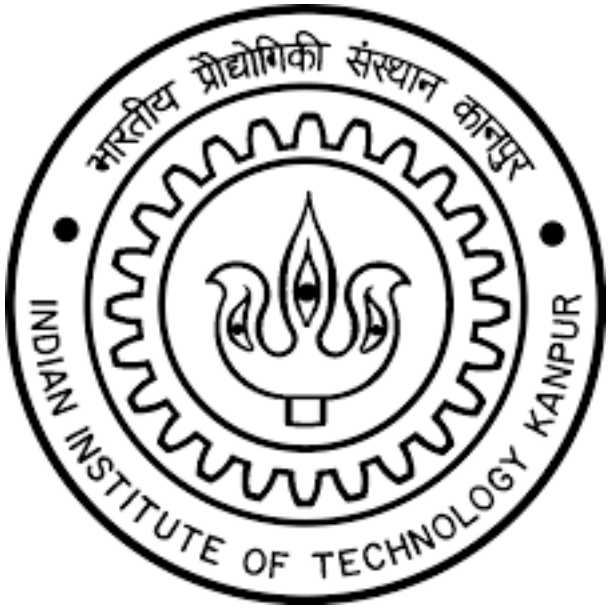


Indian Institute of Technology
Kanpur

In Collaboration
with

National Program on Technology Enhanced Learning (NPTEL)

Presents

Course Title:

Basic Cognitive Processes

By: Dr. Ark Verma,
Assistant Professor of Psychology,
Department of Humanities & Social Sciences,
IIT Kanpur

Lecture 24: Attention - I

Some Key Questions…

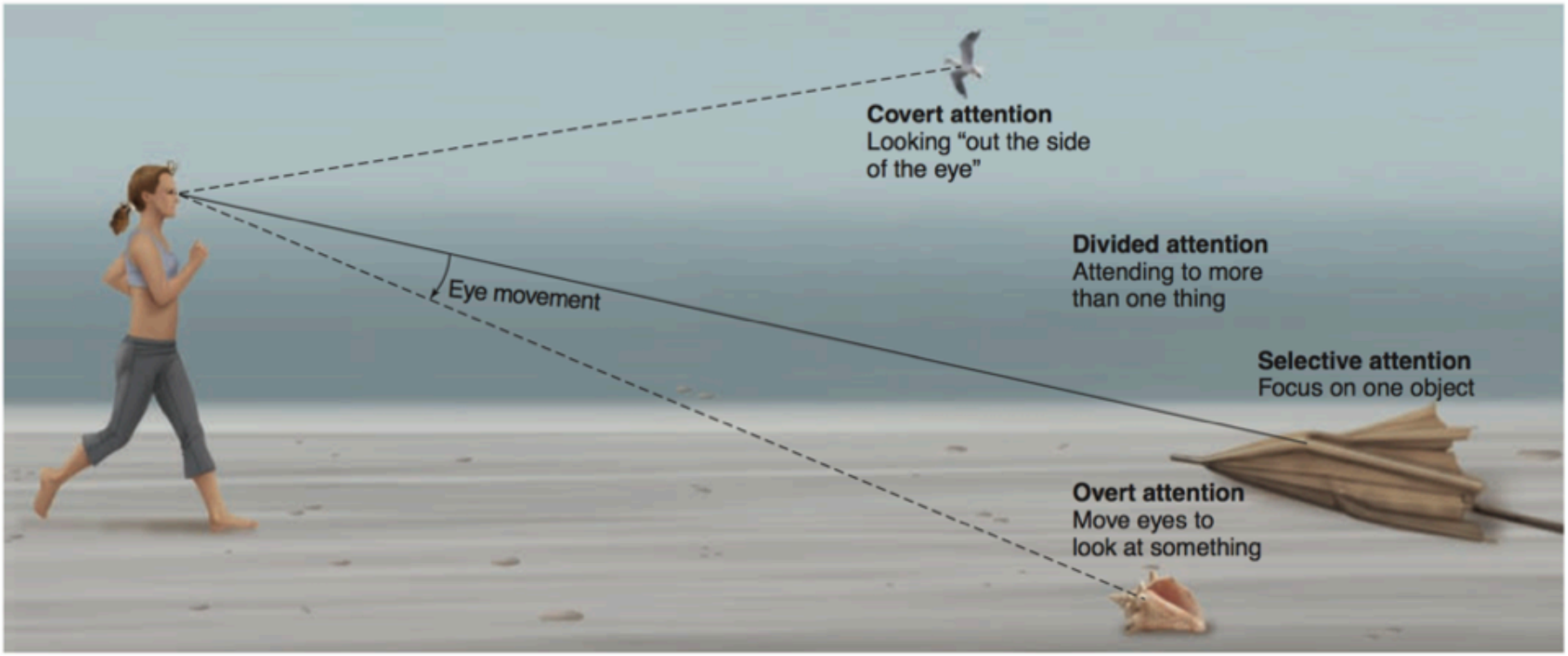
- Is it possible to selectively focus on one object/event, while many others are simultaneously going on?
- If yes, then under what conditions?
- What does research on attention tell us about multi – tasking?
- Is it that we are not attending to all other information that we are not focusing on?

Preliminary Definitions…

- *Attention*: the ability to focus on specific stimuli or spatial locations.
- *Selective Attention:* focusing attention on a specific object, event or location.
- *Overt Attention*: the process of shifting attention from one place to another by moving of eyes to those specific objects or locations.

- *Covert Attention*: when attention is shifted without the actual movement of the eyes.

- *Divided Attention*: the ability of attending two objects at the same time.



● **FIGURE 4.1** Crystal attends to various objects on the beach, illustrating a number of different types of attention.

Image Source: Goldstein (2011). Cognitive Psychology_Connecting Mind, research & Eveyday Experience. *Cengage Learning*

Attentional Processes: Visual Search

- ***Search*** refers to our behaviour of scanning the environment looking for particular features – i.e. actively looking for something when one is not aware of the location it will appear.

- ***Search*** becomes more difficult by ***distracters,*** i.e. non – target stimuli that divert our attention away from the target stimulus.
  - False alarms usually arise when we encounter such distracters while looking for the target stimulus. for e.g. counterfeits.

- the number of targets & distracters affects the difficulty of the task.
    - e.g. try to find T in the two figures, Panel A & B
- An interesting finding is the *display size* (i.e. the number of items in a given visual array) *effect,* which is the degree to which the number of items in a display hinders the search process).

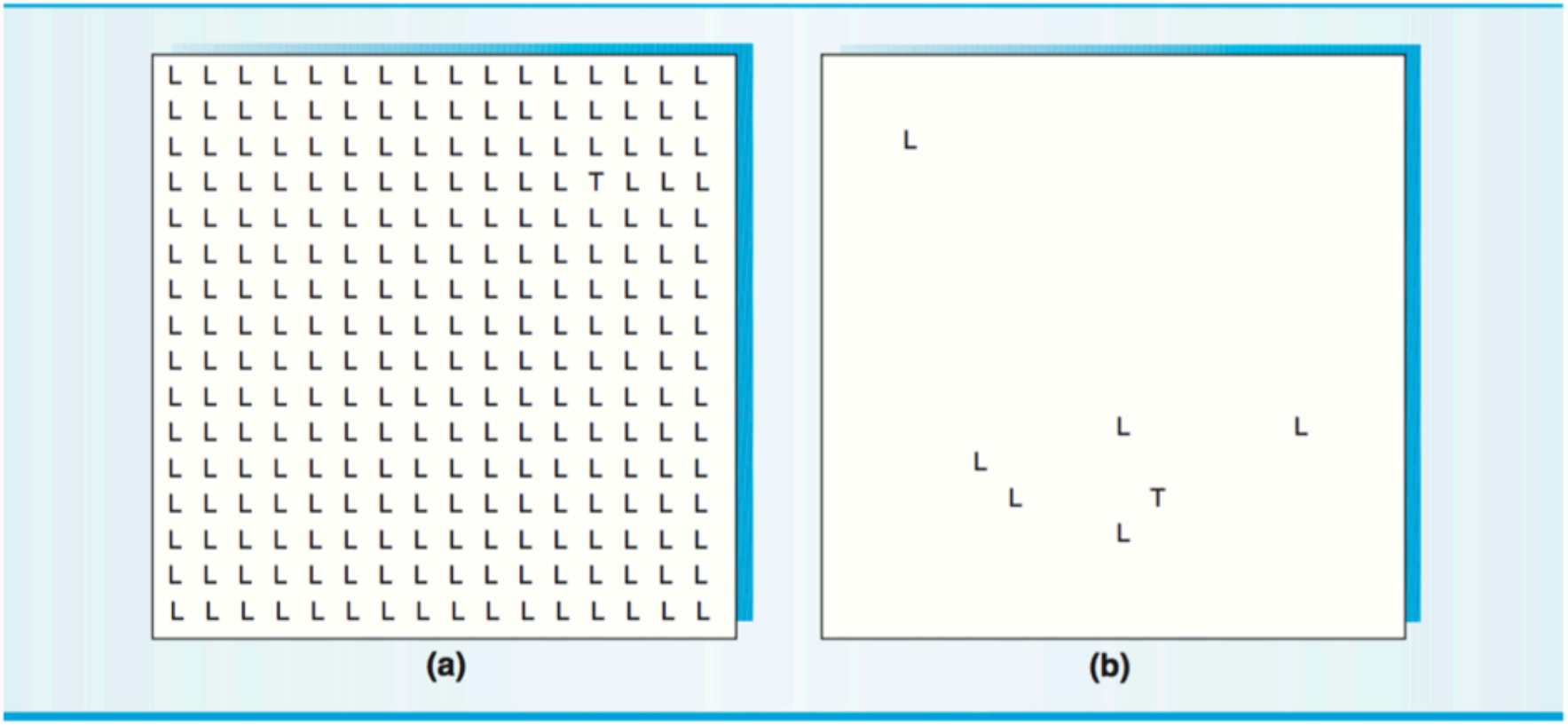


Figure 4.2 **Display Size.**

Compare the relative difficulty in finding the T in panels (a) and (b). The display size affects your ease of performing the task.

Image Source: Sternberg & Sternberg (2011). Cognitive Psychology. *Wadsworth Publishing*. 6th Ed. (p. 143).

- Distracters cause more trouble under some conditions than under others.
    - we conduct a **feature search**, when we simply scan the environment for a specific feature (Treisman, 1993). Distracters play little role in slowing our search in this case. for example, finding O in the panel c.
- because O has a distinctive form as compared to the rest of the items in the display; it pops out.
- Features singletons, i.e. items with distinctive features stand out in the display (Yantis, 1993); when feature singletons are targets, they seem to grab our attention; even those that may be distracting.

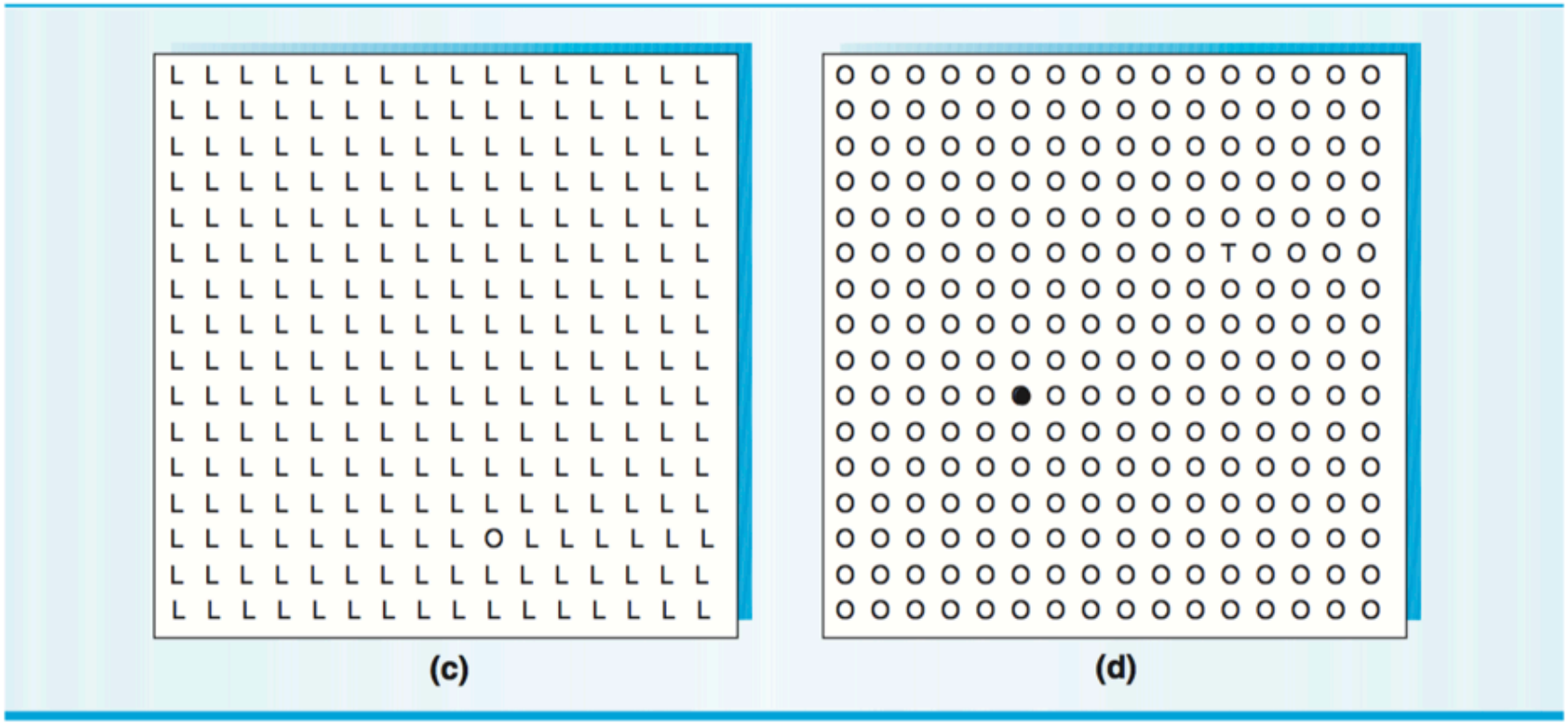


Figure 4.3 **Feature Search.**
In panel (c), find the O, and in panel (d), find the T.

Image Source: Sternberg & Sternberg (2011). Cognitive Psychology. *Wadsworth Publishing*. 6th Ed. (p. 144).

- on the other hand, when the target stimulus has no unique or even distinctive features.

- In these situations, the only way we can find such items is by **conjunction search**, i.e. we look for a particular combination (conjunction) of features. for e.g. the only difference between a T & a L is the particular integration of line segments. Both letters comprise a horizontal line and a vertical line.

- The dorsolateral prefrontal cortex as well as both frontal eye fields & the posterior parietal cortex play a role only in conjunction searches, but not so in feature searches (Kalla et el., 2009).

- **Theories of Visual Search**

  - **Feature - Integration Theory** explains the relative ease of conducting feature searches and the relative difficulty of conducting conjunction searches.

  - Going by Treisman's (1986) model of visual search, for each possible feature of a stimulus, each of us has a mental map for representing the given feature across the visual field. Say, there is a map for every colour, size, shape or orientation. there is no added time required for additional cognitive processing. Thus during feature searchers, we monitor the relevant feature map for the presence of any activation anywhere in the visual field.

  - This monitoring process can be done in parallel (all at once). This will therefore show no display size effects.

- However, during conjunction searchers; an additional stage of processing is needed. During this stage, we must use our attentional resources as a sort of mental glue; where in the two or more features are conjoined into an object representation at a particular location. In this stage, we can conjoin the features representation of only one object at a time. This stage, must be carried out sequentially, conjoining each object one by one. Effects of display size (i.e. a larger number of objects with features to be conjoined) therefore appear.

- Such a model of visual search is supported by the work of Hubel & Wiesel, (1979), who identified specific neural feature detectors.
    - these are cortical neurons that respond differentially to visual stimuli of particular orientations (e.g. vertical, horizontal, or diagonal).
- More recent research has indicated that the best search strategy is not for the brain to increase the activity of neurons that respond to the particular target stimuli; in fact the brain seems to use the more nearly optimal strategy of activating neurons that best distinguish the targets from the distracters, while at the same time ignoring the neurons that are tuned best to the target (Navalpakkam & Itty, 2007).

- **Similarity Theory:** According to similarity theory, Treisman's data can be reinterpreted; as being a result of the fact that as the similarity between target & distracter stimuli increases, so does the difficulty in detecting the target stimuli (Duncan & Humphreys, 1992).

- Thus targets that are highly similar to distracters are relatively harder to detect. Targets that are highly disparate from distracters are relatively easy to detect. (e.g. finding the black circle in panel E).

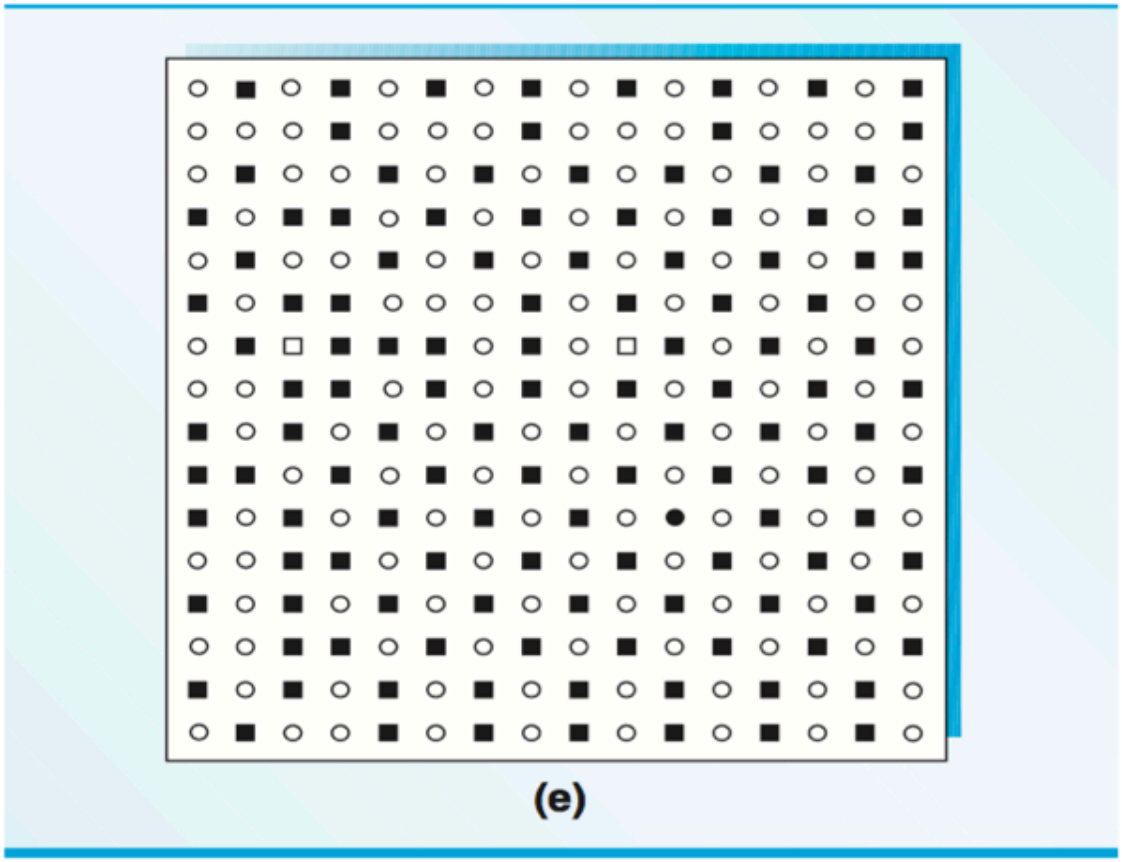


Figure 4.4 **Similarity Theory.**
In panel (e), find the black circle.

Image Source: Sternberg & Sternberg (2011). Cognitive Psychology. *Wadsworth Publishing*. 6th Ed. (p. 146).

- The target is highly similar to the distracters (black squares or white circles); therefore it is very difficult to find.

- Further, the difficulty of search tasks depends upon the the degree of disparity among the distracters; but it does not depend on the number of features to be integrated. for instance, one reason it is easier to read long strings of text written in lower case letters than text written in capital letters is that capital letters tend to be more similar to one another in appearance. Lowercase letters, in contrast, have more distinguishing features. e.g. try to find R in panels F & G.

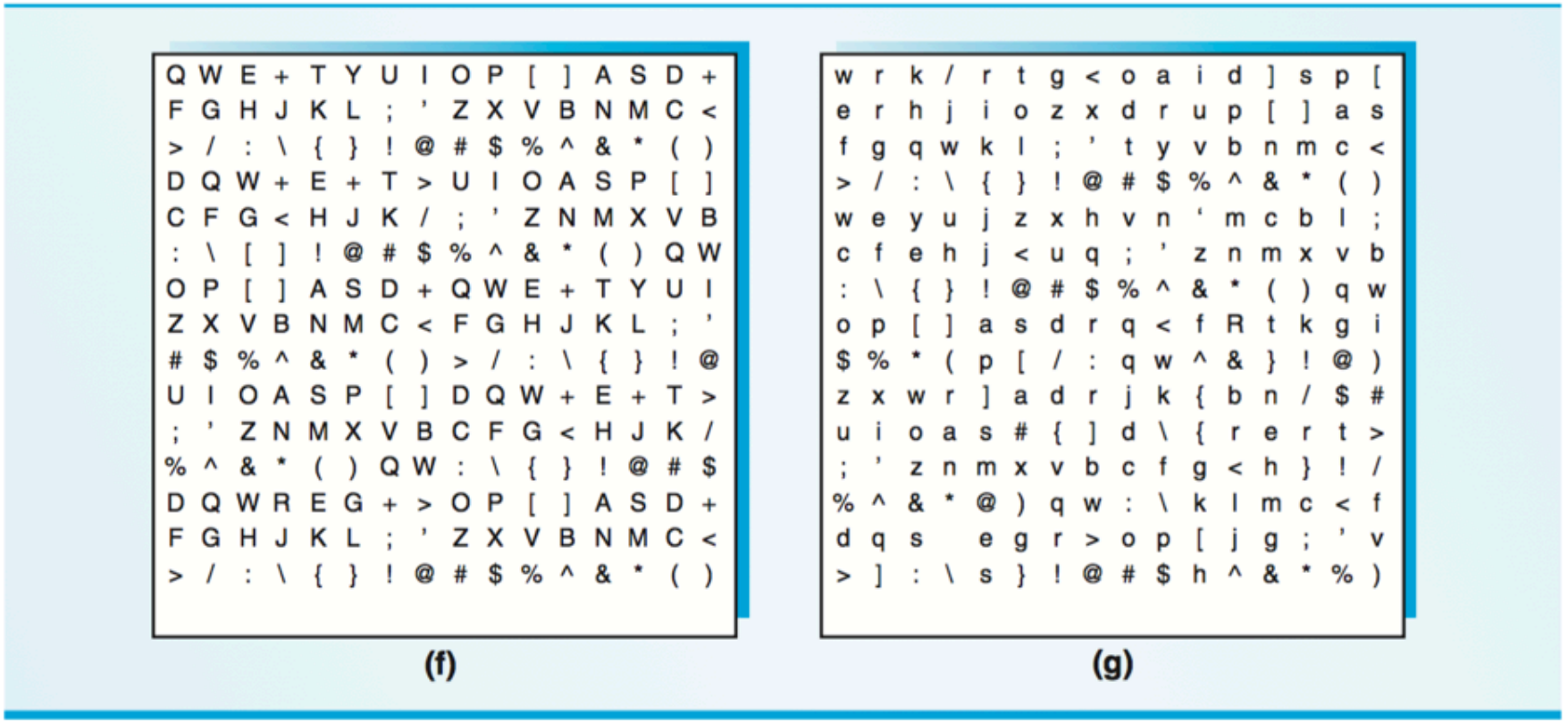


Figure 4.5 **Similarity Theory.**
In panels (f) and (g), find the R.

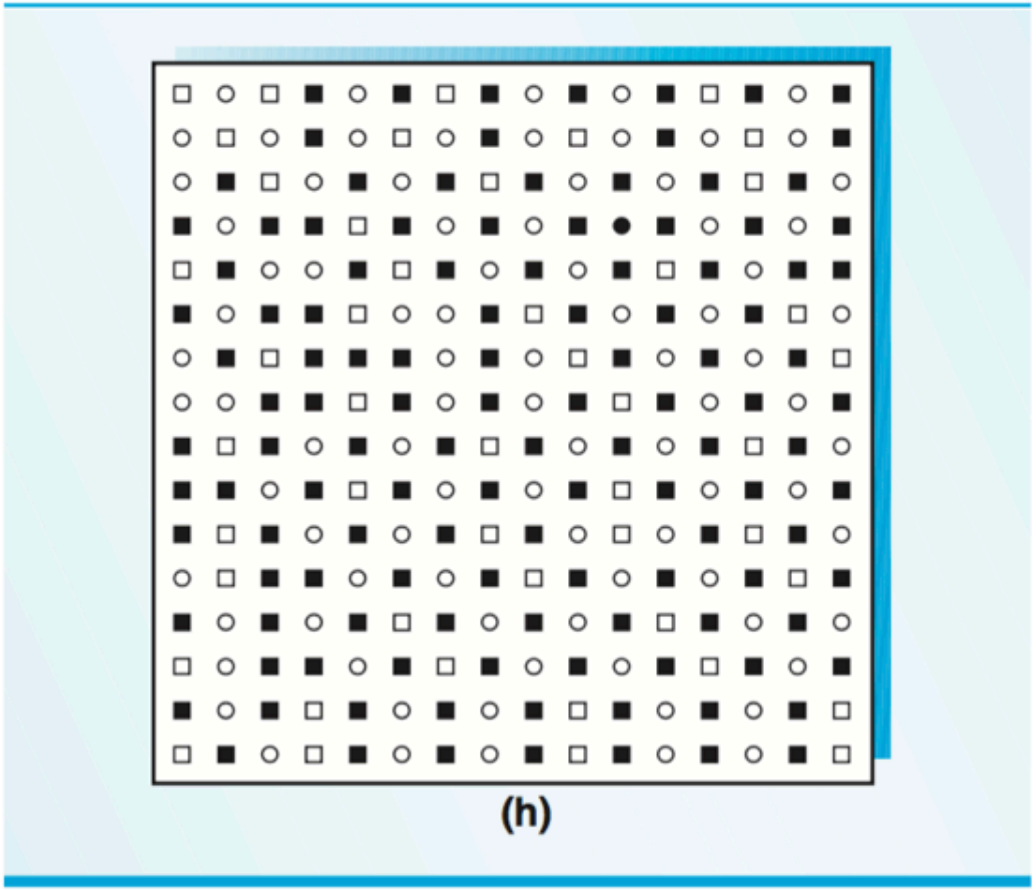
Image Source: Sternberg & Sternberg (2011). Cognitive Psychology. *Wadsworth Publishing*. 6th Ed. (p. 146).

- **Guided Search Theory**: An alternative to Treisman's model is offered as the *guided search theory* (Cave & Wolfe, 1990; Wolfe, 2007).

- The guided search model suggests that all searches, whether feature searchers or conjunction searchers involve two consecutive stage. The first is a parallel stage: the individual simultaneously activates a mental representation of all the potential targets. The representation is based on the simultaneous activation of each of the features of the target.

- In a subsequent serial stage, the individual sequentially evaluates each of the activated elements, according to the degree of activation. After that, the person chooses the true targets from the activated elements.

- Acc. to this model, the activation process of the parallel initial stage helps to guide the evaluation and the selection process of the serial second stage of the search.
    - For example; try to find the black circle in panel H.
        - the parallel stage will activate a mental map that contains all the features of the target (circle, black). Thus black circles, white circles & black squares will be activated.
        - during the serial stage, one will first evaluate the black circle, which was highly activated. You will also evaluate the black squares & white circles as they are less activated & dismiss them as distracters.



4.6 Guided Search Theory.

(h), find the black circle.

Image Source: Sternberg & Sternberg (2011). Cognitive Psychology. *Wadsworth Publishing*. 6th Ed. (p. 147).

To Sum Up

References

- Sternberg & Sternberg (2011). Cognitive Psychology *Wadsworth Publishing*. 6th Ed.