

## SUBMISSION INSTRUCTIONS

Please remember the following things:

1. **Don't change the page structure of the original assignment** (e.g. make sure that you don't use two sides for a question that was originally restricted to one side, and make sure that you don't submit a single page that includes responses to two different questions). If you're using a program other than Microsoft Word, you'll need to be especially careful about preserving the page structure – please make sure that your submission is consistent with the structure of the online pdf version of this document.
2. Print out a copy of your answers and turn it in before the end of class on the due date. Make sure that you fill in and include the cover sheet that appears on the next page. If you decide not to answer one or two questions, submit the blank pages (with empty boxes) for these questions. **Please put your name on top of each page and print out your answers single-sided.** We will separate your packet and distribute different pages to individual graders.
3. Upload the file to the course website on Blackboard. The file should be uploaded via the Assignments page. The uploaded file will give us a permanent copy of your assignment (in case of query or loss of the paper copy). If you're having trouble submitting your file, try using a different browser before contacting us. Note that submitting an electronic copy alone is not sufficient – **if you do not submit a hard copy, then you will not receive any credit for this assignment.**
4. Some questions may ask you to sketch graphs or draw diagrams. If you choose to submit hand-drawn diagrams for these questions, it's fine to leave the corresponding boxes on the electronic copy blank.

PLEASE FOLLOW THE ABOVE INSTRUCTIONS CAREFULLY. To encourage you to do so, 10 % of your assignment grade will depend on following the instructions correctly.

- If you do not print out your answers single-sided and write your name on each page, you will lose 5% of your grade.
- If you do not upload an electronic copy of your assignment to the Assignments page on Blackboard, you will lose 5% of your grade.
- If your hard copy does not preserve the page structure of HW3.pdf (see Blackboard), you will lose 5% of your grade.

Turn in this homework in class on Thurs October 3 or earlier to Rony's mailbox (BH 336D).

## COVER SHEET

Honor code:

“My responses to these questions represent my own ideas and I have not received undue assistance from any source”

Your signature: \_\_\_\_\_

Please choose one of the following options:

: I would like to pick up my graded assignment at the end of class. The final grade will be written on the underside of the first page, but I understand that others may see my graded work.

: I prefer that my graded assignment not be distributed at the end of class, and understand that I will need to collect it during Rony's office hour .

Your signature: \_\_\_\_\_

### HW3

Name: Shashank Singh (sss1)

1) Suppose that I show you a photograph of a scene and ask you to say what it contains. Your friend Bob proposes that your visual system solves this problem by constructing and manipulating “images in the head” and uses Fig 1.9 in the textbook (p 23) to support his claim.

Bob wants to call the pattern of brain activation in Fig 1.9b a “representation” of the stimulus in Fig 1.9a. Does this pattern of brain activation qualify as a representation according to Markman's definition? Markman's definition includes four components---explain why each one is either present or absent in this case.

NB: Fig 1.9b might be described as a representation (i.e. a textbook picture) of a representation (i.e a pattern of brain activation) of the stimulus in Fig 1.9a. Here we're not interested in whether the textbook picture (i.e. the pattern of dots on a page) qualifies as a representation---your answer should describe whether the pattern of brain activation qualifies as a representation.

(i) Represented world is ☒ present ☐ absent (circle one).

Explain why you think this component is present or absent.

The represented world is the photograph and its contents.

(ii) Representing world is ☒ present ☐ absent (circle one).

Explain why you think this component is present or absent.

The representing world is the set of possible brain activations.

(iii) Representing rules are present absent (circle one).

Explain why you think this component is present or absent.

The the conversion of a stimulus to a pattern of brain activation is not defined by a set of representing rules because a given stimulus may result in one of many patterns of brain activation. In particular, this pattern will vary somewhat across trials of a stimulus, due to other, unrelated variations in brain state, etc.

(iv) Process that uses the representation is present absent (circle one).

Explain why you think this component is present or absent.

The process using the representation is your ability to determine the contents of the image.

2) a) What is the homunculus fallacy (p 13, 171 Markman), and why is this a fallacy? Feel free to consult other resources (including the web), but make sure that you put your answer in your own words.

The homunculus fallacy is an attempt to explain a phenomenon by a process that itself depends on the phenomenon (e.g., explaining human vision in terms of a homunculus who himself must utilize vision). Such an explanation is fallacious because it simply restates the phenomenon in terms of the homunculus, which itself is not understood.

(b) Markman's definition of "representation" includes four components. Representational proposals that commit the homunculus fallacy are typically missing a detailed specification of one of the four components. Identify this component and explain why it is especially relevant to the homunculus fallacy.

Representational proposals that commit the homunculus fallacy typically fail to specify the representing rules that translate the represented world into the representing world. The homunculus serves as a "black box" in which these rules are hidden.

(c) Explain why Bob (the friend mentioned in Q1) is in danger of committing the homunculus fallacy.

Bob fails to specify any rules for identifying the contents of the represented world in the representing world, and hence he may be committing a homunculus fallacy by implicitly assuming that there is a process (the homunculus) for manipulating the "mental image" to extract its contents.

### HW3

**Name: Shashank Singh (sss1)**

3) a) A traditional wall clock relies on an analog representation. In other words, a traditional wall clock uses one continuous dimension to represent another - continuous dimension. List these dimensions:

A wall clock uses the dimension of rotation angle (representing world)  
to represent the dimension of time (represented world)

(b) In the case of a traditional wall clock, the representing dimension loses information about the represented dimension. Suppose that value X along the represented dimension maps to value Y along the representing dimension. Explain why knowing value Y is not enough to recover value X with certainty. You should assume that the clock keeps perfect time.

The wall clock identifies times that differ by exactly 12 hours (e.g., 3:14AM and 3:14PM). Thus, while it is possible to determine the time exactly in a given 12 hour interval, it is impossible to determine, in general, the 12 hour interval in which the current time lies.

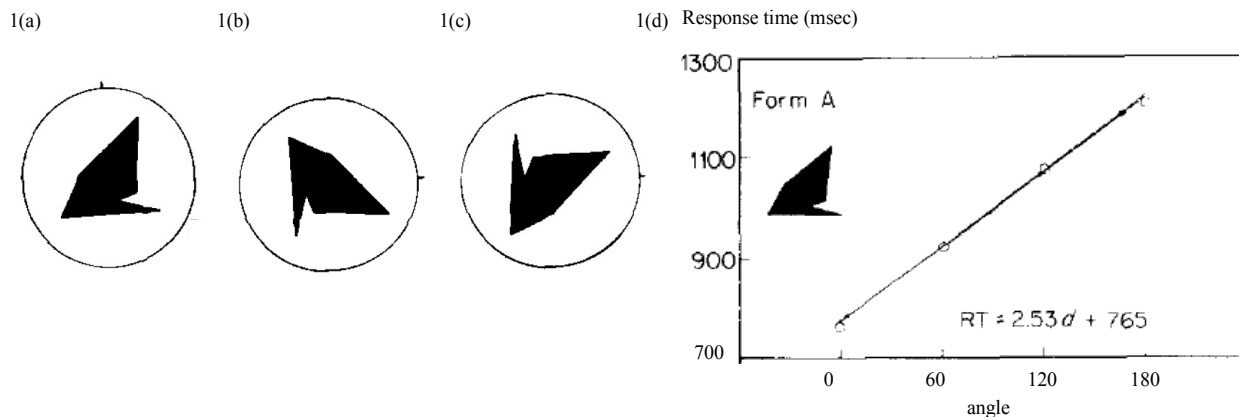
(b) Explain why a digital clock qualifies as a symbolic representation rather than an analog representation.

A digital clock serves as a symbolic representation because it relates discrete elements (Arabic numerals) of the representing world arbitrarily (via our interpretation of numerals and our 12-hour time system) to the represented world (time).

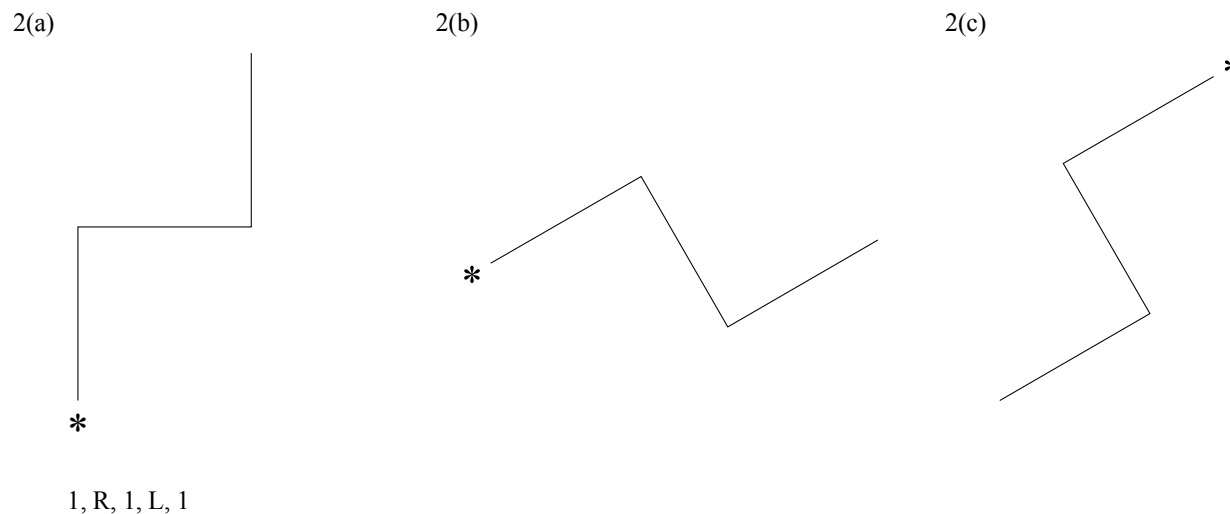
### HW3

Name: Shashank Singh (sss1)

4) Page 96 of the textbook describes the Shepard and Metzler mental rotation study that inspired one of your CogLabs. Similar studies have been carried out using two-dimensional stimuli. Images 1(a) and 1(b) below are the same up to a rotation, but images 1(a) and 1(c) are not. Figure 1(d) shows that experiments with 2D stimuli produce the same clean linear fits that you read about for 3D stimuli.



In this question we'll consider a 2D rotation task involving simple line drawings. Figures 2a, 2b and 2c below show three examples -- note that each one has an asterisk at one end of the stimuli.



(a) Suppose that the stimuli are mentally represented as sequences of steps and turns starting from the asterisk. For example, the stimulus in 2(a) is represented as "1,R,1,L,1"

which corresponds to the sequence "1 step forward, turn right, 1 step forward, turn left, one step forward."

The step-sequence representation for (b) is 1,R,1,L,1

The step-sequence representation for (c) is 1,L,1,R,1

### HW3

**Name: Shashank Singh (sss1)**

(b) In the rotation task, participants are presented with a pair of figures and asked to say "same" or "different" depending on whether they are the same up to a rotation. Bob proposes that people solve this task by generating step-sequence representations for each figure then comparing these representations to see whether they are the same.

Consider only "same" trials". Draw a plot like Fig 1d above which shows what Bob's theory predicts about how response time varies as a function of the angle between the figures. Don't worry too much about the numbers on the y-axis -- we're only interested in the shape of your curve.

Explain why Bob's theory generates the predictions that you drew.

Assuming the time required to generate a step-sequence representation for a figure is independent of the rotation angle of the figure, since the step-sequence representation itself is independent of the angle, the time required to differentiate or identify two figures based on their step-sequence representation is independent of their rotation angle.

(c) On average, does Bob's theory predict that people will be faster for "same" pairs (e.g. pairs like 2a and 2b) or "different pairs" (e.g. pairs like 2a and 2c)?

Bob's theory predicts that the response time for "same" pairs will be greater / equal / less than the time taken for "different" pairs (circle one)

Explain your answer and make sure that you state any assumptions that you needed to make.

Assuming the step-sequences are compared sequentially and that the comparison terminates immediately upon finding a difference, fewer stepwise comparisons will be needed to find a difference between different figures than to confirm that all steps in two identical figures are identical.



5) Suppose that exactly the same parts of the brain are used in exactly the same way when looking at a stimulus and when calling up a mental image of the stimulus (Anderson pp 102-104). Does this provide conclusive evidence that some mental representations are like pictures? Make sure that you support your answer with a clear explanation.

If the neural activities associated with viewing a stimulus and invoking a mental image of the stimulus are nearly identical, then the process of invoking a mental image of that stimulus must be nearly identical to viewing that stimulus. For this to be the case, the stored mental representation of the stimulus must be very similar to the representation of the stimulus when viewed, suggesting that the stored stimulus is in fact a "picture" of the stimulus, assuming that the mental representation of a stimulus being viewed is itself simply a "picture." In this sense, it follows that some mental representations must be like pictures.