dusan had told us that if we could not get the eye tracker to calibrate, we should let the participant go so that we would not use more time than they had signed up for. I had this in mind for each experiment session I ran. However, knowing how important and hard it is to collect enough data motivated me to try really hard to get the calibration to work. Whenever I had trouble, I tried to calm down and referred to the Eyelink II manual to target the problem. It was rewarding every time it was successfully calibrated. After the first two subjects, I started to better understand how to use the eye tracker and I became more comfortable with the entire procedure. I only failed to calibrate the eye tracker for one of the participants. I tried many different angles but the eye tracker would not calibrate. After about 15 minutes of struggling, the participant started to get impatient so I let her go. We still granted them credit for showing up.
Having to run the lab by myself was very useful. Despite being nervous and anxious about the whole process, I was able to focus and successfully run the experiment. I now feel much more prepared to help with future experiments.

**Results**

We analyzed the data using ANOVAs and paired sample t tests to compare the mean reaction times and accuracy of subjects in the three different conditions. We calculated how many fixations a subject made during the decision phase of each trial. The three groups showed a high preference for the horizontal axis in the pretest. The data on the eye motion showed fewer eye fixations for the English-other group as compared to the Mandarin-English group and the English-only group. There was more variability in the English-Mandarin group than in the other two groups. Data also showed that subjects have a tendency to look at the left option for longer than the right option. However, this data does not contribute relevant information to our study since we are interested in the horizontal axis versus vertical axis differences. When comparing the groups’ performance on the horizontal and vertical axes, the data indicated no significant differences between speakers of English and English Mandarin bilinguals. The English-other group performed better than the other two groups.

**Discussion**

Similar to our results in last quarter’s experiment, data showed no significant evidence that Mandarin-English speakers perform better on tasks related to the vertical axis than on horizontal axis related tasks compared to the English-only group. Based on these results, we cannot infer that Mandarin-English speakers can think about vertical timelines more efficiently compared to the other two groups in our study. Furthermore it does not support Boroditsky’s claim that Mandarin speakers think about time differently. Given that the test lasted 20 minutes,
the overall adaptation to other axes was about 3-5 minutes. It is more likely we have a quick
adapting spatial mechanism than it is for one to change their worldview in such short amount of
time.

It was rewarding to assist Dusan with the Psycholinguistic Visual and Verbal Study for
the past two quarters. It gave me insight to how experimental designs can be varied and
developed to further confirm data. Adding the eye-tracker to the experiment allowed us to
provide stronger evidence. Results also revealed other patterns that (although not relevant to this
experiment) could be useful to other studies. In addition to gaining a better understanding of the
inner workings of a research process, I gained more confidence in my ability to work
independently in a lab. Moving forward, I hope to assist in more studies to continue developing
my skills.
References


Bidirectional Relationship Between Word Learning and Executive Control

Johanna Hunter

Over the winter quarter of 2017, I was able to work as a research assistant in Catherine Sandhofer’s lab, with Natsuki Atagi on the Categorization and Switching study. This study runs participants under the expectation to share the results of recent research suggesting that the relationship between word learning and executive control may be a bidirectional relationship. The recent research suggesting this correlation can be viewed in the results of the Yoshida and colleagues’ study (Yoshida, Tran, Benitez, & Kuwabara, 2011). The Yoshida and colleagues’ study examined the difference in attentional control and word learning in monolingual and bilingual children, specifically, in 3 year-olds. The study used an artificial task and an attention control task to ultimately find that, for both the monolingual and bilingual children, the child’s attentional control skills strongly related to their ability to adjectively learn (Yoshida et al., 2011).

Another example of recent research that suggests the bidirectional relationship between word learning and executive control is the Kapa and Colombo study (Kapa & Colombo, 2014). This study examined the idea about whether the executive functioning skills in adults and young children could accurately predict their language learning abilities. This study’s results revealed that 4- and 5- year olds’ attentional monitoring and shifting skills related to their noun and verb learning ability. Therefore, children’s attention and shifting skills had an effect on their ability to learn new words and expand their language (Kapa & Colombo, 2014), which shows that executive functioning skills in children does predict their language learning abilities. Another study that has suggested a relationship between word learning and executive control is the Fisher and colleagues’ study assessing selective sustained attention in 3- to 5- year-old children (Fisher,
This study used the Track-It program, which was also used in our study, to evaluate selective sustained attention in preschool children. The Track-It program requires children to track a single unique target object moving among a set of distractors along a random trajectory until it disappeared. In this study, the target object moving among the other objects could be as noticeable as the distractors, or more noticeable than the distractors. 5-year olds performance tended to be better than 3-year olds when the object being tracked was just as noticeable as the distractors, while 3-year olds were better at tracking an object that was more noticeable than its distractors. The results of the study were that the development of the executive control of selective sustained attention follows a specific developmental course (Fisher et al., 2013).

Because of the strong and similar results of the previous studies, our study continues to analyze the bidirectional relationship between world learning and executive control, specifically, in 4- and 5-year old children. Our study aims to examine how different cognitive processes, specifically inhibitory control, sustained selective attention, and working memory, relate to novel word learning in 4- and 5-year old children. Unlike the previous studies, our study chooses to examine inhibitory control and working memory in addition to sustained selective attention skills. This is because the ability to learn words encompasses more than just one’s attention skills, or lack thereof. Word learning requires not only the ability to attend to correct object-word mappings, but also the ability to remember correct object-word mappings, use of working memory, in order to inhibit attention from incorrect object-word mappings, our inhibitory control.

In our study, analyzing this relationship in children was done using three different activities with the participants. The first activity we would use with the participant was the novel
noun generalization task. With this task, the participant was presented with ten novel object categories, the first 5 categories were organized by shape and the last 5 categories were organized by texture. Within each category, three exemplars shared a central property, either shape or texture, and differed on other aspects. Exemplars of each category were presented one by one and each given the same label (e.g., wug). After viewing and touching the exemplars of the given category, the participant was then exposed to four objects on a table, none of which had been presented to the participant earlier. They were then prompted to label one of the four objects in front of them with the novel label given for that specific category. On the table there would be one instance of the target category coupled with three distractors.

The second activity used in our study was the Fish Flanker Test, which tested inhibitory control. This activity is an attentional network task that has been adapted for children, as the target arrows have been replaced with fish. First, as a test trial, we show the participant one fish and ask them to press the keyboard button corresponding with the fish in the same position. We continue the test trial by showing them a line of fish either all facing the same direction, which would be congruent, or in which the target fish (one in the middle) is facing a different direction than its neighboring fish, which would be incongruent. In this case, the child is asked to only focus on the target fish and press the button that matches the directionality of the target fish. The participants are then tested based on these directions. Inhibitory control was calculated by subtracting the accuracy on incongruent trials from the accuracy on the congruent trials.

The third activity used was the Track-It Task (Fisher et al., 2013), which was incorporated to test sustained selective attention and working memory. For this activity, the participant had to track a single target object that was pointed out before the game began, as it moved with a set of distractors in a random pattern until all the objects on the screen
disappeared. The participant was then asked to tap on the screen where they last saw the target object, this was followed up with all the objects on the screen, and the participant had to tap on the object they had been tracking. Sustained selective attention was measured by the participant’s accuracy in reporting the last location the target was seen at while working memory was measured by the participant’s accuracy in reporting the identity of the target object after each trial. After performing all these activities with the child, we would input their data into the Excel sheet.

As a research assistant, there was much more to do besides perform the previous activities with the participants. In order to assure participants for the study, we had to schedule them. We were able to do this by calling the numbers on the call sheet every week, speaking to the parent about the study, and finding a time in which we were running the study that worked with the parents’ schedule. If the parent was too busy to talk on the phone, as I usually called between the hours of 9-11 AM or 2-4 PM, I would send them an email with all the information of the study and times we were running the study. After scheduling the participant, I would create an event on our study’s Google calendar, which would notify the lab assistant that had left that slot available to run participants, with the participant’s ID number and the date and time of their appointment. I would then make sure to follow up with a confirmation call the day before the scheduled appointment to remind the parent of their agreement to participate in the study.

Since I have been a research assistant on this study since the summer, I have become very familiar with scheduling and running participants. Based on my experiences, I have noticed a few things while testing the participants with the activities mentioned above. To begin, regarding the novel noun generalization task, most participants tend to have an easier time matching the correct novel label with the target object in instances comparing the central property of shape.
However, when it comes to labelling objects based on solely texture, they seem to get more distracted by the distractors, or randomly guess between the objects on the table. It is easier for them to perceive similarities in shape rather than texture. Regarding the fish flanker test, children get very restless if they are not getting the right answer, as they know if they are right or wrong based on the sound emitted after they press the keyboard. With the more wrong answers they get, the faster they continue to go through the game, which usually leads to more incorrect answers. This affects their sustained selective attention because the more frustrated they get, the less attention they seem to direct to the activity. However, with Track-It, they are not told if they tapped on the wrong area, or had been following the wrong object. Regarding this game, children, for the most part, have a higher likelihood of tapping the correct object than the right location where the object last appeared. In other words, they always know which object they are supposed to be tracking, but sometimes incorrectly tag the last location of the object they were watching.

As a cognitive science major, I am very interested in our study and the activities we run on our participants. This lab and its research has taught me that language is not all about the cognitive process of attention, but that inhibitory control and working memory are also very important processes in regards to word learning. I see this firsthand while testing the participants, in particular with the Track-It task, as it tests both inhibitory control and working memory. I look forward to continuing to learn and work on our study.
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The Effects of Physical Warmth on Fear Learning

Jude Orfali

Fear learning, the associative learning paradigm wherein organisms learn to predict and fear certain aversive stimuli, is adaptive; however, some fears are detrimental to have. Understanding how to eliminate such harmful fears may lead to improvements in health. Prepared safety stimuli are those that naturally signal safety and therefore are less easily associated with fear and are able to inhibit conditioned fear responses (Hornstein, Fanselow, & Eisenberger, 2016). Previous research has suggested that social support figures serve as prepared safety stimuli (Hornstein et al., 2016). Additionally, previous research investigating the relationship between physical and social warmth has indicated that social support and physical warmth have similar underlying processes (Inagaki & Eisenberger, 2013). Both physical warmth and social warmth activate the same parts of the brain and feeling one type of warmth surfaces feelings of the other (Inagaki, Irwin, & Eisenberger, 2015). Consequently, physical warmth may also serve as a prepared safety stimulus and inhibit fear learning, reducing potentially detrimental fears. Specifically, experiencing physical warmth may suppress associations with fear.

In a recent study, Inagaki and Eisenberger investigated the neural mechanisms that were associated with physical and social warmth (2013). They compared which areas of the brain were activated in response to socially warm stimuli and socially neutral stimuli as well as physically warm and physically neutral stimuli. Participants were instructed to read socially warm and neutral messages from family and friends while lying in an fMRI scanner. Then, they were instructed to hold a physically warm object (a warm pack) and a neutral one (a ball) while still lying in the fMRI scanner (Inagaki & Eisenberger, 2013). Participants were subsequently asked to rate how socially connected they felt and how physically warm they felt following each
trial. The results of the study showed that holding the warm pack, as opposed to the ball, led to increased ratings of social connection. The researchers also found that the same neural mechanisms involved in temperature perception and regulation were involved in processing social connection. The regions activated in response to both physical and social warmth include areas in the middle insula and the ventral striatum (Inagaki & Eisenberger, 2013). This research ultimately shows that there are overlaps in both the way physical and social warmth are experienced and the way they are processed in the brain.

Following these findings, researchers conducted a study in which they investigated the effect of blocking opioid-rich regions, involved in the perception of physical warmth, on feelings of social warmth and social connection (Inagaki et al., 2015). The regions aforementioned that are involved in the sensation of both physical and social warmth were essentially targeted, as they have an abundant supply of opioids. Researchers administered either an opioid antagonist or a placebo to participants. Following the ingestion of the drug, participants were instructed to hold a warm object, then a cold object, and lastly a neutral object. They were subsequently asked to rate how warm each object was and how socially connected they felt after holding each object (Inagaki et al., 2015). The results of this study indicated that participants that took the opioid antagonist (naltrexone) experienced a reduction in their feelings of social connection. Specifically, naltrexone blocked the activity of opioids so that holding a warm object led to a reduction in the feeling of social connection that is usually elicited when an individual has a physically warm experience (Inagaki et al., 2015). Ultimately, this study further validated the relationship between physical and social warmth. The results from this work indicate that physical and social warmth overlap in both the way they are experienced and in the neural
activity that might be underlying this experience, such that inhibiting the ability to sense physical warmth inhibits the ability to feel a social connection.

Furthermore, the relationship between social connection and physical warmth is not contingent on external processes, but can be affected by internal psychological and physiological processes. In a study investigating temperature and social connection, researchers found that without manipulating body temperature, higher oral temperatures were correlated with feelings of social connection, suggesting that an internal measure of warmth is also associated with social connection (Inagaki et al., 2016). Similarly, another study found that individuals excluded in an online ball tossing game had lower finger temperatures. Additionally, the negative effects associated with exclusion were greatly reduced after holding a warm object (Ijzerman et al., 2012). Furthermore, researchers found that cold temperatures affected individuals’ psychological feelings of belonging and connection. Specifically, drinking cold water threatened feelings of social connection among participants with low familial support (Chen, Poon, & DeWall, 2016).

In summary, psychologically feeling left out can influence body temperature and internal temperatures can influence experiences of social connection. Therefore, the relationship between social and physical warmth is not dependent on external factors, such as experiencing a warm object, but is also affected by internal states.

In another series of studies, researchers investigated the role of social support stimuli as prepared safety stimuli (Hornstein et al., 2016). Social support relationships, and the connections with others that they provide, are essential for survival, therefore, social support figures may naturally signal safety and individuals may feel less fearful when in the presence of or viewing images of such figures. In one study designed to test this, it was examined whether participants could associate fear with social support stimuli (images of social support figures) during a fear
conditioning procedure. In a second study, it was examined whether the presence of social support stimuli led participants to show a lower fear response to previously conditioned fear stimuli (Hornstein et al., 2016). The results of this work showed that participants did not associate fear with social support stimuli and that these stimuli also inhibited the fear response when paired with a conditioned fear stimulus. It was concluded that social support figures serve as prepared safety stimuli (Hornstein et al., 2016). These findings show that social support is less easily associated with fear and can enhance fear extinction, reducing detrimental fears and improving health outcomes. Based on these studies, demonstrating that physical and social warmth share underlying processes, and that social support figures serve as prepared safety stimuli, physical warmth may inhibit fear learning, such that individuals are not capable of associating fear with warm stimuli.

Altogether, previous work suggests that there is a strong overlap in physical warmth and social warmth processes (meaning, the experience of being social connected). Together with their similar survival-relevance, evidence indicates that physical warmth may play a similar role as social support during safety signaling processes. The current study aims to investigate whether physical warmth serves as a prepared safety stimulus. We will examine whether it is more difficult to associate fear with physical warmth, compared to soft or neutral materials.

**Method**

**Participants**

Participants will be undergraduates at the University of California, Los Angeles (UCLA). A targeted sample size of 30 has been selected.
Procedure

Prior to participants’ arrival in the lab, a telephone screening will be conducted, verifying that all participants are above the age of 18, are not taking any medication related to mental illness, and are not pregnant. If participants pass the telephone screening, they will be asked to come into the laboratory for a galvanic skin response (GSR) screening session. During this session, we will test whether the GSR equipment being used in this experiment can detect participant’s responses. Participants will be told to place their left hand palm up on a flat surface and two electrodes will be placed on the medial phalanges of the index and middle fingers. They will then be instructed to take a deep breath and exhale, count to five slowly in their head, and repeat this process while remaining as still as possible (a process known to activate peripheral nervous system activity and lead to elevated GSR). If the equipment can detect a participant’s response they will be considered to have passed the GSR screening and will be given a consent form and questionnaires to fill out before being scheduled to return for the experiment session.

In the experiment session, a shock calibration procedure will be conducted, in which the appropriate level of electric shock will be found for each participant individually. The starting level of shock will be 30 volts and will be increased by 5 volts at a time until participants inform the experimenter that it is extremely uncomfortable, but not painful. A second GSR test will then be run before beginning the experiment (to ensure that the equipment is picking up responses during the experiment session).

During the experiment, 4 object stimuli will be used as conditional stimuli (CSs): a warm pack, a soft ball, a hard ball, and a wooden block. During all trials of the experiment, participants will view a fixation cross on the center of the screen while one of the four objects is placed in their hand. Each trial will last 10 seconds, during which the object is in their hand for the entire
time, and will be followed by a 20 second inter-trial-interval. Each trial will be preceded by a screen displaying a trial number (i.e., “trial 1”), and experimenters will have a master list of counterbalanced trials to inform them which object is to be used for that specific trial—which will then be placed in the participant’s hand as soon as the trial begins. Each trial will be followed by a screen displaying the words “end trial”, so that experimenters know to remove the object and prepared for the following trial.

In the first phase of the experiment, the habituation stage, there will be three presentations of each of the four total stimuli, for a total of 12 trials, and there will be no shock in any trial. In the acquisition phase, there will be six presentations of each stimulus, for a total of 12 trials, but some trials will be paired with shock while others will not: 3 of the stimuli (the warm pack, the soft ball, and the hard ball) will be paired with a co-terminating 200ms shock (CS+s), while one stimulus, the wooden block, will not (CS-). This will be done so that we can later examine GSR for each CS+ condition to the GSR in the CS- condition at each stage, allowing us to use the CS- as a baseline to determine whether fear learning occurred. In the extinction phase, no shock will be administered and each stimulus will be presented six times, for a total of 24 trials. Once all phases are completed, participants will be unhooked from all the equipment and asked to fill out a second questionnaire and informed that they have completed the experiment.

**Expected Results and Discussion**

In this study, we expect that participants will learn to associate fear with the two stimuli that do not produce a physically warm experience (the soft ball and the hard ball), while they will not learn to associate fear with the warm pack. We predict that holding the warm pack will prevent fear learning, as participants will not associate physical warmth with fear. Ultimately,
this is important because it shows that the use of physical warmth could be a method to inhibit fear learning and reduce harmful, unhealthy, and potentially detrimental fears, resulting in beneficial and healthy outcomes. Future research would investigate whether physical warmth also inhibits conditioned fear responses (the second property of prepared safety stimuli that social support stimuli have been demonstrated to hold), ultimately informing whether physical warmth might be helpful in strategies to reduce the development or occurrence of unhealthy or harmful fears.
References


Social Cooperation: Predicting behavior using theory in evolutionary psychology

Juliana Kotz

A multitude of theories may attempt to explain why and how social cooperation occurs. Once understood, the ability to predict in which circumstances cooperation will be maximized can be developed. Through an evolutionary psychology lens, a chief, underlying explanation is that cooperation occurs because humans are only interested in helping their own fitness, which includes their lives and the lives of their relatives. In following this theory, it would not be surprising for humans to make distinctions between those within their social group and those who are not as well as create biases towards the latter. It would also be reasonable for negative or positive emotions to arise during a situation in which humans have to work with one another. Both group biases and emotional responses towards others can be viewed as motivators working to promote self-serving outcomes, even if the people exhibiting these reactions are not aware of it.

Instinctually, greater cooperation would be expected to occur between people within a social group than between people from different social groups. Cosmides and Tooby (2013) argue that greater attention is granted towards those within a person’s social group leading to stronger long-term memory of social information for those members. Being able to store and use that social information can help to build better relationships with one another. From an evolutionary psychology standpoint, the advantage of cultivating relationships is that it increases the chances of working together in the future for mutual benefits, thus leading to social cooperation. In this way, cooperation is in a person’s best self-interest since they will be benefiting from the relationship regardless of whether the other person also benefits from the exchange.
On the other side of the collaborative effort among those within a social group, however, is the weak relationship between those from different social groups. Clearly, a strong relationship does not usually form, or else they would not really be considered from separate social groups in the first place. Because of this weak bond between outgroups and the strong bond between ingroups, attention does not necessarily need to be given to outgroups, except when there is potential for some sort of threat from them. In fact, evidence shows that people are better at remembering the angry faces of those from an outgroup than an ingroup (Ackerman et al., 2006). Anger is an emotional warning sign that an attack of some sort is possibly about to occur. If people from outgroups are seen as possibly dangerous when they are not being ignored altogether, then it would not be expected to have great cooperation between members of outgroups.

All of this taken together, what is most evolutionarily advantageous and what is within a person’s capability in terms of storing social information and keeping social relationships, may have led to the rise of distinctions between members of ingroups and outgroups. This is because humans’ fitness increases only when they cooperate with those who they know will cooperate with them. If they decide to put in energy and possibly other resources towards someone who may not do the same for them, then their fitness decreases (Cosmides and Tooby, 2013). There is less certainty that those whom a person does not have a social relationship with, such as members of an outgroup, will cooperate simply based on the fact that they do not know each other. Biases that favor ingroup members and do not favor outgroup members would then be motivators for interacting with the ingroup and not with outgroups. With this in mind, if humans have evolved to metaphorically label others and learn to cooperate with those labeled an ingroup member, then it is conversely possible that if humans are told what another’s label is instead of
deciding for themselves, they will still treat that person as an outgroup member and be less cooperative. Thus, it may be possible to predict how cooperative a person is likely to be just based off of their perception of who is in their social group and who is not.

Evolutionary psychology theory on self-interested reasons for cooperation is not the only theory on cooperation that exists. Leppänen and Hämäläinen (2017) assert that helping behavior is influenced by people’s emotions rather than the desire to be helped by another person to complete one own’s goals. Evidence for such a claim comes from the observation that people expressed anger or disgust when they took a loss in social exchanges and positive emotions when they gained something out of the social exchange. Leppänen and Hämäläinen argue that these emotions expressed by the participants in their social dilemma task are driving forces in predicting the likelihood of cooperation with one another. From the evidence of their study, they believe that cooperation is not as dependent on working towards personal gains such as theory in evolutionary psychology has maintained for decades.

While emotions certainly can play a role in the decision of whether to cooperate and what the level of cooperation will be, that does not rule out the possibility of self-interested goals prompting cooperation. Conceivably, emotions can work as a type of motivator or alarm system for organisms to complete goals that will serve to increase their fitness by means which can include cooperation. To reiterate what was mentioned earlier, only cooperation with those who reciprocate will be evolutionarily advantageous. Alternatively, cooperating with those who do not show helping behavior in return is not advantageous so the organism will want to avoid being in that situation. Emotions can help humans to know when to cooperate and when to avoid cooperation (Cosmides and Tooby, 2013). In following the evidence presented by Leppänen and Hämäläinen, feeling anger or disgust towards someone who does not cooperate could be an
indicator to not cooperate with that person in the future. It becomes easier to be motivated to not work with those a person has negative feelings towards. Correspondingly, feelings of positivity can function as a motivator to work with that person again in the future since this type of emotion makes it easier to want to cooperate. Therefore, new research findings on influential factors in social cooperation can shed light on the preexisting theory in evolutionary psychology, but they do not necessarily disprove it nor serve to replace the theory.

When considering the combination of emotional responses to others’ level of cooperation and biases that may be held towards others of different social groups, it could be speculated that people will be more likely to have negative emotional responses to those in outgroups. Along the same line of reasoning, people may be less likely to have positive emotional responses towards those in outgroups. Conversely, people may be more likely to have positive emotional responses to those within their social groups and less likely to have negative emotional responses to those within their social groups. It would also be interesting to measure the level of emotional responses, both negative and positive, towards both types of groups. Intuitively, people may have stronger negative expression of emotion and more muted positive expression of emotion towards those in outgroups. Moreover, people may have stronger positive expression of emotion and weaker negative expression of emotion towards those within their social group.

In order to carry out the suggested processes associated with cooperation such as forming biases towards members not within one’s group and letting emotional responses guide the decision to give or withhold help, evolutionary psychology would suggest that there are brain mechanisms that evolved to execute these particular abilities. In order to understand the development of biases from a neuroscience perspective, investigation of areas in charge of categorization and understanding social information may be useful. Prefrontal and parietal
cortical areas have been shown to activate during categorization tasks (Vogels et al., 2002). Beyond declarative knowledge, social interactions require processing social knowledge. So, brain areas involving theory of mind may play an important role in being cooperative. Perhaps in the categorization of members of different social groups, the theory of mind network is more activated when interacting with those from an ingroup than with those from an outgroup. Additionally, in order to fully understand the role of emotional expressions during social cooperation, areas in the limbic system typically associated with emotional processing such as the amygdala and the hippocampus may be worthwhile to explore in the context of a cooperation task.

In all, several factors may need to be integrated in order for a person to perform a cooperative act. Among those factors may include, but are not limited to, biases towards different social groups the person is and is not apart of and emotional responses towards those the person is going to potentially cooperate with. Understanding the neurological bases for these two processes as well as further research into other processes that go into a person’s decision to cooperate with someone else may be constructive in cultivating the ability to predict when people will choose to be cooperative. This would be helpful for situations in which it is important or even necessary for people to cooperate with one another. For instance, a real application of predicting human cooperation tendencies may be how to maximize cooperation among people of differing political affiliations so that they can make substantial legal progress on the issues that pervade our society. Not only would this be useful in cutting down on the amount of time spent struggling to come to an agreement on policies at differing levels of government, but it might also lead to a settling down of the extremely polarized political climate
that exists in the United States currently and could very well continue to exist in the future of American politics.
References


Action Perception and Prediction of Single and Multiple Actor Sequences

Kinshuk Sen

The brain as an organ was believed to thrive on the process of “division of labor” wherein different portions of the brain would accomplish different tasks simultaneously in order to make the most efficient and thorough use of the limited resources at hand. Cortical regions for language and action were always believed to be independent of each other in terms of their respective functioning: the motor and premotor cortex were involved with actions while the left Perisylvian cortex, around the Sylvia Point, was specialized for language (Pulvermüller, 2005). This “strict modular organization” was reaffirmed through studies on patients with neurological diseases: a stroke or physical damage to one portion had no effect on the other part of the brain, i.e. the patient did not lose function for both due to damage to just one region of the brain. This idea, known as the “modular perspective” was believed to be the predominant ideology for a long time, until it was hypothesized that it is indeed possible that while processing words, neural connections are made between the cortical areas of language and action respectively (Pulvermüller, 2005). Through neural anatomical connections and links between cortical areas of language and action, cortical functions were seen to be served by “distributed interactive functional systems rather than local encapsulated modules” (Pulvermüller, 2005).

There is certain likelihood that the cortical areas of language and action develop specific links in situations whenever “actions correlate with specific language processes” (Pulvermüller, 2005). One such application is that of the perception of action words, for example “lick,” “kick,” and “pick,” that combine language elements and motor programs. They activate premotor and the motor cortex in a “somatotopic fashion” (Pulvermüller, 2005). For example, in the case of the action word “lick” the word is associated with an action that relates to the tongue or the face, and
thus there is heightened activation in the inferior fronto-central areas, as compared to leg words such as “kick” which in turn show a heightened activation in the superior temporal sites, as compared to the face words. “These results show that meaning access in action word recognition is an early automatic process reflected by spatiotemporal signatures of word-evoked activity” (Pulvermüller, 2005). This can be considered in relation with the Hebbian principle: connection between neurons that are simultaneously activated are strengthened, or simply, the neurons that “fire together, wire together.” Therefore, it can be said that the neuronal synaptic connections between the somatosensory cortex and the motor cortex are strengthened with the functioning of neurons in both of these cortical areas.

However, the understanding of interconnections between language and action cortical regions is incomplete without talking about timespan between exposure to the action word and the activation of the cortical region. Since action processing is at the same time as verbal processing, spatially in the brain, there will be competition. It is this difference that could help us understand whether cognitive perception of, for example, actions words is immediate, implicit, and a form of “bottom-up” processing, or if it takes effort and cognitive ability to complete the task. In the Pulvermüller study, “late postlexical meaning-related processes are reflected by late components of the event-related potential (ERP) and field, which are maximal ~400 milliseconds after word onset. However, neurophysiological differences between word categories that reflect lexico–semantic processes have been found as early as 100–200 milliseconds” (Pulvermüller, 2005).

In this current study, the researchers sought to see the effects of the subject being primed with a certain word and then being exposed to an action. This was seen in terms of congruency, or lack thereof, between the priming word and the action show, as well as the SOA (stimulus
onset asynchrony), i.e. the time duration between when the word is no longer on the screen to when the action is shown. This study will also manipulate the SOA to see under which time condition is the effect of priming the most prominent. Since it was predicted that the perception was in an oscillatory fashion, it was predicted that the SOA at which the oscillation found its peak, that will be the point of maximum action perception. The actions in these cases were shown in a within subjects fashion wherein they were chosen to be as neutral as possible, i.e. “walk” and “run”, so as to not ideally instigate an emotion or an interfering response in the subject’s mind. The response times were measured in each case, showing whether or not the priming is effective. It is hypothesized that there should be an effect of priming on the action, i.e. when the word and the action are congruent, the response time will be lesser and the accuracy will be higher, as opposed to when they are incongruent. It is hypothesized that the ideal SOA would be neither too short so as to overlap, and not too long so as to see the word and the action as independent stimuli, but somewhere in the middle.

Method

Subjects

A total of 33 undergraduate students from the University of California, Los Angeles, signed up for this experiment through the online forum of SONA Systems. There were 24 females and 9 males, with ages ranging from 18.06 to 51.86. The participants were fluent in English, and were given credit up to two points as compensation for the study.

Design

This was a 2 X 2 within-subjects design study with two independent variables and one dependent variable. The first independent variable was the type of action. This independent variable had two levels: walking and running. These motions were used since they were
recognizable to most healthy participants, and were considered neutral thus were expected to not cause any perceptual interference with the task. The second independent variable was the type of priming word. This independent variable had two levels: “walk” or “run.” The third variable that was varied independently (but not necessarily considered as an independent variable) was the SOA or the Stimulus Onset Synchrony.

The dependent variable was the reaction time to the action of the point-light figures (walking or running). This was measured by the subject’s speed at pressing the left arrow key if they saw the point light figure walking, and pressing the right arrow key is they saw the point light figure running.

**Materials and Apparatus**

Prior to the main experiment, an AQ questionnaire was provided to the subject. The questionnaire first asked for the subject’s initials, trial number, as well as their email address. The questionnaire consists of multiple questions in which the participant is asked to rank whether they “definitely agree”, “slightly agree”, “slightly disagree” or “definitely disagree.” This was followed by the actual experiment, known as WPA. The main experiment was also started with the program asking for the subjects’ name, date of birth, trial number, and etcetera. For this experiment, the programming was done on MATLAB. The program comprised point-light biological motion figures which showed the major joints of the body and further showcased movements and actions, as well as word flashes that were used for priming the subject. The experiment started with the step for the subject to read to fully understand the task. This was followed by a series of trials that helped the subject become better acquainted with the task, before actually going into the main experiment. These visuals were all showed on a desktop.
This was in total a two-part study, wherein each part had to be at a week or more’s time difference from each other.

The Stimulus Onset Asynchrony (SOA) was used as a time gap between the end of the visual display of the word and the beginning of the action. There were multiple levels to this ranging from zero to 800 milliseconds, in increments of approximately 33 milliseconds. In total there were about 25 different SOA’s. Every combination of SOA, word type, and action type was presented 30 times across the two parts of the study, i.e. the combination of 66 milliseconds, the word “walk,” and the action running was presented 30 times in total. The word appeared for 33 milliseconds, and the action lasts for 0.50 seconds, and they get 2.5 seconds to respond. It was also important to note the significance behind the time durations for which the word or the action were exposed for: we need to give them a good amount of time so that they should be able to process it. And the word was there for 33 milliseconds because they need to be able to detect the word in the shortest time possible. We don’t want to give them too much time to respond for each trial, so that we can have them do multiple trials in one session.

Procedure

This was a two-part study. The first time the subject came to the lab, they were taken to a private room and were asked to put their chin on the elevated chin rest attached to the table. They were asked to initial into a sign-in sheet that also assigned them a subject number for the experiment, and recorded the dates of both the parts to the study. The researcher opened the AQ file for the subject and asked them to fill in the initial details. The researcher then explained the subject the steps to complete the task: the subject must choose an option with the helps of the arrow buttons and after choosing, they must move to the next question by pressing the space bar. After the subject was fully aware of the task, the researcher shut the lights, and closed the door.
Upon completion of the questionnaire, the subject would ask for the researcher, who would then open a new file called WPA, which had the main experiment. The researcher would again explain steps for the experiment: they subject was told that they will see a word (either ‘WALK’ or ‘RUN’) flash on their screens (see figure 5), and after a certain time interval they would see an animation of person either walking or running. The task was to press the “left-arrow key” if they saw the animation walking, and the “right-arrow key” if they saw the animation running. If the subject were to feed in the wrong answer, a pre-programmed beeping noise would ensue letting the subject know of their mistake. After this explanation, the researcher would shut off the light, leave the room, and close the door.

After completion of this task, the subject was free to go, only to return when they had signed up for the next part of the study, a week or more later. During the next study, the subjects were not asked to fill in the AQ questionnaire again, but go straight to the experiment. The total experiment took from 45-60 minutes per study. After completion of both tasks, the subjects were rewarded two credits as compensation.

Results

The experiment’s findings showed consistencies with the hypotheses that had previously been claimed. Figure 1 depicts the average rough data of the reaction times and SOAs of subjects in the experiment across part 1 and 2 of the experiment. Figure 2 depicts the average smooth data of the reaction times and SOAs of subjects in the experiment across part 1 and 2 of the experiment. Both of these data graphs were subtracted from each other using Fourier Transformation in order to eliminate the downward sloping nature of the graphs (attributed to practice effects). After this, we get Figure 3, wherein we see the average oscillations of all the participants. However, since this figure is averaged out, we are not able to see clear peaks and
valleys to understand individual differences between subjects. Therefore we look at Figure 4, or Individual Subject Oscillations (RUN) to truly understand the significance of SOAs and at which SOA does that individual experience a peak in their oscillation, and thus perceive the action in the most efficient way.

Since, only a portion of the study has been completed, no conclusive remarks can be made. It can be seen that there is an effect of priming on the perception the action, i.e. if the word is in congruence with the action, the perception recognize the action more accurately and faster. This is the opposite if the word is incongruent with the action. It is also seen that SOA will have an effect on priming and that the ideal time between exposure to word and exposure to action would be in the middle ranges (in our case it would be around 300 milliseconds).

**Discussion**

By looking at the graphs, in specific figure 4, we can see that the oscillations of perception change between people: some are fast and some are slow. But unfortunately, when we take the average of all the participants, we lose the peaks and valleys, which are important to understand individual difference when it comes to action perception. This can be considered to be a limitation to this study. One way of bettering this could be to do more in depth analysis, like using Bayesian analysis. Bayesian analysis is a statistical paradigm that answers research questions about unknown parameters using probability statements.

Also, since we started the study by understanding the true nature of action perception and the factors that affect it, for the sake of further studies we could possibly see the effects that emotion and perception of emotions have on action perception. Instead of using just simplistic actions like “walking” or “running,” we could in turn manipulate the action on an emotional scale, i.e. showcase a happy walker (displayed by a broader stance, skipping motion, and
swinging hands), in contrast to a slow walker (displayed by a smaller stance, slower speed, and slouched posture). This could possibly help us understand how perception of action can be change due to external factors.

Another possibility could be that we could showcase the same actions of neutral “walking” or “running” (devoid of any obvious emotions) to the subject, but manipulate the subject’s emotion. For example, if the subject was initially primed with a stimuli that would make them happy (like pictures of food, friends, family, or even Disneyland), and then showed the actions, maybe their perception of the action would be different from another subject who had been primed with something made them angry. This could have a big impact in eyewitness testimonies, or understanding how our own mind can make be clouded or even enhanced by emotion, and thus make us wrongly perceive things, heightened or subdued at the cost of our own emotion. In conclusion to this study and the ideas discussed here, we can better understand how the brain has a plethora of neural networks that work in synchrony in order for us to perceive something. It reinstates the Hebbian principle, and supports the ideology that there are indeed specialized parts of the brain for language and actions, that work together in order for us to perceive action words.

Figure 1: Average rough data of the reaction times and SOAs of subjects in the experiment across part 1 and 2 of the experiment.
Figure 2: Average smooth data of the reaction times and SOAs of subjects in the experiment across part 1 and 2 of the experiment.
Figure 3: The average oscillations after subtracting figure 2 from figure 1.
Figure 4: Individual oscillations of each subject showing the peaks and valleys of each perception oscillation.
Figure 5: A compressed representation of the experiment showing the priming word (speed of exposure), SOA, action (speed of exposure), and the time given to the subject to make a decision and press the arrow key.
How can one become a more efficient learner? As students, this is one question to which we all want to know the answer. Too often, we load our class schedules up with the maximum number of units, only to find ourselves rereading the textbook during the wee hours of the night, unable to understand why our test scores still aren’t improving. If only there was a better way to study, one that did not involve rereading the text until we can no longer focus on the page.

Many people view studying and testing as two separate activities. They believe that learning takes place when one reads the textbook or notes, and that the purpose of the subsequent test on that material is to measure how much they have learned. When asked whether they think that any learning occurs during the test, most people would likely say no. While this may sound intuitive, research in the field of cognitive psychology suggests that this is not necessarily the case. Roediger and Karpicke (2006) had participants learn educational materials in one of three different ways. One group was told to read the materials for a set block of time, then reread it for another three blocks of time, resulting in four blocks of reading time. A second group read and reread the material for the first three blocks of time and completed a free-recall test during the fourth, final block of time. The third group only read the material for the first block of time. For the remaining three blocks of time, this group completed a free recall test on the information. After the four blocks of time, all participants took a final recall test. When asked who they thought would perform best on this final test, participants responded that they believed that those who had had the most study time would have the best scores, whereas those who had had the least study time (the group that only studied once and was tested three times) would have the worst scores. If one believes that learning only occurs during study time, then this prediction is
very logical. However, the exact opposite was true. On the final test, the more testing trials participants had had, the better their scores were. Participants who had only studied the material for one block of time and spent three blocks of time testing themselves on it outperformed the other conditions. In contrast, participants who had studied for all four blocks of time showed the worst performance on the final test. These results suggested that rather than just acting as a way to measure learning, tests could actually facilitate learning.

Roediger and Karpicke’s results suggested that when one takes a test and successfully recalls the answer, the correct information which they recalled will be strengthened in one’s memory. Thus, if one is asked to recall that same information in the future, they will be more likely to successfully recall it once again. However, the scientific community was unsure as to what these results meant for unsuccessful retrieval attempts. What would happen if someone answered a question on a test incorrectly? Would the wrong information be strengthened because it was the information that the person retrieved? If so, this would not benefit learning, as the strengthened incorrect information could interfere with the retrieval of the correct information in the future. For a long time, the cognitive psychology community had subscribed to the idea of “errorless learning.” This is the idea that learning is optimized when errors are avoided. According to the idea of errorless learning, unsuccessful retrieval attempts would be counterproductive to overall learning because the retrieval of incorrect information would just strengthen undesired retrieval pathways, which would then lead to more confusion when trying to retrieve the actual, desired information.

In 2009, Kornell, Hays and Bjork tested this principle, and in doing so, challenged the concept of errorless learning. In their experiment, participants learned word pairs which consisted of weak semantic associates (i.e. whale-mammal). For some word pairs, participants
just studied the intact pair for five seconds. For other word pairs, participants just saw the first word and were asked to generate a guess for the word that they thought would complete the pair. They had eight seconds to come up with their guess. Once eight seconds had passed, participants were shown the correct answer and had five seconds to study the correct pair. It is important to note that participants only correctly guessed the word that completed the pair three percent of the time. This means that 97 percent of the time, participants were generating incorrect responses to complete the word pair. Following this study phase, participants were given a short distractor task before taking a final cued recall test. If scientists’ beliefs about errorless learning were accurate, one would have expected participants who had to generate a guess prior to seeing the correct answer to perform worse on the final test than those who did not generate a guess because those who had generated incorrect information would have more competing information in their heads. However, the exact opposite was true. Participants who had first generated a guess for the word that they thought would complete the word pair significantly outperformed those who had just studied the intact pair. Several follow up versions of this study were conducted. One made the read-only condition 13 seconds long in order to equate for time between both conditions. Another had the final test 24-48 hours after the initial session, and yet another was between subjects. All of these studies mirrored the results of the initial study. Pairs for which participants had to first generate a guess consistently outperformed study-only pairs. This led researchers to conclude that taking a test prior to studying the information is superior to simply reading the material. Even if one generates an error, overall retention will not be hurt. In fact, it may even be helped by the process.

More research on the topic was conducted by Huelser and Metcalfe (2012). As in the study described above, Huelser and Metcalfe also had participants learn word pairs either by
studying them intact or by generating a guess to complete them first. Additionally, they were interested in whether relatedness of word pairs would play a role in which way was more effective. Thus, half of the word pairs were related and the other half were unrelated. They found that for related pairs, the test condition outperformed the study-only condition. This was consistent with the findings of Kornell, Hays, and Bjork (2009). Surprisingly, however, they found that for unrelated pairs, the study-only condition outperformed the test condition.

Research by Potts and Shanks (2013) also contributed to the understanding of the phenomenon of errorful generation. Potts and Shanks wanted to see if the errorful generation benefit would extend to novel learning. Novel learning refers to the learning of completely new concepts or information, where people do not have preexisting background knowledge. In these situations, responses on a pretest are mostly errors which are unlikely to be related to the cue or the target. The prevailing view at this time was that an errorful generation benefit would only occur when there was a preexisting semantic association between the cue and the target.

To test their hypothesis, Potts and Shanks had participants learn novel English words and their definitions. The words were old, obscure, and seldom used. For example, one of the words was valinch, which means “tube.” Another was hispid, which means “bristly.” Because this experiment was supposed to test novel learning, the experimenters wanted to make sure that participants had not encountered these words before. They were relatively successful; participants only knew the correct definition of the words six percent of the time. As in the other studies mentioned above, there was a read-only condition and a generate condition. In the read-only condition, participants were presented with the intact word-definition pair for seventeen seconds, during which they were instructed to study the pair. In the generate condition, participants saw just the word without its definition for ten seconds, during which they were told
to generate a guess for what they thought the word’s definition was. Once these ten seconds had passed, participants saw the word with its correct definition for seven seconds, during which time they were told to study the pair. As in the other studies, participants were given a final test at the end to measure how much they had learned during the study. Potts and Shanks found that when participants had to guess a word’s definition prior to seeing the correct answer, participants were more likely to remember the word’s definition than when they merely read the correct pair. Thus, these results mirrored those found by Kornell, Hays and Bjork regarding weak associate pairs and those of Huelser and Metcalfe (2012) regarding related pairs.

Because the experiment conducted by Potts and Shanks was concerned with novel learning, it showed that generating a guess is superior to just reading even when one has no preexisting associations. This, combined with the results found by Huelser and Metcalfe, has led psychologists to theorize as to why this may be the case. One such theory is that perhaps with known words, we have a web of associations which gets in the way of generating the unrelated word on a test. For example, when we see the word “dog,” we immediately think of all of the words we associate with that word, including cat, puppy, bark, and woof. If the word pair consists of two related words, this is not a problem because the web of associations can lead us to the correct answer. However, if the word pair consists of two unrelated words, there is an added level of difficulty when retrieving the correct word. According to this theory, when we see a word, the associated words immediately come to mind. The correct, unrelated, word is not part of this web of associated words, so we are taken down the wrong path, away from the correct word. When we encounter a novel word, we have no preexisting words we associate with it, so we cannot be taken down the wrong path.
The research I helped conduct this quarter under the guidance of postdoctoral student Courtney Clark as well as Drs. Robert and Elizabeth Bjork, expanded upon these prior research findings. Particularly, we were interested in what would happen if instead of generating a guess, participants just further processed the cue. In one of our studies, participants learned Swahili words and their English definitions in one of three ways. In the read-only condition, participants had ten seconds to study the Swahili word and its English definition. In the generate condition, participants had five seconds to generate a guess for what they thought the Swahili word meant before seeing the correct answer for five seconds. In the copy cue condition, participants had five seconds to see the Swahili word, copy it, and count the number of letters it contained. This was done to ensure that participants were actively processing the Swahili word while preventing them from generating a guess as to what they thought the word meant. After studying all of the words, participants completed a distractor task and then took a final cued recall test. We were particularly interested in how the copy cue condition, a new manipulation, would compare to the other two conditions, which have been studied extensively as mentioned above.

In a different study we conducted, participants learned English word pairs consisting of weak semantic associates. Participants had five seconds to either generate a guess for the word completing the pair, or five seconds to copy the cue and count how many letters it contained, depending on the condition. Participants then had as much time as they wanted to study the intact pair. As in the other study, participants then completed a distractor task before taking a final cued recall test. As before, we were interested in how final test performance would vary with condition type. However, due to the self-paced element in this study, we were also interested in how long they would study the intact pair.
The mechanisms behind the errorful generation benefit are still not fully understood, and memory researchers are still dedicated to learning more about its nuances. For the time being, we as students can still take advantage of these findings by applying them to our own lives. We should not avoid pretesting out of fear that our incorrect answers will get in the way of learning the correct information. Rather, we should embrace pretests, armed with the understanding that they can lead to more successful encoding, and later retrieval, of studied information.
References


Analysis of Social Exchange Theory through Wason Selection Task

Madeleine Gavin

Abstract

Social exchange theory, an explanation for differential results among deductive reasoning tests, has been adapted and refined by Leda Cosmides over the past two decades (Cosmides 2010). Cosmides has introduced hazard management theory and identified three essential characteristics of social exchange: the possibility to cheat, a benefit from cheating, and the intention to cheat. In the current experiment, a version of the Wason Selection Task will be used to evaluate the influence of these developments to social exchange and hazard management theory. Participants will be recruited through Amazon Mechanical Turk and tested with the online platform Qualtrics.
Humans engage with deductive reasoning and decision making countless times every day, both consciously and unconsciously. Although deductive reasoning and decision making consume much of our time and cognitive capacity, the underlying mechanisms behind these processes are not yet fully understood. The Wason Selection Task was originally developed to evaluate the effect of falsification, but it was adapted to test the influence of social exchange theory on our deductive reasoning skills through tests of modus ponens (If P, then Q) and modus tollens logic (If P, then Q → if not Q, then not P). The original results of this study revealed subjects had a great deal of difficulty identifying modus tollens when the context of the problem was abstract. When the rule was framed in a social context, subjects were more likely to demonstrate accurate deductive logic. This resulted in an overall performance facilitation.

There is not one single, universally accepted explanation for the significant difference in accuracy found through social context facilitation on the Wason Selection Task, although social exchange theory is the most prominent. In 1985, Leda Cosmides introduced social exchange theory, a theory that categorizes many instances of deductive reasoning and decision making through the presence of a perceived cost that will be paid to experience a perceived benefit. The first explanation that was proposed for our inability to correctly logically deduce the right answers for the Wason Selection Task is our human tendency to ignore falsification: “In adult experience truth is encountered more frequently than falsity, and we seldom use a proposition or judgement that something is false in order to make a deduction” (Wason 1968). This theory is closely connected to the concept of confirmation bias. Although this theory does provide a potential explanation as to why subjects fail to correctly prove some rules, it does not attempt to explain why subjects can correctly use deductive rules in different contextual scenarios.
Cosmides addressed this discrepancy by proposing a highly specialized psychological module that contains algorithms we can use to process social exchanges, which she calls social contract algorithms. Social contract algorithms determine whether a situation is an instance of social exchange; if it is, the social contract algorithms use domain specific inferences to define a cheater in the given situation and illuminate the processes used to detect a cheater. In this context, a cheater is someone who experiences the benefit without paying a cost. Cosmides also argued that these algorithms are innate, not learned, emphasizing how “successfully conducted social exchange was such an important and recurrent feature of hominid evolution, that a reliable, efficient cognitive capacity specialized for reasoning about social exchange would quickly be selected for” (Cosmides 1985). Social contract algorithms provide an explanation as to why subjects might perform better on a Wason Selection Task where the scenario was ‘If a person is drinking alcohol, then they must be over 21’ when compared to ‘If the card has an even number, then the opposite side is red’ because in the former example it is possible to use a social contract algorithm.

Social exchange theory has not been accepted without criticism, Cheng & Holyoak (1989) offered a different explanation for the contextualized differences in accuracy we experience when analyzing a situation through deductive logic, pragmatic reasoning schemas. Pragmatic reasoning schemas are “abstract knowledge structures induced from ordinary life experiences…defined in terms of classes of goals…and relationships to these goals” (Cheng & Holyoak 1989). Unlike social contract algorithms, which Cosmides argued to be innate, pragmatic reasoning schemas are learned through experience and will only be evoked if it is possible to map the situation at hand onto the schema. Cheng & Holyoak argue that social exchange theory fails to recognize and consider when a situation does not necessarily require a
cost to be made, but rather a requirement to be met. Pragmatic reasoning schemas apply a conditional permission, the precondition or cost of social exchange theory, and a conditional obligation, the action to be taken or the benefit of social exchange theory, to various situations. We can apply a pragmatic reasoning schema to the scenario ‘If a person is drinking alcohol, then they must be over 21’; being 21 years of age is not necessarily a cost, but it is a requirement to be met or a precondition, and drinking alcohol is the action to be taken.

The theories of social exchange and pragmatic reasoning schemas have continued to develop over recent years. In 2007, Cosmides & Tooby introduced hazard management theory, which follows the same structure as social exchange theory, but instead of paying a cost to experience a benefit, hazard management frames a situation as a precaution that must be taken if there is potential for a hazard. There has been empirical evidence found in support of both social exchange and hazard management theory: “Neuroimaging results and evidence that brain damage can selectively impair social exchange reasoning (while sparing precautionary reasoning) support the evolutionary hypothesis that these are two distinct specializations, not one superordinate deontic system” (Cosmides et al. 2010). Cosmides has also defined three distinct characteristics of a situation that influence how social exchanges function: the possibility to cheat, a benefit from cheating, and a clear intention to cheat. It is essential to continue the study of these various explanations for why humans demonstrate different abilities of deductive reasoning through different scenarios used in the Wason Selection Task to test the validity and reliability of the developments of social exchange and hazard management theory and further refine these theories.
Method

Our study will follow a similar structure to that of Cosmides’ past studies, specifically those conducted in 2010. We are in the process of generating six different groups of Wason Selection Task scenarios: unfamiliar social exchange scenarios, familiar social exchange scenarios, unfamiliar hazard management scenarios, familiar hazard management scenarios, abstract scenarios, and descriptive scenarios. Within each group, there is a condition in which a key characteristic of the scenario is isolated (benefit/intention or hazard/precaution) and a scenario where these characteristics are absent. There will be four distinct ideas within each group, and these four ideas will be counterbalanced across each of the four variations of these original ideas, adding up to a total of sixteen variations of the Wason Selection Task in each group.

We will be designing our experiment on Qualtrics and administering it through Amazon Mechanical Turk. Using Mechanical Turk will ensure that our participants are not limited to undergraduate students who live in North America, this is important for us to incorporate cultural influences. We will be asking participants to fill out a preliminary questionnaire before beginning the experiment; we will be collecting information such as demographics, Advanced Raven’s Progressive Matrices (ARPM), Autism Spectrum Quotient, English proficiency, CRT-2, Big Five personality test, Psychopathy Quotient, and a basic intelligence test. It is important for us to consider relevant information from these preliminary questionnaires while we are interpreting our results.
Works Cited


Cross-Cultural Variations in the Muller-Lyer Illusion

Paige Nestor

Human perception is a frequently researched topic in the fields of psychology and cognitive science. Perception involves much more than just interacting with stimulus, and there are countless processes that take place in the brain throughout perception that are still not fully understood. Many research studies investigate various factors, such as age, gender, culture, and lifestyle that influence human perception in order to gain more knowledge on the subject. Cross-cultural studies have proven to be particularly interesting showing differences in performance in visual perception tasks. A study conducted by Kitayama, Duffy, Kawamura, and Larsen (2003) found that North Americans performed better at memorizing the absolute length of a line shown inside a square compared to East Asians who performed better at memorizing the ratio of the line’s length relative to the square. Based on this study, it is hypothesized that North American cultures are more capable of ignoring contextual information than Asian cultures (Kitayama, 2003).

One way researchers gain insight on visual perception, in particular, is by studying optical illusions. Many well-known visual illusions, like the checker shadow illusion, the Ebbinghaus illusion, the Muller-Lyer illusion, and the Necker cube illusion, demonstrate how easily our visual perception of objects can be distorted. Findings like that of Fermüller and Malm (2003) suggest that optical illusions are the result of noise and uncertainty in processing images, causing a bias to see the illusion.

The Muller-Lyer illusion leads to a tendency to perceive a horizontal line as longer if it has arrowtails on the ends rather than arrowheads (see Figure 1), causing a misjudgment in the actual lengths of the two lines (Zeman, Obst, Brooks, Rich, 2013). The arrows create noise that
cannot be easily ignored unless the arrows are removed, at which point the task becomes trivial. Many theories have been presented to explain the brain processes taking place in the Muller-Lyer illusion. While no overall consensus has been made as to what the specific underlying process is, extensive studies have allowed most researchers agree on where the Muller-Lyer illusion takes place in the brain. As found in research by Weirdner, and Fink, (2006) and Weidner, Boers, Mathiak, Dammers, and Fink (2009), the Muller-Lyer illusion is believed to take place in the ventral and dorsal streams in the brain that are responsible for identifying stimuli and their locations (Zeman et al., 2013).

Based on the potential information gain available through studying both the role of culture and optical illusions in perception, the current research study was directed at analyzing cross-cultural differences in the Muller-Lyer illusion. The findings of Kitayama et al. (2003) support the study’s hypothesis that Americans will perform significantly better in an image comparison task using the Muller-Lyer illusion than participants with other cultural backgrounds.

Figure 1: Due to the Muller-Lyer illusion, people have a tendency to perceive stimulus (a) as shorter than stimulus (b) when, in fact, they are the same length.
Method

Participants

One hundred and twenty-four undergraduate students at the University of California, Los Angeles participated in the study. All participants had normal or corrected-to-normal vision and received course credit for their participation in the experiment.

Design

The independent variable for the experiment was the participant’s cultural background and, thus, was between-subjects. A participant’s cultural background was defined as American if they had lived in the United States for half of their life. The dependent variable was overall performance on the image comparison task. Performance was given as a percentage ranging from zero to 100 percent.

Materials

The experiment took place in a dark room. Participants sat at a desk with their head on a chin rest in order to stabilize their head maintain and equal distance from the computer monitor for the entire duration of the experiment. The stimuli were presented on a computer monitor placed in front of the participant. The stimuli presented were a modification of the classic Muller-Lyer illusion experiment. The stimuli differed from the classic experiment in that the lines presented were two different lengths. Responses were recorded on a keyboard located on the desk between the participant and the computer monitor. There were two sessions total in the experiment.

Procedure

All participants completed the same experiment and were read the same set of instructions to ensure that everyone heard exactly the same thing. The experiment lasted
approximately one hour. In the experiment, participants were asked to compare the relative length of stimuli that appeared side by side on the computer monitor. Between each trial, a small fixation cross appeared in the center of the screen for 0.5 seconds. Participants were instructed to select if the left line (by pressing ‘n’ on the keyboard) or the right line (by pressing ‘m’ on the keyboard) was longer for each trial. Feedback was provided following each trial. The line selected would appear green on the computer monitor if it was the correct choice or red on the computer monitor if it was the incorrect choice. All trials were randomized for each participant. After completing each of the sessions, participants were asked to fill out a questionnaire on the computer in order to determine their cultural background. The questionnaire inquired about birth location, age, places lived, time lived in each place, languages spoken, ethnicity, nationality, generation, and gender.

**Predicted Results**

The data will be analyzed through a correlational analysis of years spent in America and performance. It is hypothesized that there will be a significant positive relationship between years spent in America and performance on the modified Muller-Lyer illusion task.

**Discussion**

The current study examined cross-cultural differences in a linear discrimination task that utilized the Muller-Lyer illusion. The significant positive correlation found between time in America and performance indicates that American cultures perform better at detecting the length of horizontal lines than other cultures when the lines are presented with various arrows on the ends. This supports the findings by Kitayama et al. (2003). The findings in both experiments suggest that Americans perform better at tasks that involve ignoring contextual information that
can cause potential noise when processing visual information. Overall, these significant findings further bolster the belief that various cultures perceive various stimuli in different ways.

While information can be gained from this experiment, there are potential limitations to the study. For starters, the study had a small sample size ($n = 124$), and all participants were from a single university which limits age and intelligence levels. Additionally, the study lacks external validity as participants were only tested using black horizontal lines. Other colors or shapes could illicit different responses across cultures. Furthermore, by providing feedback after each response, there may a significant difference in improvement and learning strategies across various cultural backgrounds that could influenced the results. In future research, it would be beneficial to test comparison tasks uses a variety of different color and shape stimuli. By studying a range of stimuli, a better understanding of cross-cultural differences in perception as well as the underlying mechanisms involved in perception may be achievable.
References


Optimizing Memory in Gambling Task: Risk Aversion Perspective

Rachel Belyea

It is near widely accepted in our culture that memory loss and old age go hand in hand. Much research has been done providing evidence that memory tends to deteriorate as humans age. Luo and Craik (2008) specifically targeted areas such as working memory and retrieval of highly specific material as declining while humans get older. Of course, not all adults are affected and not every effect is particularly immense. For those affected, though, one theory brought up is that cognitive control declines over the lifespan. Our current study set out to challenge this theory. We believe that cognitive controls, like metacognition and strategy, can be used to help older adults with remembering. Perhaps experimentally imposing a strategy is not the best approach, but maybe utilizing human characteristics would promote natural strategy use.

Older adults are less likely than younger adults to partake in risky behavior (Mather et al., 2012). Though the research behind risk aversion and older adults is checkered, we believe that the utilization of this phenomenon could help memory strategies.

To begin, we should discuss risk aversion in our target group: older adults. Mather et al. (2012) found that older adults were more likely than younger adults to choose a certain gain over possibility of a bigger gain, which could indicate risk aversion. They would rather be sure in their gains than risk no gain at all. However, this did not hold true when the risk paradigm changed from gains to losses. They found that older adults were more likely than their younger counterparts to risk potentially great loss (or avoidance of loss) than choose a certain, small loss. This gives us some conflicting evidence for risk aversion—it would seem that risky behavior is contextual or based off of positive versus negative emotions. Perhaps older adults aren’t
necessarily utilizing risk aversion in their decision-making process, but, instead, are just trying to chase the certainty of positive emotion (Chen & Ma, 2009).

Deakin, Aitken, Robbins, and Sahakian (2004) also found evidence that older adults tended to be more risk averse. The task used for this experiment allowed for participants, young and old, to bet on a target object being under a certain box—the odds continuously changed. Interestingly, older adults would bet in favor of the more likely event, but even when the probability of being right was higher, older adults would not bet significantly higher. Risk aversion was present, but it wasn’t necessarily advantageous when it came to this gambling task. Based on this, it doesn’t seem like there is a strategy behind risk aversion but more of a feeling or intuition on the part of the older adult.

The evidence presented so far seems to support the idea of older adults being risk averse, however, this phenomenon does not appear to be overwhelmingly beneficial in gambling tasks alone. But what if the focus of risk aversion was taken off of isolated gambling tasks and placed on memory tasks as well? First, we must understand past research combining memory and gambling tasks.

McGillivray and Castel (2011) tested to see if masking a memory task with a gambling task would improve the memory of the material being bet on. Instead of the participants choosing how much they will bet on a situation, this gambling task presented word-number pairs. The numbers represented the word’s worth—if remembered, the participant gains the points and if not, they would be lost. As expected, older adults remembered fewer words than younger adults in this task, but the interesting part is that the point values earned between age groups was comparable. This leads us to our present question: could risk aversion be advantageous in memory tasks? It would seem that older adults are maximizing their memory, which would point
to the possible use of a metacognitive strategy (McGillivray & Castel, 2011), but the strategy may have only emerged when pressed with the want to avoid risk or avoid loss. We intended to replicate these findings in order to support the idea that risk aversion could be beneficial to optimal memory in older adults. The difference in our experiment is the exclusive testing on only older adults, whereas most studies before compare older adults (50 and above) to young adults. Would there be the same effect within the age group or would betting habits be near identical after 50 years old? It is entirely likely that the same effect would occur, but perhaps not as dramatically—the age range is compacted but still rather large. Could the risk associated with betting aid memory as it potentially deteriorates? We believe that risk in gambling tasks could be useful to memory.

Method

Participants

Forty-four adults, age 50 and older, were recruited to participate through a newspaper ad. The mean age was 66 with 22 women and 22 men. Each participant was given $20 as compensation for their time.

Procedure

The participants were given the same task as in the McGillivray and Castel (2011) paper. Six word lists were presented to the participants: 12 words per list with point values ranging from 1-10, 15, and 20 for each word. Participants bet on a trial-to-trial basis. After each trial, they are asked to recall the words they bet on for only that trial. If a word was bet on and was remembered correctly, the participant received the number of points equivalent to that word’s point value. If a word was bet on but they were not remembered correctly, the participant loses the number of points equivalent to that word’s point value. If a word was not bet on, the
participant would earn no points, whether it was recalled or not. The goal was to maximize their end score.

After the task, the participants were asked to complete a demographic form as well as a Mini-Mental State Examination (MMSE), which tests for basic cognitive function and impairment. The MMSE form was out of a total of 30 points and contained questions pertaining to such knowledge as the day of the week and counting backwards.

Results

All correlations are Pearson Correlations for this task. Like much research before, we found a negative correlation between age and number of words recalled ($r = -.56$, $p < .001$). We also found a similarly negative correlation between age and number of bets being placed ($r = -.54$, $p < .001$). There was no correlation between age and total end score ($p = .89$). The average MMSE score amongst all participants was 28.95/30.00.

Discussion

The results we got were interesting. To begin, based on the average MMSE score, cognition was not largely impaired, leaving room for us to believe older adults are more than capable of strategizing during this task. Like most research before, we found that the older the person is, the less words they remember. This held true even within the “older adult spectrum” that we exclusively tested on. Again, within this spectrum, the younger of these adults tended to bet on more words than their older counterparts; however, the scores were comparable. We were able to replicate the findings of McGillivray and Castel (2011), supporting the idea that some sort of strategy is in use when placing bets. Analyzing this significance could go a few different ways.
There is a chance that older adults are aware of the cultural stereotype pertaining to memory loss that comes with increasing age. If this is the case, it is possible that the older adults are using this awareness to bet on fewer words than younger adults because they believe they will remember less. The younger older adults may be under the impression that they are not subject to memory impairments because they are lower on the older adult spectrum and thus do not implement the same strategy. They opt, instead, to bet based on quantity over quality, which is a characteristic associated more with young adults (Castel, Benjamin, Craik, & Watkins, 2002).

We must also take the type of task into account. Our question presented earlier asks about the utilization of risk aversion in gambling tasks and its effects on memory. Risk aversion appears to be beneficial for this specific task, but it most likely needs to be paired with metacognitive strategies. As discussed above, the younger older adults seem to have betting strategies more related to young adults than older adults, so if risk aversion were the only component at play in this situation, we would expect the scores of the older adults and the younger-older adults to be different. It also seems plausible to believe that older adults would not only bet less, but also bet on lower cost words, just in case they do not remember and lose the points. The fact that they did not bet like this indicates use of strategy: the incorporation of risk aversion with an awareness of their own memory. For example, if a participant knew that they could usually remember about three items off their grocery list, they would know to bet on only or around three words. Hypothetically, in order to maximize their winnings with the most certainty, they would then make sure that those three words were of high values.

Of course, more research will need to be done to figure out what is going on behind the betting, but it does seem that memory strategies come with age. Because our findings are
correlations in this experiment, we do not know many components of why and how older adults have this type of betting behavior and memory retrieval. The next step for this line of research may be to add in a metacognitive evaluation, most likely through self-report. We do not know if older adults are aware of their betting behavior, but regardless of explicit versus implicit strategy, memory appears to be optimized through value when in a gambling task setting. It very well may be that risk-averse characteristics and metacognition work together to provide optimal memory.
References


Robin Blades

Introduction

Researchers are becoming more and more interested in understanding the thinking dispositions of their participants. Fredrick developed the CRT test to assess cognitive reflection, meaning participants’ tendency to use more effortful thinking as opposed to more intuitive responding (2005). Thomas and Oppenheimer then developed the CRT-2 to counter the overexposure and numeracy confoundedness of the CRT (2016). They also found that non-linear reasoning errors are more common among people with low cognitive reflection scores (Thomas, Oppenheimer, 2016). At a conference, Daniel Oppenheimer, Peter Juslin, Jiaying Zhao, and other associates discussed the tendency of participants to severely under predict exponential growth, perhaps due to working memory constraints (2016). Our study replicates and extends this previous research by continuing the use of the CRT-2 to determine cognitive reflection and testing participants’ ability to adjust their nonlinear graph predictions while under additional cognitive load.

Fredrick initially introduced the three-item “Cognitive Reflection Test” to test a person’s tendency to think more carefully versus more intuitively in his paper “Cognitive Reflection and Decision Making” (2005); these two cognitive processes are often referred to as System 1 and System 2. Thus, the CRT presents problems which require the participant to suppress the erroneous automatic answer to respond correctly. Fredrick analyzed the correlation between the CRT response and many other cognitive variables; in terms of time preference, he found that high CRT-scoring participants were generally more “patient”, considered themselves to be significantly less impulsive, more concerned about inflation, and (curiously) less preoccupied with their future. He also analyzed their risk preferences and discovered that in the domain of
gains, the high CRT group was more willing to gamble, while in the domain of losses, they were less risk seeking. The CRT correlated positively and significantly with the NFC, WPT, ACT, and SAT. This correlation may be related to reading comprehension and mathematical skills. Finally, he found that men scored significantly higher than women on the CRT.

The CRT quickly became one of the most utilized cognitive analysis tools in decision-making research (Thomas, Oppenheimer, 2016). However, the CRT developed two flaws: the subject pools were contaminated by overexposure and the test is confounded with numeracy. Thomson and Oppenheimer tested a group of MTurk participants and found that not only had the majority of their participants already been exposed to CRT questions, but prior exposure also significantly improved their CRT scores, thus creating potential practice effects and undermining data validity (2016). The CRT questions also require numerical ability, thus creating a confound with numeracy, that may contribute to the observed gender difference.

In their study “Investigating an alternate form of the cognitive reflection test”, Thomas and Oppenheimer created and tested a new set of more verbal-type CRT questions called CRT-2 to counter these issues (2016). They found that exposure rates to the CRT-2 test were much lower and that the CRT-2 test predicts performance on the same cognitive measures as the CRT does (and therefore is a good alternative measure of cognitive reflection). The CRT-2 still displayed a significant relationship with numeracy, but this correlation is likely due to the correlation between numeracy and measures of intelligence. The CRT-2 scores showed no significant gender difference. They also found that belief bias serves as another potential measure of cognitive reflection, as it correlated with CRT and was predictive of the same cognitive measures as the CRT.
At a conference, Daniel Oppenheimer, Jiaying Zhao, Peter Juslin, Adam Elga, Keela Thomson, Ron Rensink, and Madison Elliott discussed human judgment and decision-making related to non-linear systems (2016). In “Perception and prediction of non-linear changes”, Zhao notes that participants were able to predict linear increases, but severely under predicted future exponential growth (Zhao, 2016). Juslin hypothesizes in his paper “Small Samples and the Illusion of Linearity in Judgment” that working memory constraints underlie errors in nonlinear reasoning, and nonlinear functions are generally replaced with heuristic-like “piecewise linear approximations” (Juslin, 2016). In their paper “Cognitive Reflection and Non-Linear Reasoning Errors”, Thomson and Oppenheimer found that nonlinear reasoning errors are more prevalent in people with low cognitive reflection scores, implying that nonlinear reasoning failure can be compensated by through more analytic, “System 2” type thinking (Thomas, Oppenheimer, 2016).

We placed participants in two conditions: control and extra cognitive load. We analyzed participants’ nonlinear graph predictions based on accuracy and adjustment. We also collected data on participants’ ability to perform on the CRT test, CRT-2 test, and a host of other cognitive measures. We expect participants with extra cognitive load to be less accurate and adjust less in their nonlinear graph predictions. We also predict that participants with higher CRT and CRT-2 scores will perform better in general compared to participants with lower CRT and CRT-2 scores. Thus, we will replicate and extend previous studies by showing once again that people will adjust their nonlinear estimations more if they have higher CRT, but we also expect that cognitive load will reduce everyone’s ability to adjust.
Method

Participants

We recruited x participants through the University of California Los Angeles Psychology Department Subject Pool. The average age of the participants was x years old, ranging from x to x (x men, x women). Participants received class credit in exchange for their participation. All participants had corrected to normal or normal vision. All were students proficient in English. Group differences may be understated in this study due to less cognitive ability variety among college student populations.

Design

The manipulated independent variable was the presence or absence of a memory task that was to be done at the same time as the nonlinear estimation questions. We operationally defined this memory task as remembering a combination of four letters for a minute at a time. Participants were assigned randomly and equally to the two conditions, either control or cognitive load, in a between subjects design. We also measured several covariates in order to understand existing differences between people.

We also collected data on each participants’ performance on the CRT test, CRT-2 test, belief bias, numeracy, need for cognition, subjective numeracy, exposure, and demographic evaluation.

The dependent variables were accuracy and adjustment. We evaluated the nonlinear graph predictions of each participant based on these two variables. The operational definition of accuracy was the distance between the participant’s estimation and the correct exponential response for the graph’s future growth. The operational definition of adjustment was the amount of correction the participant made in the direction of the correct exponential response. The adjustment variable is the most important dependent variable, because it allows us to assess the
amount of cognitive effort made away from the linear, intuitive response.

**Materials and Apparatus**

The experimenter distributed a Study Information Sheet to each participant (usually no more than four). The experimenter recited a suggested study summary from a sheet of paper. The experimenter asked if there were any questions and further clarified if there were. If the participants were in the cognitive load condition, they were given a sheet to write down the four letter combinations. The experimenter also read to them a specific set of instructions for the load condition typed up on another piece of paper. This paper explained that they would be completing study question on an online survey while simultaneously attempting to remember four letter combinations. The experimenter wrote participant numbers on stick notes and passed them out to participants. The participants were led to functional computer consoles with access to the Internet where the loaded study was presented. They inputted their participant number using the keyboard and mouse provided.

If the participants were in the load condition, they went first go through a round of practice slides to ensure that they understood the task. They answered 12 verbal SAT questions in random order, while a practice recording read out series of letters at one-minute intervals played for two minutes. After this practice round, they continued on to the actual study. The participants in the control condition got five of the verbal SAT questions (to simulate the number of questions participants probably got through in the cognitive load condition after two minutes), randomly selected and presented in random order.

The next three slides informed the participants of the nature of the task: hypothetical mathematical estimation problems. They were presented with verbal subscale problems in random order, followed by graph subscale problems in random order. Both types of problems
were two to four sentences long. The verbal subscale was free response and therefore unbounded response, while the graph subscale presented a bounded y-line to mark the predicted location of the endpoint of the curve such that the response was constrained.

Participants were then given a series of CRT and CRT-2 questions intermixed in random order (Frederick, 2005). They also were given a series of belief bias questions (Thomson and Oppenheimer, 2016). After that, they completed a numeracy scale on an 11-item extended scale and a need for cognition questionnaire on an 18 item short scale. They also completed a subjective numeracy scale and exposure questions, to determine the participants’ level of knowledge about CRT, CRT-2, logical syllogisms that might affect their results. Finally, they were given a series of demographic questions.

After they completed the study, the participants were thanked and left quietly.

Procedure

The experimenter passed out Study Information Sheets to the participants and gave them a brief verbal description of the task. They were invited to ask questions. Participants were assigned credit for showing up to experiment. They were given sticky notes with their participant number on them. If in condition B with the extra memory task, they were given a sheet of paper to write down the four letter combinations, and the experimenter read a special set of instructions explaining how the multi-tasking would work.

Participants were seated at computers set up with the study loaded on the main page. Participants entered their participant numbers into the opening screen. If in the load condition, participants were run through a practice session in which they responded to a set of slides presenting old SAT questions, while simultaneously performing the letter memory task. The experimenter played the practice recording for two minutes. Once all the participants understood
how the two tasks were to be accomplished at once, they began the actual study.

The study began with a set of instructions on how to complete the math estimation questions. Once everyone had read these first slides, the experimenter told the participants to begin. Participants were told that the experimenter would come around and check on everyone as they worked. If the participants were in the load condition, the experimenter would start the real recording so the four letter combinations were read out at 1-minute intervals until every participant completed the questions and got to a slide that instructed them to wait. Once everyone reached this slide, the experimenter turned off the recording and had the participants complete the rest of the study.

The experimenter supervised the participants as they took the study and recorded any pertinent information that might affect data collection. If a participant had any questions, they were told to do their best with the information provided. If any computer errors occurred, the participant was taken to another computer, or if time was not available, they were excused from the study. When the participants reached the end of the study, they were thanked and asked to quietly leave so that no other participants would be disturbed.

**Results**

We expect the cognitive load condition participants to be less accurate and adjust less, because we hypothesize that the extra working memory task will detract from the amount of effort they can use to adjust their estimation away from the more intuitive linear response toward the more thoughtful exponential response. We also expect higher CRT and CRT-2 scores to positively correlate with more adjustment. We expect belief bias to be similarly positively correlated, as it is a good measure of cognitive reflection as well (Thomas, Oppenheimer, 2016). We expect both numeracy and need for cognition (measuring how much you enjoy and engage in
effortful cognition) to vary with cognitive reflection scores. The differences between groups in this study may understate these effects, because the participants were all UCLA college students, thus minimizing variation in cognitive traits (Fredrick, 2005).

The subjective numeracy scale and exposure questions may reveal a problematic level of participant knowledge about CRT, CRT-2, and logical syllogisms, because the participants are drawn from the UCLA Psychology Department Subject Pool; this may skew the results, but we hope that it will not. We will use the demographic questions to check for other confounds, but hopefully our subject pool will be pure. One potential result may be a significant difference between men and women in their ability to conceptualize the verbal subscale versus graph subscale questions. Women may understand the visual graph better, and therefore be more accurate and adjust better on graph subscale questions.
References


Role of Consciousness in Deliberate and Arbitrary Decision Making

Sakiko Shida

Abstract

Derived from Benjamin Libet’s findings that predictive information about upcoming decisions can be found in the brain before the subject becomes consciously aware of their intention (Libet et al. 1983), this study explores the influence of decision type (deliberate and arbitrary) on the reported decision onset time (W-time) and action onset time (M-time). The results demonstrate that the perceived time of decision and time of action change with the motivational state and challenges the validity of W-time as an accurate measure of decision onset.
Introduction

There has been a long-standing debate on the extent of the “free will” we actually possess when we make decisions. The work of Libet et al. (1983) suggests that decisions are determined by brain activity long before we become aware of the fact that we have made up our mind. In their experiment, they asked subjects to watch a clock hand rotating. Libet et al. then instructed those participants to report the clock-position when they initially felt an “urge to move,” the W-time, and the time when the subject physically moved, the M-time. The readiness-potential (RP) and the electromyographic activity (EMG) of the subjects were monitored throughout the experiment. The result showed that the cerebral activity clearly preceded the subject’s experience of the intention to act by at least several hundred milliseconds. The urge to move in subjects (W-time) occurred, on average, 296 milliseconds prior to the onset of EMG and the actual movement 86 milliseconds before the EMG onset on average. In comparison, the RP preceded the EMG onset by 700 milliseconds. Thus they inferred that before any awareness, the decision to act was already initiated cerebrally. Moreover, the frontopolar cortex and the parietal cortex have been identified as the specific regions of the brain that contain predictive information. The function magnetic resonance imaging (fMRI) signals from the frontopolar cortex precede the consciousness of the decision by up to ten seconds (Chun et al. 2008). This raises questions on the role of consciousness in decision making and voluntary motor actions.

However, previous research by Libet and his successors have generally focused on inconsequential decisions such as choosing whether to respond with the left or the right index finger (Haggard et al. 1983). How then does having a control over the consequence of the situation affect the reported time of decision and action? Our study aims to answer this question.
Methods

The study was conducted using MATLAB. To begin with, the participants tasted a sip of ten different drinks and were asked to rate each drink on a scale of one to seven, one being the least favorable and seven being the most favorable. There were three different motivational states for the decisions. In the first type, the deliberate decision block, the participants were presented with two different drinks and were instructed to choose the one they would like to drink. At the end of each block, one trial was randomly chosen for the participants to drink a sip of the beverage that they chose in that trial, giving a consequence to their decisions. The drinks for the trials were determined by the initial ratings that the participant assigned to the drinks. The difference in ratings of the two drinks presented in each trial were greater or equal to two. In the arbitrary-different decision blocks, the participants were again presented with two different drinks to choose one from, but at the end of the block they were instead required to drink both beverages from the randomly selected trial irrespective to which drink they chose. Lastly, in the arbitrary same decision block, the participants were presented with two of the same drinks and asked to choose one. At the end of the block, one trial was randomly selected and the participant had a sip of the drink presented in that trial. The participants indicated their choice of the drink on the left or the drink on the right by pressing either the left or right shift keys on the keyboard. They were also trained until they reached >80% consistency in choosing the drink that they initially rated higher in the deliberate decision type and 50±20% in being random in the arbitrary different decision type. We carried out ten trials in each block.

While the participants were making the decision of which drink to pick, there was a stream of letters changing every 200 milliseconds along with the two drinks in all decision blocks. The W-time was reported by asking the participants after every trial what letter was on
the screen when they made up their mind. The M-time was measured by asking the participants what letter was presented on the screen when they pressed the left or right shift keys. The S-time was also measured by asking what the letter on the screen was when the stimulus appeared, in order to estimate the time of stimulus onset. Each decision type had four blocks for the corresponding three different time questions (W-time, M-time, and S-time).

In addition, memory questions were asked randomly for 10% of the trials in order to equate the cognitive load. The questions listed out four drinks and asked the participants which one was a decision alternative in the trial just before the question came up. The participants were required to take a sip of an unfavorably rated drink for answering them incorrectly, motivating the participants to pay attention to the names of the drinks.

**Figure 1.** Trial design

**Results**

The results indicate that the W-time and the M-time change with decision type even when the reaction time remains constant. In the deliberate decision block, the W-time and M-time preceded the onset of movement by 220 milliseconds and 160 milliseconds respectively. In the
arbitrary different block, the W-time was reported to be 150 milliseconds before the movement began and M-time 125 milliseconds preceding the movement. Lastly, the W-time in the arbitrary same block was 150 milliseconds before the movement onset and M-time 90 milliseconds before the movement. As seen on figure 3, the M-time error is the smallest for the arbitrary same decision and grows for the arbitrary different and deliberate decision types. The error in both the perceived stimulus onset (S-time) and the memory catch trials (8±1%) did not differ significantly among decision times (p=0.44, p=0.18).

Figure 2a. W-time and RT in seconds across the three different decision types.

Figure 2b. M-time and RT in seconds across the three different decision types.

Figure 3. W-time and M-time in milliseconds for the three different decision types.
**Discussion**

The results support the W-time backward inferred from M-time and provide additional evidence for inability of humans to consciously access the onset time of their decisions. Introducing motivational factors into the decisions reinforces the idea that initiation of voluntary action begins in the brain unconsciously and before the awareness of that “decision” being made.

We are also in the process of designing new projects using this paradigm. As an extension of this behavioral study, we plan to run additional research using EEG to further investigate the neural processes underlying consequence-based decision-making. Moreover, we expect to run this paradigm on subjects with obsessive-compulsive disorder to examine any difference this mental illness may make on decision-making in individuals. Another potential study to supplement this experiment could investigate the implications of the result in relation to moral responsibility. Lack of free will creates an ambiguity in the placement on blame for people’s voluntary actions. More research on this topic may contribute in uncovering the neural mechanisms behind decision making.

**My Experience**

I had the chance to help with the collection and analysis of data using MATLAB for this experiment. Furthermore, we analyzed relevant articles and how we could apply them to our projects, developed new studies, and brought in collected data for analysis and suggestions from the whole team at the weekly lab meetings. Being able to work alongside Professor Maoz and other talented research assistants, all making important advancement in cognitive science and psychology, has piqued my interest in this field and solidified my determination to pursue higher education and continue my research in academia or industry.
References


Perception of Tilted Shapes

Sally Chu

Objects are usually defined by their boundaries. However, when an object moves and morphs into a different outline, we continue to identify it as the same object. For example, when a tadpole wiggles to alter its outline, it retains its description as a tadpole. Similarly, when the outline of a square is altered into a wavy pattern with four sides, it continues to be perceived as a square even though it no longer follows its formal definition as a plane figure with four equal straight sides and four right angles. This suggests that we are representing objects in a different manner, perhaps by their spatial skeletons instead of their contours. This theory is known as medial axis representation. Introduced by Blum as a mechanism for biological shape representation, this theory defines shapes by their symmetrical axes. Blum defines the symmetrical axis as the origins of all circles that lie tangent to the object’s outline and whose interiors are completely within the object. He focuses especially on the symmetric coordinates and axis morphology of the symmetrical axis in his theory (Blum, 1973).

Blum’s theory built the foundation of many following models on object representation. One such model is Burbeck and Pizer’s core model, which relates an object’s boundaries to each based on the scale of the object’s width. In this model, small scale boundary detectors connect to each other over short distances and large scale boundary detectors connect to each other over large distances. Instead of having detectors connect to each other directly as suggested by Blum, this model proposed that boundary detectors connected to a representation of the middle area of a shape. Burbeck and Pizer postulated that there were excitatory and inhibitory connections along the core that excited same scale connectors and inhibited different scale connectors. The inhibition provides higher spatial resolution in the core to make up for a weaker boundary
outline, explaining why an exact outline is not necessary to represent an object (Burbeck & Pizer, 1995).

A more modern approach to shape representation is the Bayesian probabilistic approach introduced by Feldman and Singh. In this approach, a shape is assumed have “grown” from a skeleton and Bayesian estimation is used to identify the skeleton that best explains the shape. This theory is a computation theory of shape representation that identifies the simplest description of a shape during its lateral growth process. One advantage of using Bayesian estimation is that it is quantifiable; it estimates the statistical significance of an axis of the skeletal shape. If an axial branch is not statistically significant, it is excluded from the MAP skeleton (Feldman & Singh, 2006).

A few studies have been conducted to test these previous models of shape representation. To test the important of shape centers in human vision, Firestone and Scholl conducted a study in which they investigated implicit representations of visual experience. They displayed closed geometric shapes on a touch-screen tablet and told participants to touch the displayed shapes anywhere they wished. The results for the screen tapping experiment showed that participants were more likely to touch along the shape’s medial axis skeleton. Although participants were more likely to touch along the medial axis, they predicted that a higher distribution would touch randomly or at the center rather than along the skeleton. These two opposing findings suggest that medial axes are not intuitive shape representations (Firestone & Scholl, 2014). Even though results from this research were shown to be statistically significant, the conclusion reached from the study’s procedures is not entirely convincing.

The current study builds on the previous theories of medial axis representation and aims to strengthen the idea of medial axis representation through further experiments. Using a tilt
perception task, the study examined whether or not participants could adapt to the tilt of a shape. Because the shapes presented were nonlinear, had a dotted boundary, or were not shapes but a part of the background, there was no clear marker as to which direction the shape was oriented. An adaptation effect would suggest that participants are adapting to the medial axis of the shape, causing them to perceive a different subjective vertical and thus resulting in an adaptation effect. The study hypothesized a statistically significant tilt aftereffect for Experiment 1, no aftereffect for Experiment 2, and no tilt aftereffect for Experiment 3.

Method

Participants

54 undergraduate students attending the University of California, Los Angeles participated in this study for SONA credit. Participants were required to have normal or corrected to normal vision.

Design

The experiment was executed in two parts. The first part was the control experiment, pre-adaptation, in which all participants completed. The second part was the adaptation test, in which participants were alternately assigned an orientation condition. The experiment was conducted using a 2x2 mixed design, with two independent variables. The first independent variable was the amount of degrees the shape was tilted. All participants were exposed to all conditions of this variable. The second independent variable was the orientation of the shape split into two conditions: left or right. Participants were assigned an orientation condition, alternately, so that half were in the left condition and half were in the right condition. Moving visual stimuli in the second half of the experiments were presented tilted to the left for those in the left condition and presented tilted to the right for those in the right condition. The dependent variable was the tilt
aftereffect, how tilted the participant perceived the shape after adapting. It was calculated by comparing the participant’s point of subjectivity in the Pretest condition to the point of subjectivity in the Test condition. These points of subjectivities were calculated based on each participant’s response per angle condition in the adaptation task in both test conditions.

**Materials and Apparatus**

The experiments were conducted in a single room. Participants sat in front of a computer screen, with their heads rested on a chin rest. Visual stimuli from all three experiments were made using MATLAB.

In the first experiment, a symmetrical, nonlinear shape which stood out from the background was used. The shape was shown tilted at varying degrees. Participants were asked whether the shape was tilted to the right or to the left. In the second half of this experiment, a wobbly shape was presented prior to the stagnant visual stimulus. Modified versions of the visual stimuli were used for the second and third experiments. In the second experiment, dots were placed symmetrically along the contour of a nonlinear shape. In this condition, there was no clear shape but rather an arrangement of dots. In the third experiment, the nonlinear shape from the first experiment was modified so that it became a part of the background.

**Procedure**

Once students were seated in front of the computer with their heads rested on the chin rest, the experimenter gave a brief overview of the study. The experiment began with the Pretest condition, which measured the subjective baseline of each participant. In this first half of the experiment, a nonlinear shape was presented briefly on the screen. Participants were asked to indicate whether they saw the shape tilted to the right or to the left. If the shape was tilted to the right, they were to respond with the “L” key, and if the shape was tilted to the right, they were to
respond with the “A” key. After this half of the experiment was complete, the participant notified
the experimenter to start the second half of the study, the Test condition. They were assigned an
orientation condition prior to beginning. In the second half of the experiment, participants were
shown a moving, nonlinear shape followed by a stagnant, nonlinear shape and asked whether this
second stagnant shape was tilted to the right or to the left. In the beginning of the second half of
the experiment, the moving shape was presented on the screen for a full minute. Participants
were instructed to fixate on this shape so that they could familiarize themselves with it. After this
adaptation period, the experiment began and shapes were presented for only a brief moment.
This procedure was used in the second and the third experiment with modified visual stimuli.

Results

The pre-adaptation point of subjectivity was compared to the post-adaptation point of
subjectivity of each participant to calculate the baseline-corrected TAE. This value compares the
participant’s perception of the subjective vertical in the Pretest to the Test conditions. Figure 1,
Figure 2, and Figure 3 illustrate the baseline-corrected TAE for each participant in experiments
1, 2, and 3, respectively. In all three experiments, an adaptation effect was found in the majority
of participants. Data analysis revealed that these adaptation effects were statistically significant.

Discussion

In this study, the medial axis representation theory was used to predict a tilt adaptation
effect in shape perception. The tilt aftereffect, calculated by the participant’s number of left or
right responses in the Test condition in comparison to the participant’s key responses in the
Pretest condition, in Experiment 1 was found to be statistically significant, thus supporting our
hypothesis. Because the shape presented in Experiment 1 was a symmetrical, nonlinear shape,
there was no clear definition as to which direction the shape was pointing. If participants showed
an adaptation effect, which they did, this would suggest that they are adapting to the medial axis of the shape. The data revealed that an adaptation effect was also found in Experiment 2, going against our hypothesis in the experiment. The study hypothesized no adaptation effect for this experiment of the study, because the visual stimulus being presented was a set of dots, so there was no clear medial axis to adapt to. Yet participants displayed an adaptation effect. This may be a result of participants connecting the dots and creating a mental shape of the visual stimulus, and the adaptation effect found may be an adaptation to a mental representation of the medial axis. A tilt adaptation effect was also revealed in Experiment 3, which also opposes the hypothesis for the experiment. Because the experiment was a part of the background, there was no clear shape to adapt to. However, this does not necessarily go against our study, because participants may have been adapting to the shape of the background itself. The tilt aftereffect in this case can also be used to show that participants are adapting to a medial axis.

A previous study done by Joung, Van Der Zwan, and Latimer showed that participants showed a tilt aftereffect generated by bilaterally symmetrical dots (Joung, Van Der Zwan, Latimer, 2006). This finding proposes a limitation to this study, suggesting that participants may be adapting to the symmetry of the shapes and dots instead of the medial axis. An Experiment 4 was conducted to control for this confound. In this experiment, dots were arranged asymmetrically, so that participants could not adapt to the symmetry. If there was a tilt aftereffect in this experiment, it would be due to medial axis representation. However, there was a huge variability in the Pretest condition of this experiment, revealing that participants in the baseline portion of the experiment were experiencing difficulty in identifying the orientation of the asymmetrical dots and indicating that the visual stimulus was modified too much and the distance between the dots was too great. The data of this experiment was discarded due to the
unsatisfactory visual stimuli. Future experiments can expand on this by controlling for the symmetrical dot pattern confound with newly generated visual stimuli as well as study how different degrees of asymmetry may affect medial axis representation. To conclude with, this study suggests that it is a possibility that we are representing shapes by their medial axes, but further studies need to be conducted to support our findings and verify that we are truly adapting to the medial axis.
References


Appendix

Figure 1. Tilt aftereffect comparison for all participants in Experiment 1.

Figure 2. Tilt aftereffect comparison for all participants in Experiment 2.
Figure 3. Tilt aftereffect comparison for all participants in Experiment 3.
In the past few decades, there has been an increasing effort to put psychology experiments on the web. The development of web based experiments is largely popular due to the fact that this type of experimental method is cost effective and can result in a larger amount of data collection. The two mentioned factors are not the only advantages of this method, but these two factors are highly motivating for researchers so we will focus on them in this paper. Traditional experimental procedures required participants to book an appointment and meet with the experimenter on their own time to conduct a research experiment. This method is time consuming and costly for both parties involved, but this can be resolved with web based experiments. Along with cost, there is also a convenience factor associated with web based experiments since participants can conduct the experiment in the time and place that is convenient for them. This added level of convenience also allows the experimenters to test a larger pool of participants and ultimately collect a larger set of data than originally possible. While there are many advantages associated with web based experimenters, one disadvantage we noticed was that these experimental procedures are difficult to operate for the experimenter and the participant. Designing web based experiments often times requires the experimenter to be familiar with extensive coding practices in order to get started. The goal of this project is to develop an open-source tool that includes the extensive advantages of web based experiments, while also allowing experimenters the flexibility to develop and manipulate their own experiments with ease. This project is an open-source tool, meaning that it is licensed and will be completely free for experimenters to use around the world. We hope that this software will continue to expand the ongoing trend to conduct psychology experiments on the web, and with the added flexibility to develop experiments without extensive programming knowledge, we
ultimately hope to inspire a new generation of prospering scientists that may not have the necessary funding for their research.

Research in the domain of web based psychology experiments was first introduced in the 1970s (e.g., Connes, 1972; Hoggatt, 1977). Although this type of experimental design was first introduced in the 1970s, a large part of the development occurred during the 1990s with the invention of the World Wide Web (WWW) in the European Laboratory for Particle Physics (CERN) (Musch and Reips, 2000). This milestone and the availability for Internet access has helped propel the movement to put experiments on the web and has helped researchers throughout the world. Since then, many research studies have examined the advantages and disadvantages of using web based experiments. In 2003, a group of researchers compared web based experiments with traditional pen-paper experiments and concluded that, “Web-based data collection neither statistically [enhances] nor [diminishes] the consistency of responses, nor [compromises] the integrity of the test, and are a suitable alternative to more traditional methods” (Riva, Teruzzi, & Anolli, 2003). Studies similar to Riva, Teruzzi, Anolli (2003) have also helped validate the use of web based psychology experiments as a practical and effective alternative to traditional methods. These proponents, and many others that are not mentioned in this paper have helped enhance the development of web based experiments.

The ease of making experiments on the web diminishes the traditional costs associated with psychology research. In the past, participants were required to book an appointment with the researcher and travel to a specific location in order to complete an experiment. With this approach, researchers were often times limited by time constraints since only a select number of individuals were available during the hours in which they could conduct the experiment. Along with time constraints, travel difficulties also plagued researchers, who were located on
University campuses and all participants were required to travel to the campus to conduct the experiment. As a result of these factors, studies such as Reips (1999), Schultz (1972), and Smart (1966) concluded that “more than 80% of all psychological studies are conducted with students as participants, while only about 3% of the general population are students” (Reips, 2000). These restrictions, along with others that are not mentioned in this paper, resulted in a limit to amount of total data that could be collected from psychology experiments. The use of web based experiments has significant altered this reality. Participants are now able to conduct experiments at a time and location when they are comfortable and data is automatically recorded in real-time. Furthermore, the development of web based experiments and the widespread access to the Internet have helped a variety of new communities become active participants. The 97% of the population that are not students have a higher likelihood of participating in research due to the development of web based experiments compared to traditional approaches. This diversity in participation has ultimately helped researchers make accurate claims that reflect the mindset of the larger population than the smaller pool of data that traditional approaches were able to collect. The ease with which participants can complete experiments, along with a decrease in time and travel restrictions, have ultimately allowed researchers to collect more data than previously imagined.

The transition to web based experiments has been an ongoing trend for the past few decades. The shift to web based experiments has not been simple however, since web based experiments are created with software systems that are “written in high-level languages such as C++, Pascal or Delphi, or with program packages such as SuperLab, PsyScope, MEL (Micro Experiment Laboratory) and ERTS (Experimental Run Time System)” (Musch & Reips, 2000). Experimenters are first required to learn these high-level programming languages, or pay for a
subscription for software packages such as SuperLab in order to develop web based experiments. These software packages can be pricey for many experimenters, especially for researchers who are not receiving the necessary funding for their research. In order to limit the difficulties that are associated with learning high-level programming languages and to limit the costs associated with software packages, we are developing a free open-source tool that allows experimenters the ease to develop web based experiments without extensive programming knowledge or a large startup cost.

While developing our open-source tool, we kept in mind the background research regarding web based experiments and aimed to improve the experience for the experimenter and the participant. The research project I have been working on this quarter is called Collector. This has been an ongoing project in the Psychology department with many past and current contributors. The faculty sponsor for this project is Dr. Robert A. Bjork. Under the supervision of Dr. Bjork, I have learned the backend and frontend source code associated with Collector. My role on this project is to help the team write source code, debug and write documentation. A large portion of the previous source code was written in the coding language known as PHP, but there has been an effort to shift away from PHP and move towards HTML and Javascript. HTML and Javascript are relatively simple language to learn and they are largely supported by common web browsers today such as Google Chrome, Safari, Mozilla Firefox, Internet Explorer, etc. For this reason, I was assigned the task to convert the files that had been written in PHP to HTML and Javascript, while maintaining the same functionality. In order to understand the intricacies of the project, I began working with a graduate student on the project named Tyson Kerr. Throughout the quarter, Tyson helped get me acquainted with the project and assigned tasks to accomplish on the trial types. The trial types I worked on throughout the quarter
included Likert and YouTube. In the Likert trial type, participants are shown a question and underneath is a likert scale of ranges for them to select. The original Likert trial type had been created with PHP and I was assigned the task to convert the file to be compatible with our current design, HTML and Javascript. The YouTube trial type displays a video on the page and allows the experimenter to control different features of the video such as start time, end time, display speed, etc. I have since finished the Likert and YouTube trial types and I will continue to work on the remainder of the trial types throughout this quarter and next quarter. Along with properly debugging and rewriting source code for trial types, I have also helped write documentation for the project. Since this is an open-source tool that many experimenters will be using, we believe that clear and descriptive documentation is crucial for proper understanding of source code. I will continue to write source code, debug/test issues that arise, and write documentation for the remainder of this quarter and next quarter.
References


Subjective Vertical in Rod-and-Frame Test

Tanya Chowdhury

Perception is a phenomenon that alters based on visual and vestibular cues. We perceive our world through sensory information received through inputs such as sight, audition, and touch. From social situations to understanding how a picture is put together, perception allows us to translate sensory inputs into a complete and coherent experience. It is important to note that our prior experiences and culture colors our perception and how we effectively interpret our visual cues. There are various experiences of perception, and one that is commonly tested is the subjective visual vertical and visual field dependence. The subjective visual vertical test is used to examine a person’s perception of the vertical which is dependent on vestibular, visual, and somatosensory inputs. The vestibular system primarily integrates sensory information from the visual system and coordinates movement with balance. Along with the vestibular system, visual field dependence is a strong dependence on vision for balance and works in conjunction with the vestibular system. Implementing the visual vertical using virtual reality is has been implemented to effectively understand the relationship between visual cues and balance. This can provide us more insight on visual perception and our vestibular system.

The famous rod-and-frame effect consists of an observer viewing a tilted frame and attempting to set a rod within the frame vertical. Generally, if the frame is tilted, the participant perceives the rod to be tilted in that direction as well. Upon setting the rod to the vertical in the rod-and-frame effect experiments, Cian et al. (2001) explored the role of cognitive facts in the rod-and-frame effect. In the first experiment, Cian et al. (2001) examined the effect of a mouse, square frame, an elephant, and a map of France on the vertical. These added effects test the visual frame and visual polarity of objects. The visual frame defines the primary vertical and
horizontal lines in the environment and the visual polarity of objects establishes a distinct top and bottom from one another (Cian et al., 2001). If all polarized objects seem tilted, participants tend to have a strong notion that they are tilted too. The four frames of reference, a square, mouse, elephant, and map of France, were either upright or tilted 20 degrees clockwise or counterclockwise. The participant’s task was to use a joystick to adjust the rod to the perfect vertical.

The result of Cian et al. (2001) showed that when upright, the presence of the tilted components, the visual objects, and upright frame had no tilt effects (Cian et al., 2001). However, when tilted, the presence of these objects had a significant effect on the direction that appeared to be vertical (Cian et al., 2001). Thus, verticality judgement seemed to be affected by the “orientational properties of the objects through mechanisms responsible for shape-perception, such as visual-polarity cues” (Cian et al., 2001). It becomes clear that the perception of vertical is dependent on cognitive influences. By manipulating the polarity of different objects, Cian et al (2001) demonstrated that the orientation of the rod relative to the vertical is regulated by the “tilt of visual features that do not contain linear segments or geometrical shapes.” This suggests that high-level cognitive processes are present in the Rod and Frame Effects.

To better understand how virtual reality affects perception, Kilten et al. (2013) explored how immersive virtual reality creates a perceptual illusion of body ownership, even when the body differs significantly from the appearance of the person’s body. In the study, the researchers primary purpose was to test whether differences between the real and virtual body have consequences for participant attitudes and behaviors under the illusory experience of body ownership (Kilten et al., 2013). They assigned thirty-six Caucasian people to a between-groups experiment where they played the West African Djembe drum while in Immersive Virtual
Reality. Each participant was assigned a virtual character that was either a casually dressed, dark-skinned virtual body or a formal suited, light-skinned body. To implement the Immersive Virtual Reality aspect, the participants were shown a four-minute video of African Djembe players performing in a traditional manner and were taught how to play they drum. Data was collected on movements of performativity, defined as dimensionality in movement within the neck, head, spine, arms, and hands. Kilten et al. (2013) anticipated that the dimension needed to characterize the casually dressed, dark-skinned virtual body would be greater than for the formal suited, light-skinned body. Once they learned within the four-minute span, they entered the baseline phase. In the baseline condition, the virtual body was represented as a pair of white hands with no body to provide the most minimal body representation. This baseline condition lasted four minutes and was utilized so that the researchers could record the initial amount of movement without any virtual body representation. In the next condition, the participants were switched to the virtual body representation, either Casual Dark or Formal Light, and were left to play the drum for another four minutes.

Participants in both groups experienced a strong body ownership towards the virtual body that they were assigned, regardless of whether the virtual body was similar to their own. However, participants in the Casual Dark group felt that their virtual body was more appropriate for the drumming task than their real body, compared to those in the Formal Light condition. This study concludes that seeing a virtual body from the first-person perspective and subsequently receiving sensorimotor feedback with respect to the physical body entails an illusion of ownership. Not only does immersive virtual reality create a sense of body ownership, but it provides evidence that virtual body ownership can lead to substantial behavioral changes in the context of performativity.
Bringoux et al. (2009) examined how immersive virtual reality could yield similar effects on the judgement of verticality as the tilt of real visual surroundings. Because studies such as Cian et al. (2001) found that the Rod and Frame Effect are dependent on cognitive influences as well as characteristics of visual surroundings, Bringoux et al. (2009) also manipulated visual surroundings during subjective vertical estimates to test the effectiveness of both geometric and cognitive cues on the vertical in an immersive virtual environment. The researchers set up three rooms, one with a classic 3-D rod-and-frame test, another with an empty room with wallpaper which increased visual directional cues, and lastly, a fully furnished room which enhanced visual-polarity cues for up and down directions (Bringoux et al., 2009).

The results demonstrated the effectiveness of immersive virtual reality for inducing the Rod and Frame Effects (Bringoux et al., 2009). The more significant and geometric the visual scene, the greater the Rod and Frame Effects (Bringoux et al., 2009). This demonstrates that the Rod and Frame Effects were dependent upon the features of the visual scene. This study not only demonstrates that the visual structure of a virtual environment influences the perception of the vertical, but also that immersive virtual reality yields similar effects on the judgement of verticality as the tilt of real visual surroundings.

In the visual perception lab at the University of California, Los Angeles, our current research tests the subjective vertical and visual field dependence using the Rod and Frame Task. This task sets out to measure the relative reliance one has on visual information and cues based on how large their errors are from vertical. This lab implements this task using Virtual Reality. The participant is tasked with setting a rod vertical in either a tilted or vertical frame, which is a measure that has previously been correlated with standing balance and acrophobia. Initially, the first background tested is a plain room with a rod on the back wall. The second background
tested is a checkered room with a rod on the back wall. As the research continues, we will develop experiments that can extract the relative weights of all three systems on subjective vertical in order to put together a model of each factor and their relative weights. We would use a Bayesian cue combination model as an optimal observer model to predict how people would weigh each sensory cue and then compare that against data collected from participants. Further, we will attempt to detect how flexible and receptive these weights are in training one sensory system over another.
References


Action Perception and Prediction of Single and Multiple Actor Sequences

Yael H. Waizman

For many years, it was believed that cortical regions that are responsible for perceiving language and actions were independent modules (Pulvermuller, 2005). Pulvermuller et al 2005 were interested in seeing whether these two cortical areas actually formed neural connections with one another during the process of perceiving action related words. This type of synaptic connection could be classified within the Hebbian Principle. This principle stated that synaptic connections are strengthened when both neurons fire simultaneously.

Pulvermuller et al 2005 understood that topographical mapping of the leg, arm, and face, are represented in the motor cortex. They suspected that if the word presented obtained an action using these three body parts (leg, arm, and face), both parts of the brain that corresponded to the word-form and action perception would fire simultaneously throughout processing. Therefore, Pulvermuller et al 2005 believed that the connection between the somatosensory cortex and the motor cortex, when fired together, formed stronger synaptic connections.

Pulvermuller et al 2005 conducted a study using MEG to test this idea of the neuronal connection between verbal and action related word processing. Their results concluded that words related to both face or leg, evoked early superior temporal activation which resulted in activity in the inferior frontal. Subsequently Pulvermuller et al 2005 concluded, face related words, elicited activity in the frontocentral areas. The inferior central activity was brief, while the inferior frontal and the superior temporal remained active for a longer period. Leg related words also produced early superior temporal activation followed by inferior frontocentral areas. However, they were far less pronounced than the face related words. Specifically, the leg related words elicited strong activation within the superior central, whereas this area held
reduced activity for face related words. Therefore, face-word context influenced overall stronger activation in the inferior frontal in comparison to leg-word context. Although leg-word context held a heightened activation in the superior central compared to face-word context. Further findings found a positive correlation between inferior frontal area activation with face-action ratings as well as, superior central activation with leg-action ratings. While the correlation between the superior central activation and face-action was negative, the correlation between inferior frontal activation and leg-action also proved to be negative. Thus, they were able to prove that there was a neural connection when processing action related words in the two cortical areas of the brain.

This present study further explored the implications of the mentioned neural connections between the two cortical areas for processing language and action. Since the Hebbian Principle states that such neurons that fire together form stronger synaptic connections, this may be what guides us in terms of our overall word-action perception. This experiment tested how two priming words such as “walk” or “run” affected participant’s perception of a figure walking or running. The participants were required to respond with which action the figure portrayed, either walking or running, after being presented with the priming words. The participant’s reaction time was then recorded to test this.

It was hypothesized that participants would perform with rapid reaction times when perceiving congruent actions with the priming words, presented beforehand. Conversely, it was expected that the participants would have a slower reaction time when the actions and the priming words are incongruent. Therefore, if the priming word, “walk” was congruent with the following action of walking, the participant would respond with a quicker reaction time than if
the action was running. This same pattern of results was expected with the priming word run and the action of running. If the word “walk” and the action of walking is processed simultaneously in the brain, seeing the priming word beforehand should then provide the participant with the advantage of perceiving the action of walking more quickly. This same argument was used with the word “run” and the action of running. Overall, it was expected that we would witness such results that provide concrete evidence in regards to the advantages that take place in our perception with cortical areas (words and actions) connecting together.

Method

Participants

Thirty-three ethnically diverse University of California, Los Angeles college students participated in this experiment (24 females, nine males, age range: 18.06 - 51.86). All of the subjects registered online through UCLA’s Psychology Department Subject Pool website, SONA. These participants were unaware of the purpose of the experiment prior to participating in the study, and received two course credits on SONA afterwards.

Design

A 2 x 2 within subjects design varied by different stimulus onset asynchrony (SOA) was utilized to test whether individuals obtained a quicker reaction time to congruent versus incongruent word-action representations. The independent variables used in this experiment were priming words with their congruent and incongruent actions. The first independent variable contained two levels, the priming word “walk” or “run.” The second independent variable also contained two levels, an action of point-light biological figures that performed the action of walking or running. The third independent variable was the SOA. SOA served as the duration
between when the priming word was no longer present on the screen and when the action appeared. The actual experimental question measured the dependent variable, being the user’s reaction time to the action of the point-light figures walking or running, by pressing the left arrow key for walking and right arrow key for running. The accuracy of the participants’ responses was not recorded, only their reaction times. This was done in order to examine at what specific SOA the participants were able to process the action at a faster rate. This was categorized through an oscillatory fashion of when each participant processed a word and then perceived the following action. The activation of the priming word and action could be seen in the peaks of these oscillations that depend on the different SOAs. If a participant sees an action during a peak of their oscillations, they were able to process the information at a faster rate and therefore have a faster reaction time. This is why this experiment presented many different SOAs, in order to determine which frequency the participant is at their peak of their perception of action-perception.

Materials and Apparatus

The stimulus within this experiment was coded through MATLAB. The stimulus was made to be white point-light biological figures representing the major joints of the human body such as, head, shoulders, elbows, wrists, hips, knees, and feet. These points of light were presented in the middle of a black background screen as actions of walking and running. To avoid extraneous variables, each participant held his or her head on a chin rest to ensure constant distance from the screen throughout the duration of the experiment. Thus, each subject looked at the stimuli from the same distance.
After resting their heads on the chin-rest, the participant began a trial run to ensure their understanding of the presented task. The trial run served as an identical representation of the actual experimental task. Both in the trail run and the experimental task they were presented with a fixation point in the middle of the screen in which they needed to look at. The priming words of “walk” or “run” then appeared on the screen for 33 ms. The time in between the priming words disappeared from the screen and the actions appeared on the screen was varied through the different SOAs. The whole experiment had 25 different SOA lengths. The lowest SOA was 0 ms and the highest was 800 ms. These SOAs were incremented by 33 ms from 0ms all the way to 800 ms. The order in which the different SOAs took place in the experiment was random. After the priming words disappeared and the SOA passed, the point-light figure was presented performing the action of either walking or running for a total of 0.5 s. Once the action disappeared, the participants were instructed to press the left arrow key if he or she believed the moving action to be walking, or to press the right arrow key if he or she thought the moving action was running. The participants had 2.5 s total to respond to the action they saw. Therefore, the task of the participant was to focus and respond to the action as opposed to the priming word. When the participant inputted an incorrect response, they would hear a “beep” and the words “incorrect response” would appear on the screen. The words “response was too slow” was presented on the screen if the participant did not respond in time after the action disappeared. If the user’s responses were accurate, the task would continue on regularly.

Procedure

The experimenter took the participant into a private room in which they were then instructed to sit on a chair and rest their head on a chin-rest that was adjusted to a comfortable
height suitable to each participant. The participants first filled out their name, gender, email, and date of birth on a form on the computer screen. After submitting this information, the task was opened using MATLAB. Firstly, the directions of the experiment appeared on the screen in white font on a black background. The experimenter instructed the participant to read the directions carefully and ask any questions he or she may still have. After the task was clear to the participant, they pressed the spacebar key to continue and began the trial run. The experimenter remained in the private room with the participant until the trial run was complete. That way if the participant had any further questions or if they did not understand the directions properly, they could be re-directed by the experimenter. Once the trial run was over and the experimenter answered all of the remaining questions the participant may have had, the experimenter left the room and the participant began the actual experimented task. The full task took about 45-50 minutes. After finishing the task, the participants concluded their portion of Part 1 of the experiment and were instructed to return the following week for Part 2. The second part of the experiment was identical to the first one, with the purpose of acquiring more data on each participant.

Results

Overall the results showed that the participants had a much faster reaction time in congruent situations than in incongruent ones. This was when the priming word “walk” was followed by the action of walking, or the priming word “run” was followed by the action of running. Whereas when the priming word “walk” was followed by a running figure, or the priming word “run” was followed by a walking figure, the participant’s reaction time was
significantly slower. This supports the idea that the action-based words are strongly connected in the brain, allowing them to conduct faster signals with one another.

Figure 1 shows the participants’ raw data graphed based on their reaction times and the varied SOAs. This raw data was smoothed out and re-graphed in Figure 2. Both Figure 1 and Figure 2 have this downward trend in the beginning of the experiment. This was believed to be the participant’s practice effects. A fourier transformation was used in order to see the overall averaged oscillations across participants as shown in Figure 3. This graph shows the frequencies in which the oscillations are at their peaks. Figure 4 shows the individual oscillations for every participant when exposed to the priming word “walk.” While figure 5 shows the individual oscillations for every participant when exposed to the priming word “run.”

Discussion

The purpose of this experiment was to investigate the effect that priming words had on our ability to quickly process actions that are congruent or incongruent to priming words. It was predicted that participants will have a faster reaction time when processing an action that is congruent with the priming words. Meaning, if a participant was exposed to the priming word “walk” and then to the action walking, they would have been able to process this action more quickly than if the action was running. Furthermore, if a participant was exposed to the priming word “run” and then the action running, they would have been able to process this action more quickly than if the action was walking. A limitation in this experiment was that the data analysis can not only rely on permutation tests. Future data analysis should be done using the Bayesian hierarchical model to account for individual variabilities.
Future studied can be done in order to examine the effects emotion has on action-perception. Instead of having the participants view these point-light biological figures running or walking, we could incorporate emotion related behaviors into the experiment. For example the actions could include a happy walker versus a sad walker. It would be extremely interesting to see how such emotion related action behaviors would differ or be similar to the current results.
References


Figure 1. Participants raw data based on their reaction time and varied SOAs.
Figure 2. Smooth data representing the participant’s practice effects.
Figure 3. Averaged out oscillations across participants through the fourier transformation.
Figure 4. Individual oscillations for every participants when exposed to the priming word “walk.”
Figure 5. Individual oscillations for every participants when exposed to the priming word “run.”
Semantic Alignment for Different Rational Number Formats

Yasemin Yahni

Although much is unknown about the ways we categorize and store information, research delving into the process of learning and learned associations promises to be a step towards sorting the bookshelf that is the human mind. Professor Keith Holyoak conducted a series of experiments aimed at demonstrating links between the implicit characteristics of different rational numerical structures (e.g., fractions as discrete measurements, predisposed to implementation in discrete, counting-related tasks), and subjects’ performance on different numerical judgment tasks. With continuous visual representations of magnitude, subjects demonstrated a greater aptitude for identifying the appropriate percentage or decimal quantity, increasing both accuracy and speed of response, whereas with discrete representations, subjects favored fractional representations of the data. Ultimately, a conclusion was drawn regarding “semantic alignment,” or the propensity to associate certain rational numerical structures with semantically appropriate formats.

The theory of semantic alignment proposes a link between the structure of our semantic knowledge about the world and the arithmetic relations we see in math problems. More specifically, semantic alignment specifies an analogical mapping between the default semantic relation between the objects used in a mathematics problem statement and the actual mathematical relations being queried (Bassok, 2001). For example, Martin and Bassok (2005) note that division is an asymmetric arithmetic relation (e.g., $a/b \neq b/a$). Semantic alignment suggests that people should perform best when applying this asymmetric mathematical relation to a pair of objects that share an asymmetric relationship in our semantic knowledge network (e.g., a vase can contain tulips, but a tulip cannot contain vases). The researchers observed that
middle school, high school and college students made fewer errors in division problems when
the objects were related in this asymmetric fashion. Especially in word problems in math, it took
longer for students to get to the answer if the question was misaligned and semantically
symmetric than if it was aligned and semantically asymmetric (Fisher, 2011). For adults,
alignment of semantic and mathematical relations is an almost automatic process (Bassok,
Pedigo, Oskarsson, 2008).

The seemingly automatic process of semantic alignment should be extended to
developmental populations, so that students can use their vast knowledge of the world to inform
their acquisition of difficult mathematical concepts. When teaching kids mathematical concepts,
much attention is given to a unidimensional concept of magnitude. This allows a relation to be
formed between the numerical value and the mental placement of a value on a number line
(Holyoak, 2015). However, much other information about how numbers relate to one another
and can be used is lost in this process. In the US education system, after natural numbers,
fractions and decimals are introduced in early elementary school and students struggle with both
of the concepts after being far more accustomed to the structurally simplistic nature of integers
and natural numbers. Researchers in Dr. Holyoak’s lab are working to extend the benefits of
semantic alignment to help students learn and apply rational numbers.

Rational numbers are used to describe mathematical relations and express results of a
division problem by specifying relations between two sets of data such as part-whole, and this
data can be presented visually in either a continuous or discrete fashion. The ability to
distinguish between continuous and discrete quantities develops at an early age. This distinction
highlights the need to use different types of rational numbers. To describe values such as height
and weight we use continuous quantities and for separate and countable elements we use discrete
quantities. Even though decimals and fractions are mathematically regarded as alternative notations of each other, previous research has shown that they refer to different concepts (DeWolf, Holyoak & Bassok, 2015). The bipartite structure of fractions allows us to recognize a relationship between two sets more easily. Even though they also express magnitudes, we are more likely to identify them as a ratio for two individual sets of data: numerator and denominator (DeWolf et al., 2015). We use fractions when counting or describing visually easily discernable objects (i.e., discrete, countable entities). In decimals, the denominator is fixed to 100, which creates a unidimensional characteristic and therefore makes decimals less inherently useful for comparisons and relations. However, previous research has shown that this unidimensional characteristic of decimals makes them perfectly suited for representing magnitudes of continuous quantities (DeWolf et al., 2015). A decimal corresponds to the value of a ratio \((a/b=c)\), and therefore we tend to associate decimals with estimation. In other words, when trying to evaluate the value of a decimal number we tend to approximate which decreases the accuracy relative to using fractions in a counting procedure. For a continuous set of data, we should provide some sort of measurement scale to estimate the value using a decimal number. This is a step that requires extra time and cognitive force; however, it is necessary for more accurate results (DeWolf et al., 2015).

In this research, our hypothesis was that decimals are better-suited for continuous quantities and are used to describe magnitudes, whereas fractions are better-suited to describe discrete quantities and are better to express relations. The first of the two experiments was a magnitude comparison task. Participants had to decide whether a symbolic quantity was larger or smaller than a non-symbolic quantity (a picture that showed a continuous magnitude or a discrete magnitude). In this experiment, we found that people have fastest reaction times (RTs)
when the number is either a decimal or a percent, and people are slower when the number is a fraction. The second experiment was a relational judgment task. Participants had to look at a display that contained both a symbolic quantity and a non-symbolic quantity (either continuous or discrete) and decide whether the number and picture pair showed a part-to-part ratio or a part-to-whole ratio. Participants were fastest and most accurate when the display contained a fraction paired with a discrete picture. Decimals and percents were indistinguishable. The results, reaction times to different tasks using either fractions, percents or decimals, supported our hypothesis about semantic alignment by showing that different types of rational numbers, based on their structure, are better-suited for different tasks.

Semantic alignment theory might be helpful to enhance the learning experience of rational numbers for children in late elementary school and middle school. By emphasizing the importance of semantic alignment between fractions and discrete quantities, we can make children realize the extension of this knowledge to daily life and augment their understanding of the concept of rational numbers. Using decimals with continuous quantities and fractions with countable ones proposes a more efficient use of mathematics in daily life. While it is important for children to understand the differences between rational number formats, mathematics education in the US is very procedural, and many kids fail to realize conceptual links between different kinds of numbers (e.g., that $3/8 = .375 = 37.5\%$). By accentuating the different structures and applications of decimals and fractions, we can help the kids internalize the concepts better and build a more conceptually complete framework of rational numbers.

By conducting a series of experiments we concluded that the theory of semantic alignment suggests that we process quantitative information in different ways based on the information’s natural structure and the way it was presented to us. By associating discrete values
with fractions and continuous values with decimals we can more effectively interpret the data that is presented to us. This research, and many more that are dedicated to understanding the complex design of our learning techniques, aims to optimize the way especially mathematics is learned by younger students. Semantic alignment, the ability to correctly align the concept that is presented to us with the correct type of data, rational numbers for our case, based on semantics, is highly practical and promotes better understanding for certain concepts.
References


Biological Motion Perception and Causal Illusion

Helen Yu Du

Biological motion is information rich and it has high evolutionary significance. Biological motion perception allows human not only to identify basic motion, but also to infer meaningful intentions and traits that are useful in social interaction (Blake & Shiffrar, 2007). Modern research on biological motion perception often employ Point-Light (PL) Displays developed by Johansson in which light patches are attached at major joints of human actors. PL Display represents human biological motion by tracking the paths of those light patches (Thornton, Vuong & Bulthoff 2003). Other tools extended from this display model including linking the light dots into lines and represent human motion in stick figures are also popular (Blake & Shiffrar, 2007).

The experiment I worked on in Dr. Hongjing Lu’s Computational Vision and Learning lab (CVL lab) under researcher Yujia Peng adopted this stick figure display tool to investigate how human causal interactions may create illusory body movements. This experiment is inspired by Chen and Scholl’s (2016) research on how seeing causal history in static shapes induces illusory motion perception.

Human often have inferred causal history over real life objects upon seeing them. For example, people perceive a ball of crushed paper as a flat sheet of paper being subsequently crushed by hand. People perceive a half full bucket of ice cream as a full bucket of ice cream with a smooth surface subsequently scooped away. Chen and Scholl (2016) investigated if such causal history inferred from a static image is influential enough to even generate illusory motion when the motion is in fact absent. In their experiment, they created “actual change” stimuli during which a truncated figure was immediately presented after the complete image. They also
created “gradual change” stimuli during which an intermediate presentation was presented in between the complete and truncated figure. Subjects are instructed to identify which type of change happened.

Their result suggests that observers would construct and perceive illusory gradual motion (when it was actually sudden motion) only when object contours were consistent with causal intrusion or extrusion events. Moreover, their experiments also suggest that such causal history is closely connected with higher-level processing instead of lower-level geometric processing (Chen & Scholl, 2016).

Similarly, the experiment I worked on examines if human iterations entailing certain causality can induce gradual motion when there is actually sudden motion. The experimental stimulus presents an interactive action in which one green stick actor throws an object and the other red stick actor catches it while the actual object is not presented. The green thrower is always presented first and the red actor follows the green actor by showing a “sudden posture change” that consists of two static posture frames or a “gradual posture change” consisting multiple static frames. These actors are presented in three different ways: both facing each other (meaningful “throw and catch” interaction situation), back to back directions (non-interactive situation), or presented upside down (inverted situation). The subjects are required to judge if the red catcher makes a “sudden posture change” or “gradual posture change” and indicate their choice by pressing the left or right arrow key on a computer keyboard.

During this quarter, we constantly modified the experiment and carried out 5 versions in total. Version 6 is the first version I worked on. In making sure that the participants can distinguish the “sudden change” and “gradual change”, practice trials similar to the test trials
were given. Participants had to hit 80% accuracy rate within 4 sets of practice to go on to the test. However, data suggests many participants did poorly.

To solve this problem, version 7 developed two sessions of practice. The first session, only the red target figure was presented at the center of the screen. The participant would judge if it performed a sudden or gradual change and they would hear a beep if they made the right choice. Similar to version 6, participants doing version 7 needed to achieve 80% accuracy to move on to the second practice session. The second session consists of 12 trials similar to that of the real test without any feedback given. The aim of the first session is to make sure participants can distinguish between “sudden” and “gradual” condition whereas the second session familiarizes them with the test.

From the result of version 7, the researcher suspected that a few participants did not really fixated at the center and paid attention to both actors. To make sure that participants fixate at the center and use their peripheral vision to see both actors during the experiment, another task was added in version 8. The new task is to detect whether the green actor changes color from green to blue briefly in the trial. Similar to how participants respond to the posture change task, they press the up arrow to indicate “color change” and the down arrow to indicate “no color change”. This task aims to direct subjects’ attention to both figures as they might anticipate changes in both and not simply staring and wait for the red actor to make their judgment.

The result of version 8 shows that the color change task might have distracted the participants in responding to the posture change task even though it was designed for them to focus at the center. During the subjects’ practice trials, I also observed that it was a much demanding experiment for the participants to perform. Hence, in version 9, the color change task is removed. In version 9, practice trials are modified as well. This version consists three sessions
of practice. The first and second sessions consist only the red target actor with feedback given. Practice 1 is slightly easier than practice 2. The third session consists both actors with no feedback, mimicking the real test condition. The 80% accuracy cap is also removed and the practice moves on regardless of the accuracy rate. There is also an overall change that both the actors’ sizes and the distance between them are reduced.

The last version, version 10, is to replicate an earlier version (version 5). Eighteen data was collected for this version before moving back to version 9. Up till now, the experiment has not yielded any significant result. However, we hope with more participants, the result will start to show some significance.

As we discussed in week 10’s lab meeting, to further improve on the experiment, we still need to address a few problems such as the following two.

First, we need to consider adaptation effect. The motion used in the stimuli is the same “throw and catch” motion throughout the whole experiment. Research conducted by Pstill, Viera and Carrasco (2007) suggests that adaptation reduces stimulus salience. As a result, subjects may get used to this motion relation and thus, experience a loss of sensitivity and develop perceptual bias. To address this problem, multiple action-reaction pairs can be selected from the CMU Motion-capture database (where the current motion pair is selected) such as “high five” and “handshake”.

Second, we need to consider possible reaction bias towards choosing “sudden posture change” as the target red actor appears “suddenly”. This may be a confounding variable that creates a response bias among the participants. One possible solution to address this is maybe present both red and green actors at the same time from the beginning instead of a sudden
appearance of the red figure. This change may also help the subjects focus more at the center of
the screen as they would not know what and when to expect from the figures.

Finally, I would like to express my gratitude to Dr. Lu, Yujia, as well as other researchers
and RAs in the CVL lab. I really appreciate their help and trust. Working in the lab has been a
great opportunity and enriching experience for me. Managing experiment time slots and
participants on the SONA system, running subjects for experiments, and dealing with different
unexpected situations polished my communication, organizational and interpersonal skills. These
hands-on experience brought me closer to what psychology research is like. The weekly lab
meetings also offered me valuable insights into forefront knowledge and researches in the field
of cognitive science. I do hope with more data collected next quarter, our experiment will show a
significant result. I also hope to learn more from this lab experience and contribute to the lab in
meaningful ways in the future.
References


Human Interaction Perception through Viewing Motion Trajectories

Yue Zhou

Human interaction perception is prevailing tasks that human beings frequently performing, consciously or unconsciously. Perceiving interaction status among other people helps the perceiver interpret social contexts and roles, infer other people’s mental states and goals and predict and prepare for the potential consequences the current interaction entails. For human beings, human interaction perception is an essential component of our understanding of the world around us and may be a key factor underpinning empathy. For certain profession under certain situations, expertise in human interaction detection is needed when identifying the breakpoints and perpetuators of conflicts through viewing surveillance videos.

The classic study by Heider and Simmel in 1944 indicated that people are adept at inferring interactions and motivations from viewing highly simplified decontextualized stimuli. A more recent study by Baker et.al in 2009 aimed to provide a computational model accounting for the process and strategies in human motion perception. The results from that study showed the fruitfulness of a Bayesian model in this direction. During this past quarter, my work at Lu Lab has been helping collecting behavioral data for a study that aims to provide a hierarchical model for human interaction judgments and utilizes stimuli generated from real-life videos.

In Heider and Simmel’s study, the subjects were shown with a video where several simple geometric shapes (a large triangle, a small triangle and a small circle) carried out a series of motions against an empty background with only a rectangular frame. Some participants were asked to freely describe the events in the video and others were asked a series questions on the personalities of the shapes and the motivation of their motion. In the free response condition, most participants interpreted the video as depicting motions of animated beings. In the question
condition, most participants interpreted and attributed the motions in terms of human-like actions with social contexts. From their answers, it can be seen that they tend to assign rich personalities and characters to the shapes and meanings to their actions, a lot of times involving complex social relationships.

These results, especially the participants’ uniformly interpreting the stimuli as meaningful actions of human-like beings in free response without further instructions, showed humans’ robust ability and intuition to interpret highly simplified stimuli in terms of human interaction and hence the effectiveness in using the more controlled decontextualized presentation of stimuli to probe human interaction perception. However, the video employed in this study has a length of two and half minutes with various differences in the shapes’ orientation, speed, direction of motion etc. therefore posing difficulty on pinpointing the factors that contribute to the participants’ perception. Moreover, the methods the researchers used to solicit the participants interpretation of the stimuli is self-report after viewing the entire video. Thus, the answers are far from being controlled and are difficult to conduct quantitative analysis with.

In Baker et. al’s study, the researchers developed a Bayesian model which interpreted actions of an agents as a function of the environment and their goals. The experiments also collected behavioral data from human participants to verify the predictiveness of the computational model. The participants were shown with animations of agents (decontextualized geometric shapes) moving in a maze-like environment and were asked to infer the agents’ goals at different points of their actions and to predict plausible actions base on environment and goals.

Results from this study showed the effectiveness of a Bayesion model in human motion perception. The stimuli used in this experiment is more controlled than in Heider and Simmel
study. However, the stimuli in both studies were entirely artificially generated in the lab. Therefore, whether the results are transferrable and applicable to human motion perception in real-life situations still requires further examination.

Inspired by the fruit and limitations of studies in this field, researchers at Lu Lab and a statistics lab devised the current study suggesting a possible Bayesian model of human interaction perception with convergent human behavioral data.

In exploration of a balance between real-life stimuli and controlled experimental paradigms, the researchers came up with a creative way to generate stimuli. They attached a camera to a drone and shot the scenes of human actors carrying out activities on the ground. These aerial videos are the raw materials for the stimuli used in the experiments. The researchers extracted the body location information of actors in the videos and generated dots, using their trajectories to represent the changes in the actors’ body locations in the video.

Similar to the experimental paradigm in Baker et. al’s study, the current study collected data from behavioral experiments to examine the computational model’s prediction of human judgment. A series of three experiments were conducted. My involvement was running the subjects and guiding them through the instruction and training period.

In each study, the participants were given the same set of instructions. During briefing, the video in Heider and Simmel’s study was shown to them at first. While viewing the video, I would mention some common interpretation from the subjects’ report in the 1944 study to the participant and explain that human beings can extract rich interaction information from highly simplified stimuli. Most participants nodded or expressed resonance with the interpretations. After that, the participants were shown a clip from the aerial videos with a little blue square and a little red square tracking the two actors of interested in the scene. I explained the cover story
asking the participants to imagine that they were working for a company and their job was to inspect the video and identify during which time span in the video were the two actors interacting with each other and if they interacted at all throughout the video. Then the decontextualized stimuli with two dots representing the actors and their trajectories indicating their body locations were shown to the participants and I explained how the later stimuli was generated from the previous video. Then the participants were instructed that in the experiment they would view similar animations of two dots moving around and record their perception of their interaction status from time to time by pressing different keys with one indicating no interaction, one indicating interaction and one indicating that they were not sure about the actors’ interaction status. The participants first went through a practice period with four trials to make sure they understood the instructions as expected. Then the data of their judgment in the experimental trials were recorded.

The difference between the three experiments lies in their stimuli. In the first experiment, the stimuli were all extracted from the aerial videos. In the interactive trials, the animation was the trajectories of two actors that were interacting with each other in the original video. In the non-interactive trials, the animation was comprised by a trajectories of two actors, each from a different video, hence their actions are irrelevant from each other. As a results, the model’s prediction fitted well with the human behavioral data.

In the second experiments, all the stimuli, interactive or non-interactive, were synthesized by the generative model. The results of human judgments were also consistent with expectation here.
In the third experiment, the speed of the two actors’ motion was manipulated to be a salient variable. The data collected for this experiment would need further analysis and interpretation.

The results first two studies provided evidence for the fruitfulness of the proposed computational model. However, there still exists limitation to the dataset tested here. For example, the actors in the aerial videos were carrying out scripted tasks which is till different from spontaneous real-life interactions. The experimenters are in the process of devising further experiments with this paradigm. As an undergraduate research assistant, I am excite to get involved in them.
References

