The Schema is (Still) Mightier Than the Sword – Part 2

How Cognition Predicts Player Spatial Coding Systems

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GAME DEVELOPERS CONFERENCE
MARCH 18–22, 2019 | #GDC19

What is a schema?

- Organized mental representations of stimuli to help relate concepts to one another
- Stored in long-term memory
- Often subjective and based on experience
- **Assimilation** is the process of fitting information into an existing mental framework

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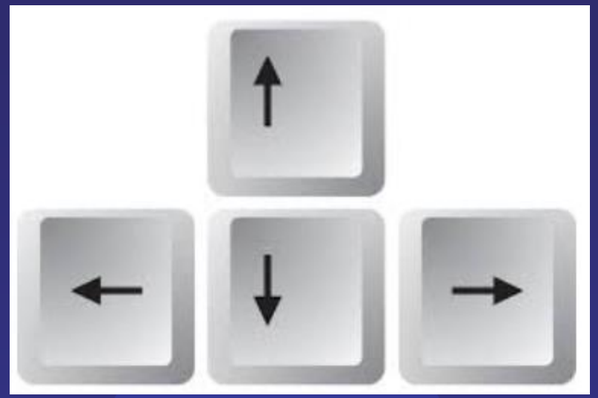
Predicting Knowledge Formation – The Role of Schemas

Warm-up Activity: Which way is East?



Predicting Knowledge Formation – The Role of Schemas

Cognitive Mapping

- A **mental map** that relates player preferences and perceptions within a spatial matrix.
- These mental representations assist player decision-making and drive information processing

Cognitive Mapping 101 – “Route mapping” schemas

Titanfall

Cognitive Mapping 101 – “Route mapping” schemas

Minas Tirith (*Lord of the Rings*)

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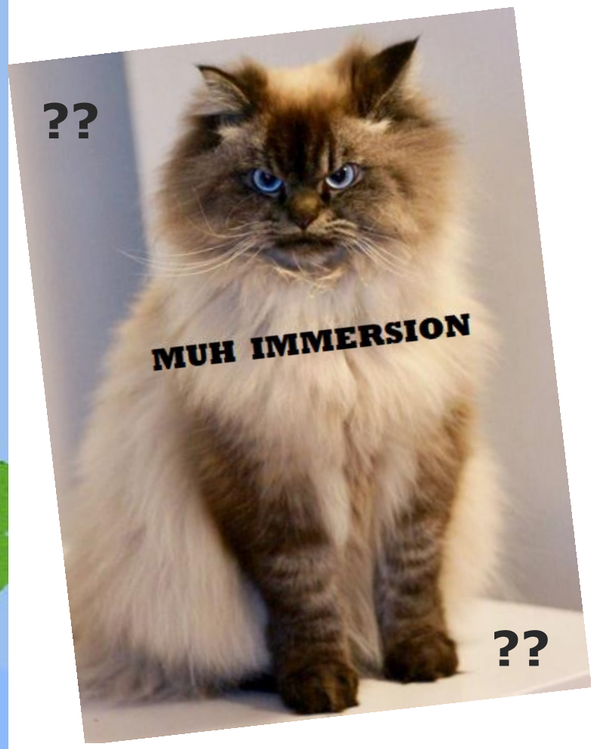

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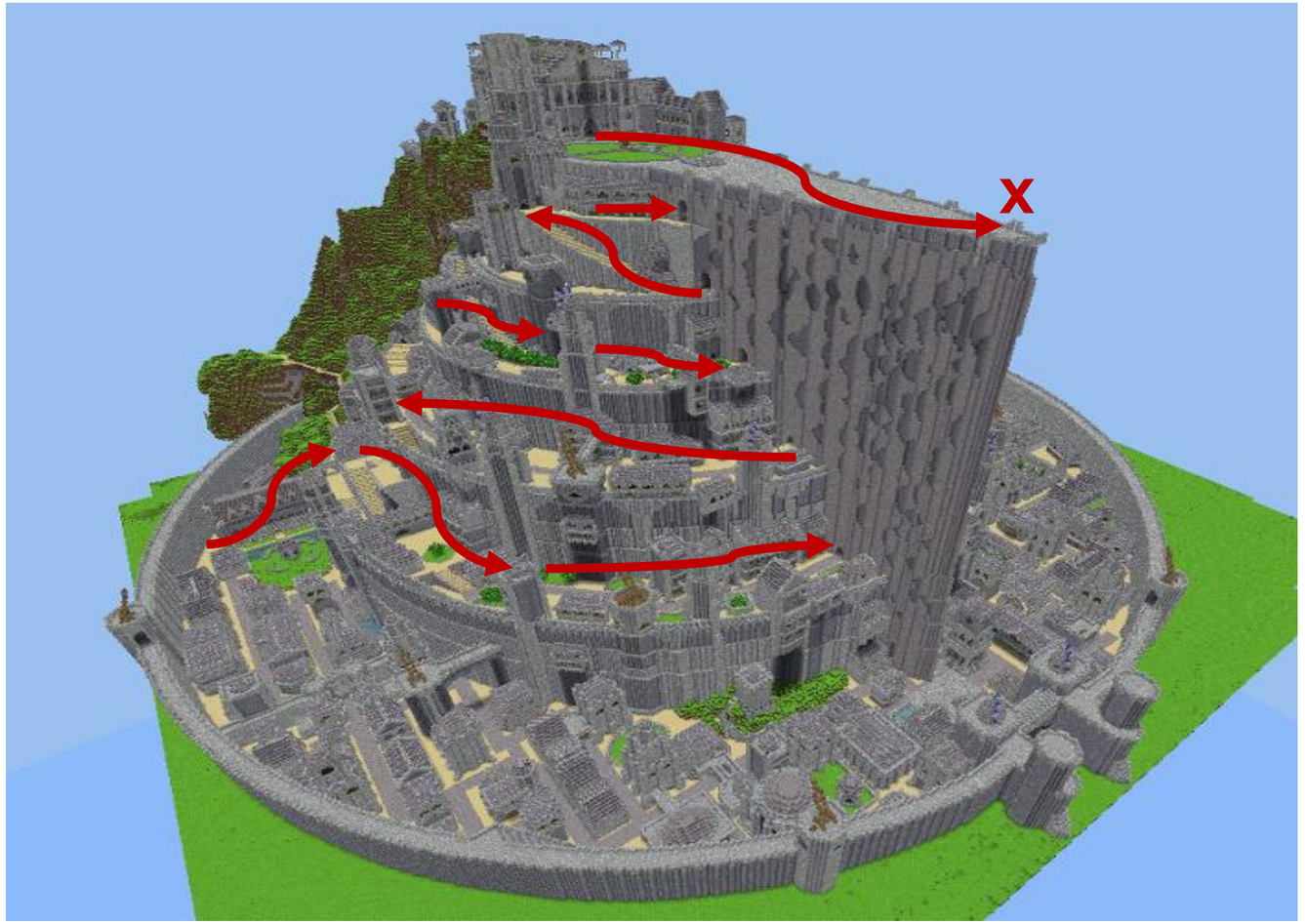


Minas Tirith (*Lord of the Rings*)

Cognitive Mapping 101 – “Survey mapping” schemas

Overwatch

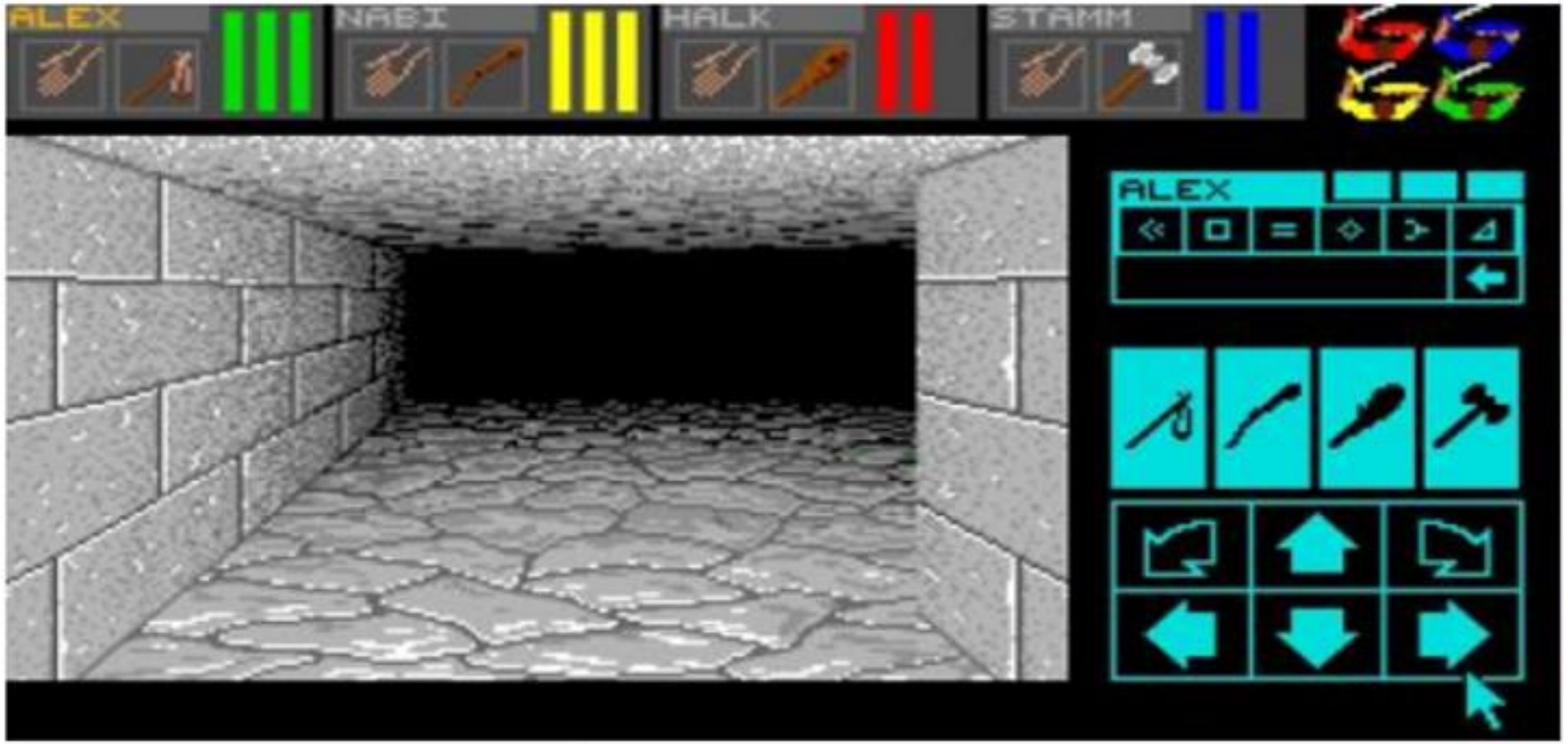
Cognitive Mapping 101 – “Survey mapping” schemas

Horizon Zero Dawn

Cognitive Mapping 101 – “Survey mapping” schemas

Horizon Zero Dawn

Cognitive Mapping Schemas



Dungeon Master

Cognitive Mapping Schemas

“piloting between landmarks”

“oriented search”

Red Dead Redemption 2

Predicting Knowledge Formation – The Role of Schemas

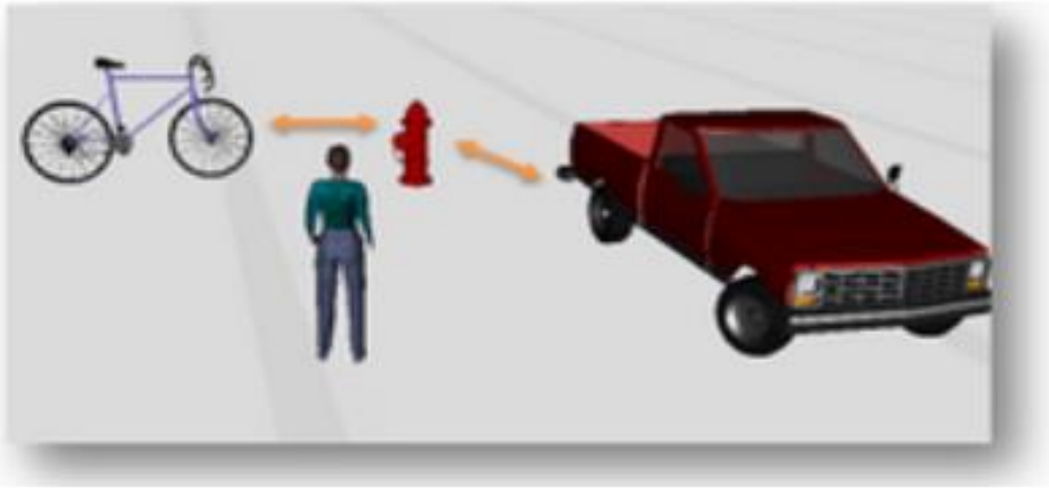
Cognitive Mapping

- **Mental maps** also offer cognitive reference points to streamline spatial coding systems players use for spatial alignment and mental rotation

Spatial Coding Systems

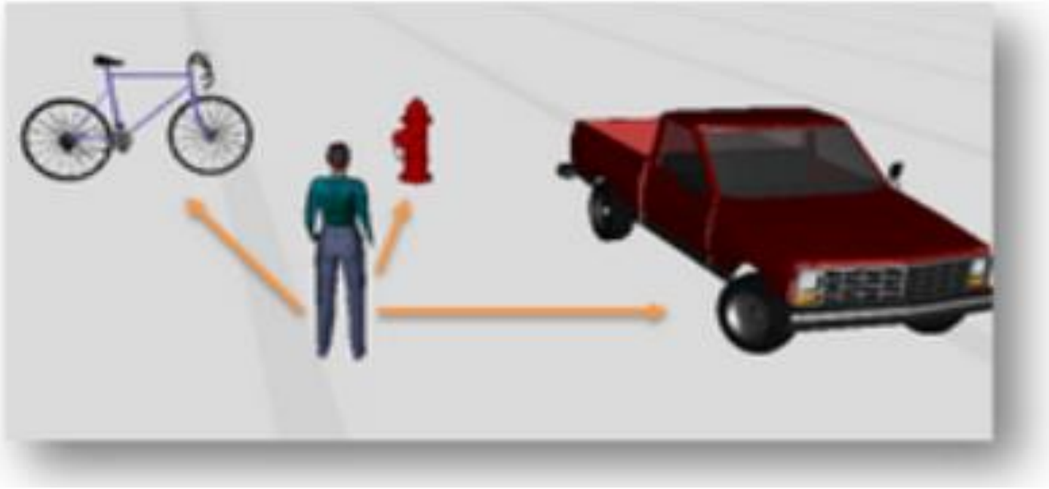
Allocentric (object-to-object)

The encoding of information about the location of objects or stimuli in relation to others



Egocentric (self-to-object)

Represents location of objects or stimuli in relation to the self (left-right, front-back, up-down)



Egocentric Mapping: Self-to-Object

Red Dead Redemption 2

Allocentric Mapping: Object-to-Object

Red Dead Redemption 2

Egocentric Mapping: Self-to-Object

Fortnite

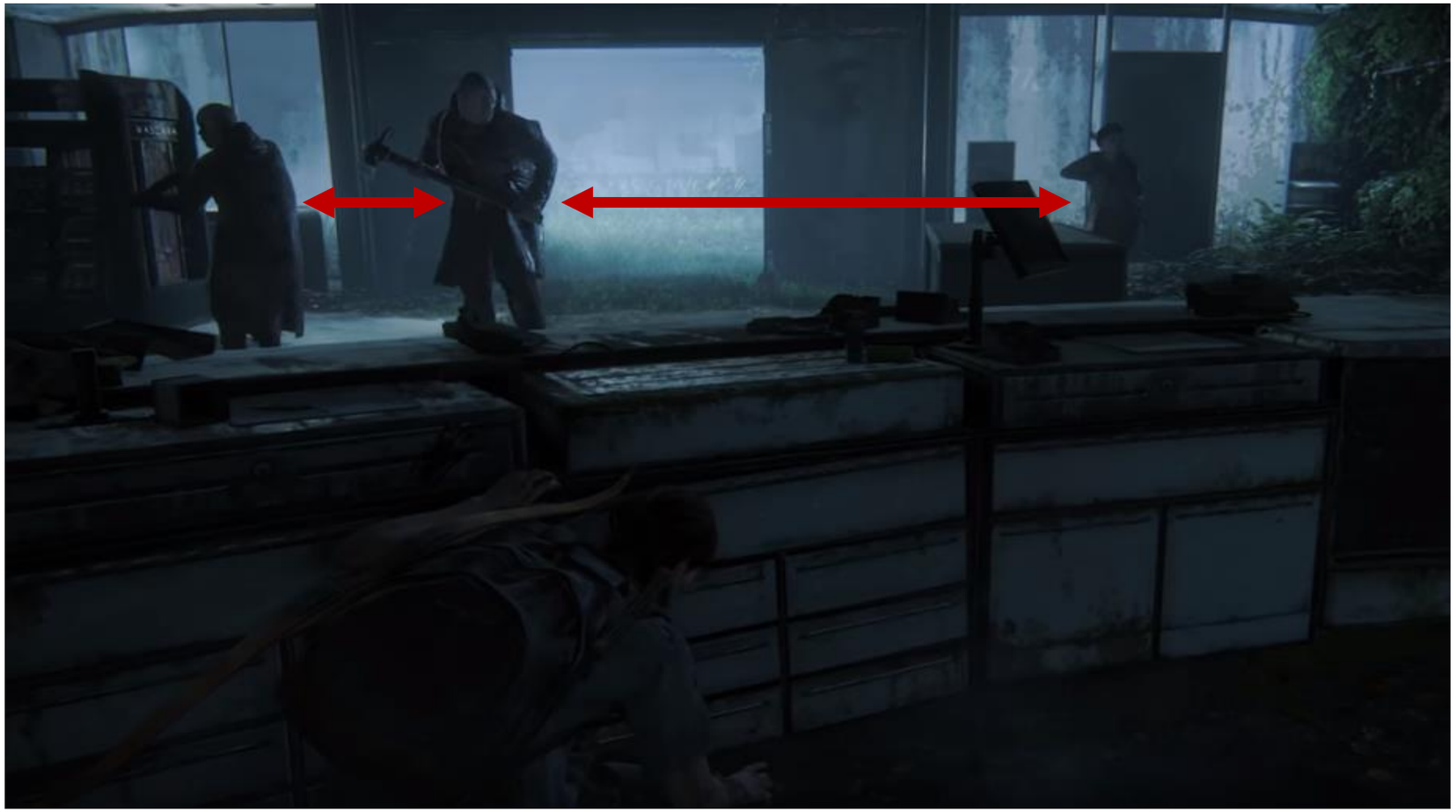
Allocentric Mapping: Object-to-Object

Fortnite

Egocentric Mapping: Self-to-Object

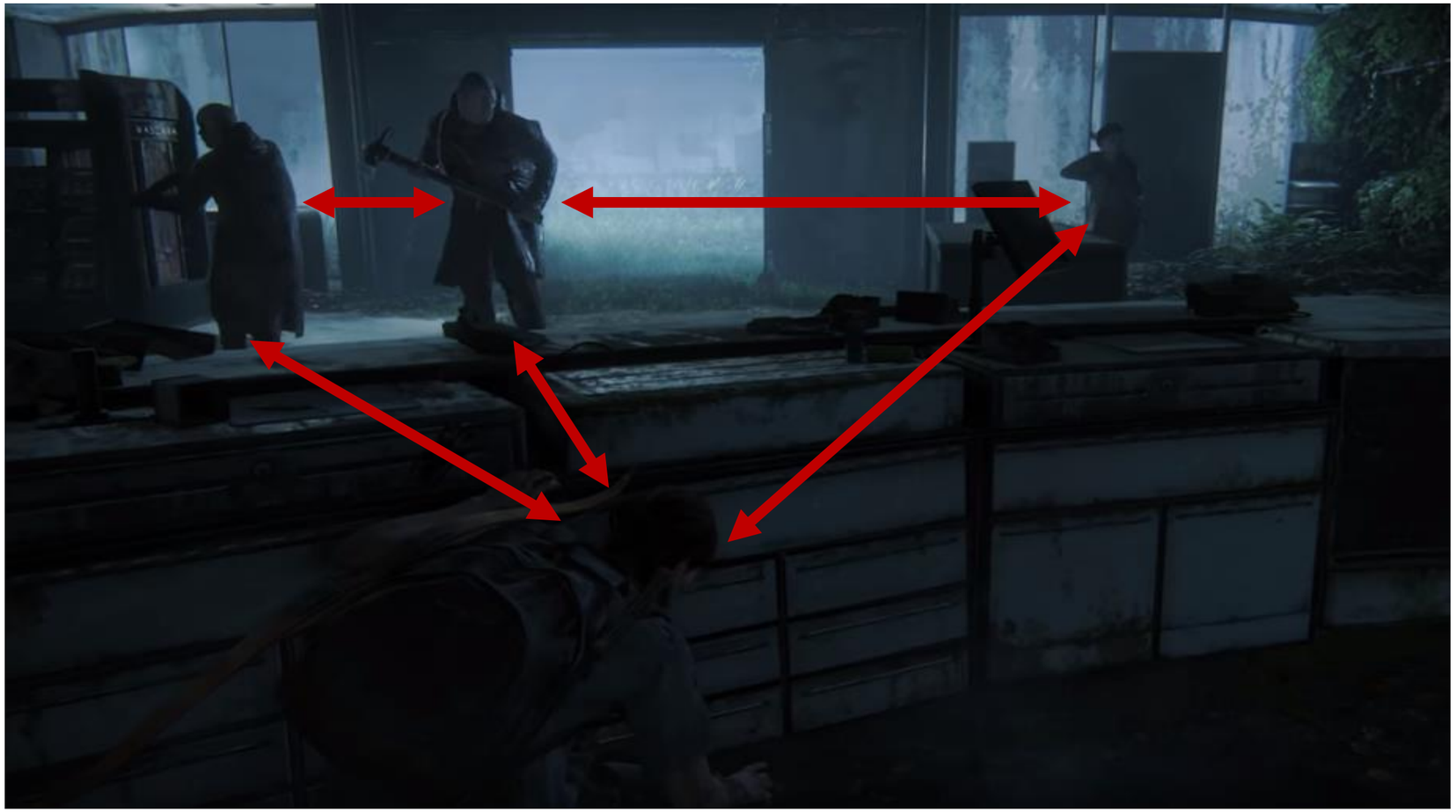
The Last of Us 2

Allocentric Mapping: Object-to-Object



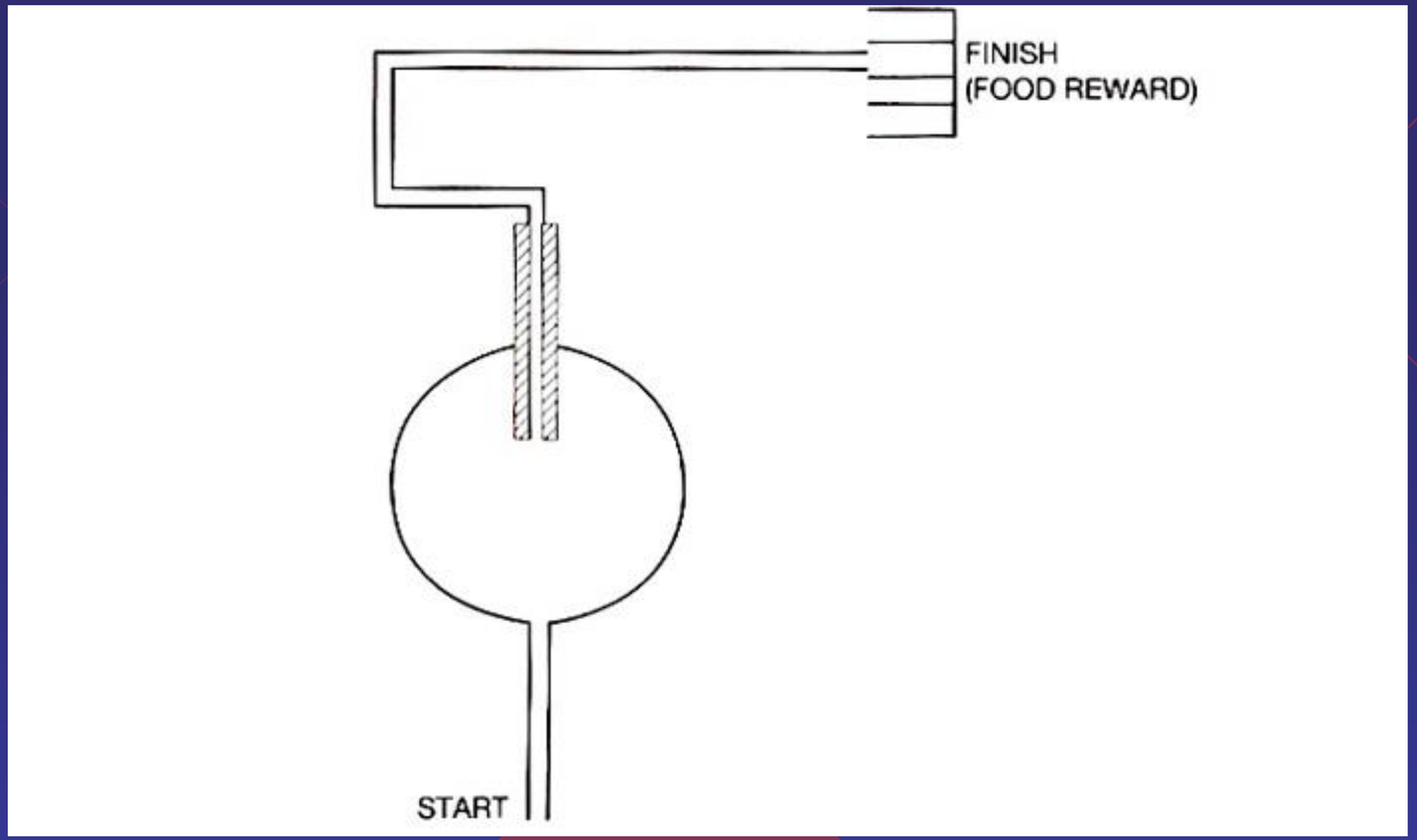
The Last of Us 2

Mental Mapping: A Real-Time Process



The Last of Us 2

Predicting Knowledge Formation – The Role of Schemas



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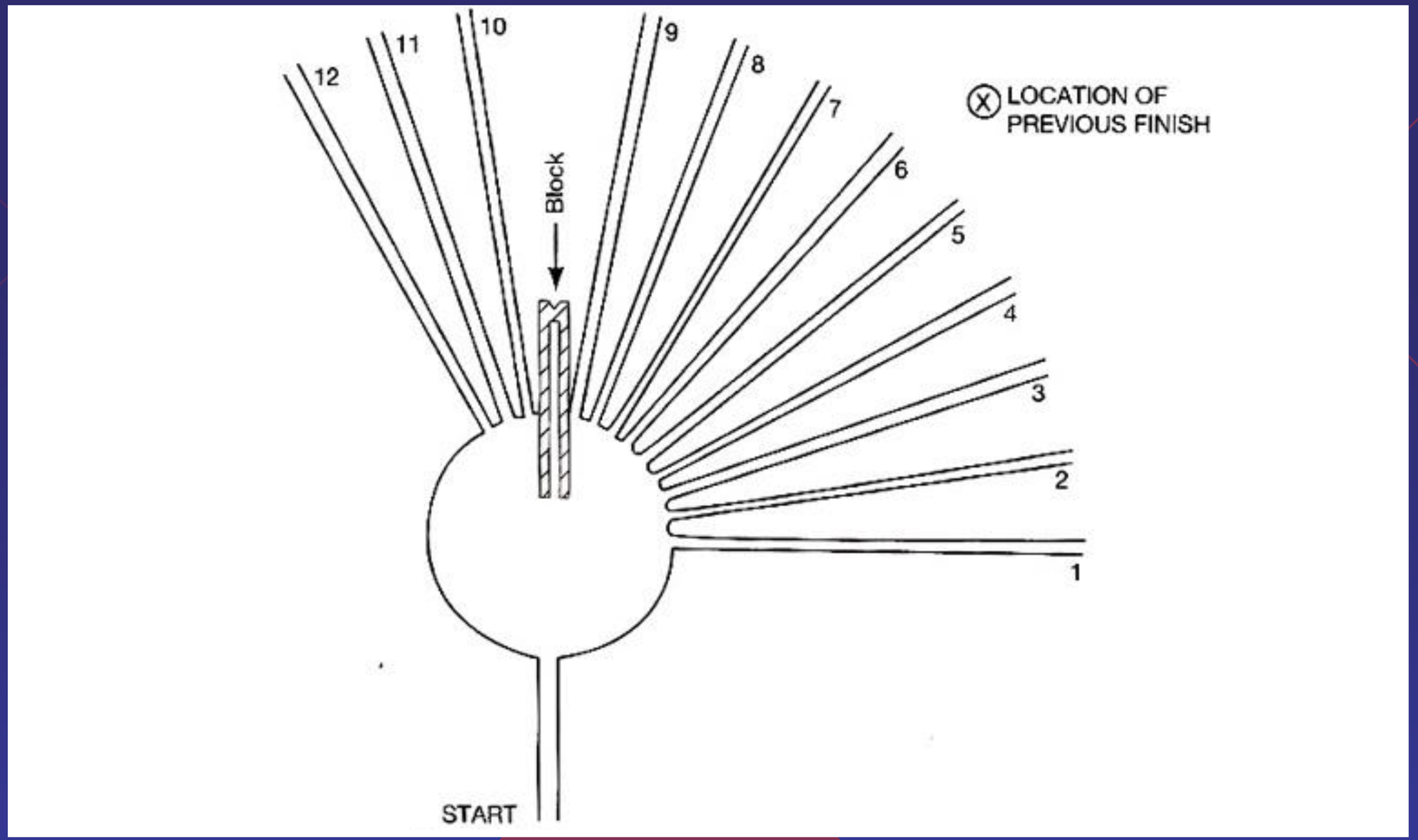
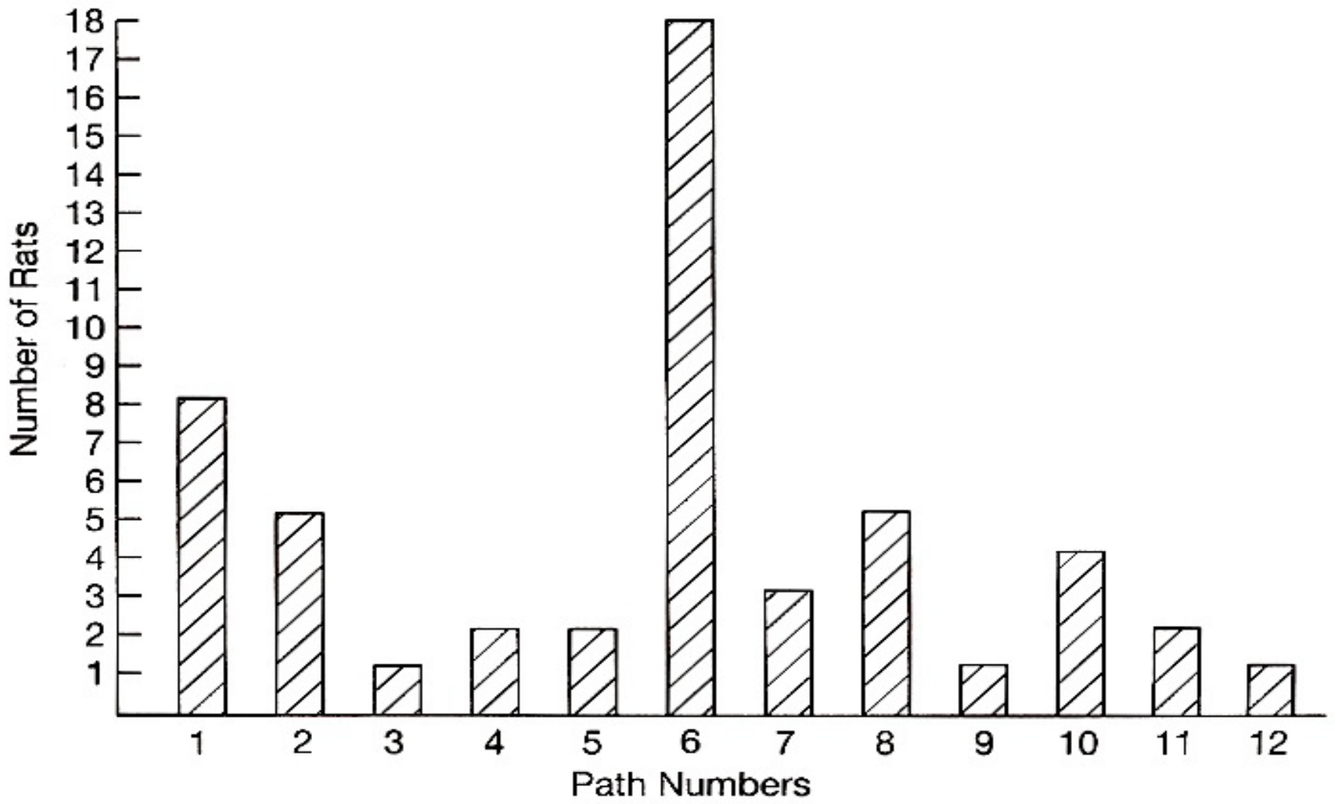


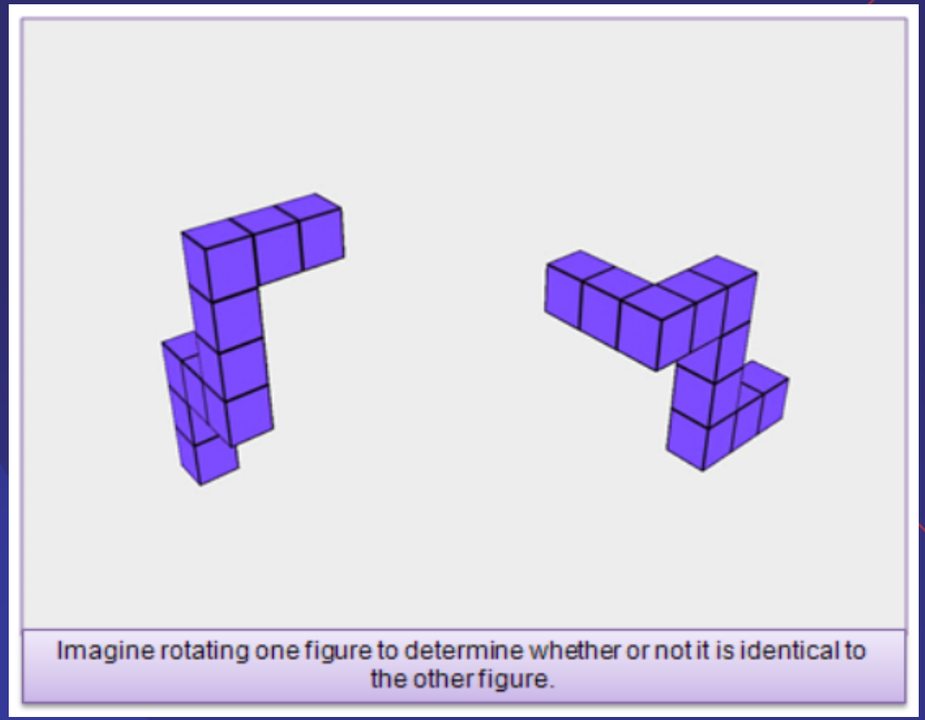
Predicting Knowledge Formation – The Role of Schemas



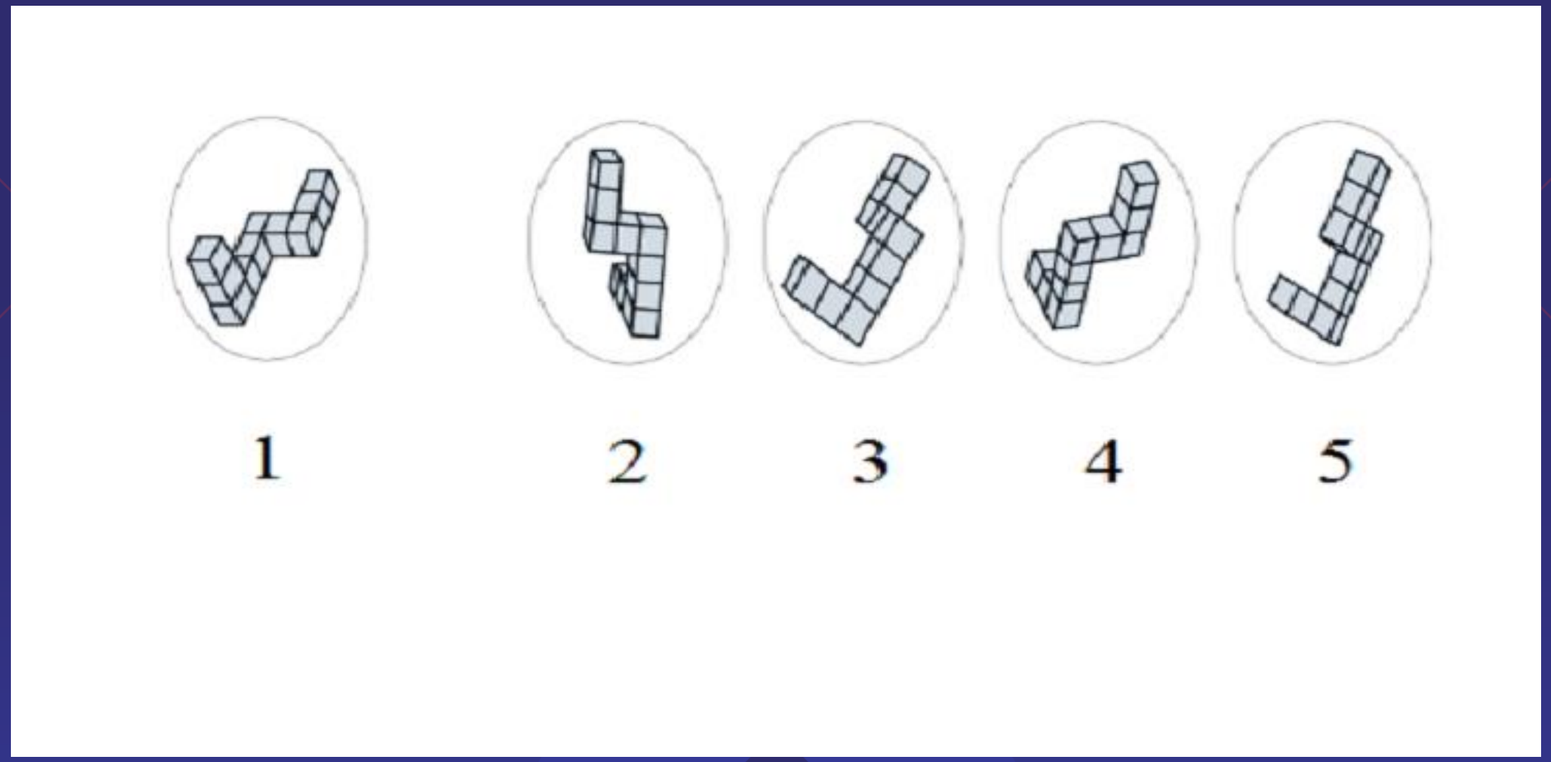
Predicting Knowledge Formation – The Role of Schemas

Mental Rotation Tasks

- Scientific tests measure allocentric mental rotation
- Action gaming seems to improve this skill over time (Cherney, 2008)



Predicting Knowledge Formation – The Role of Schemas



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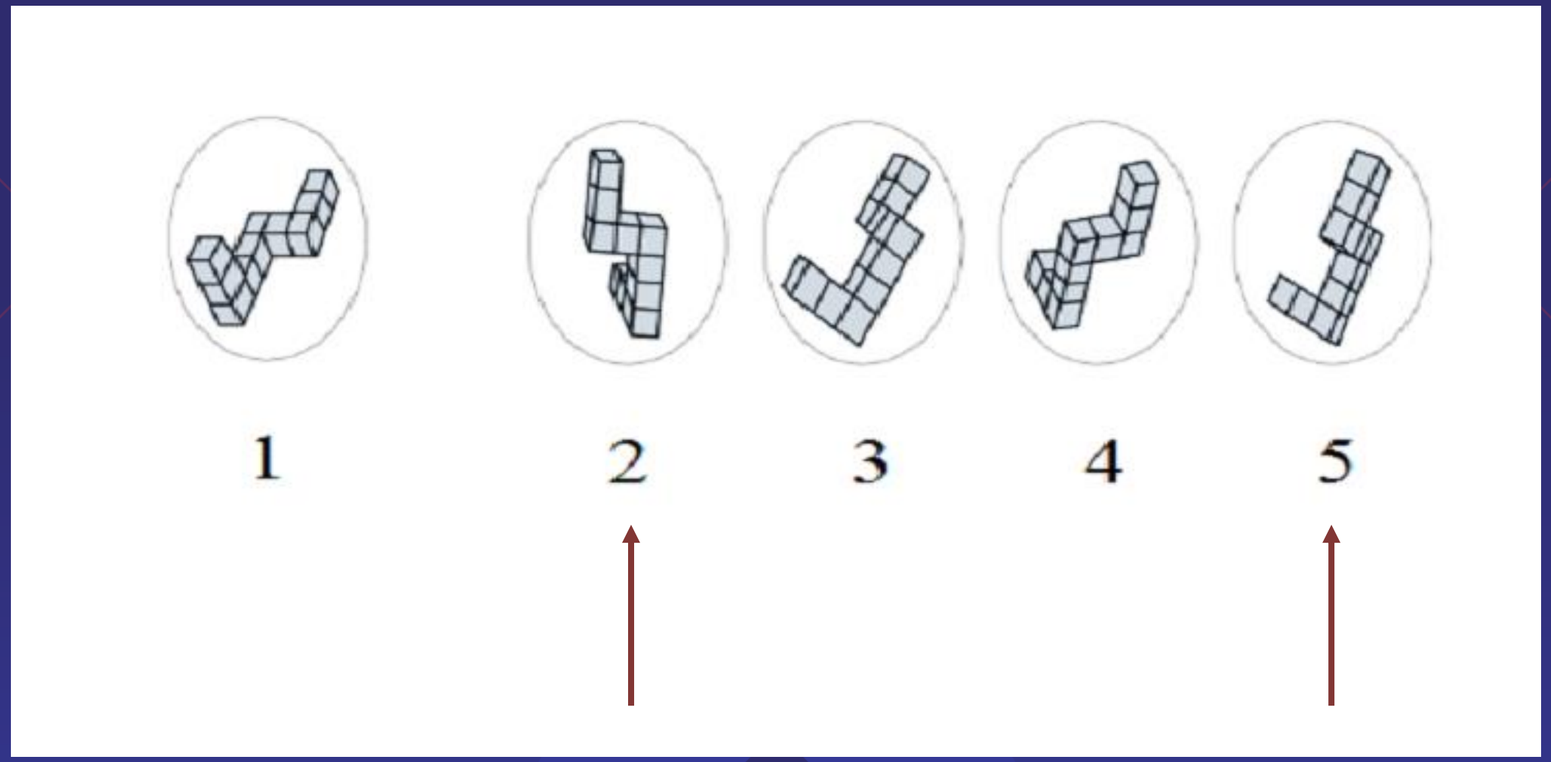
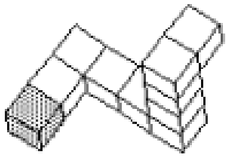


Example Trials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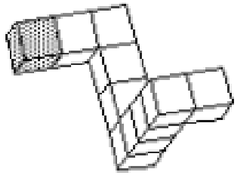

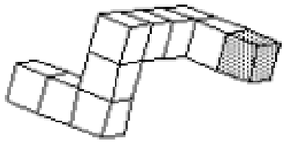
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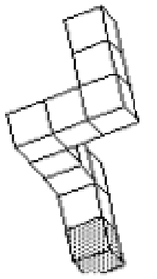

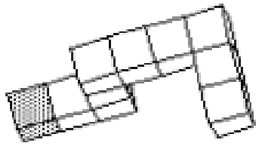
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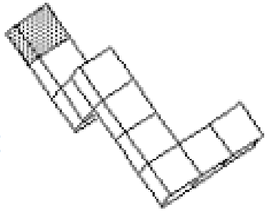

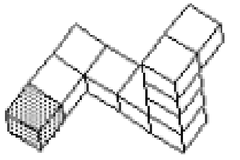
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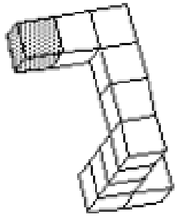

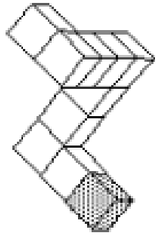
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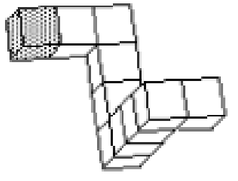

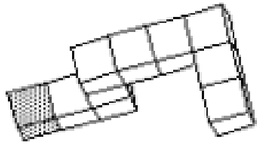
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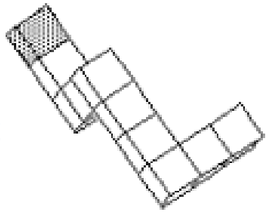

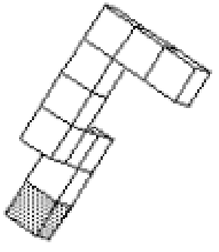
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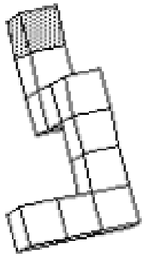

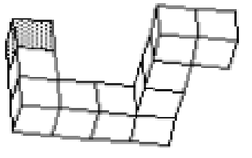
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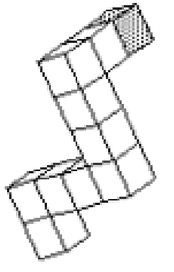
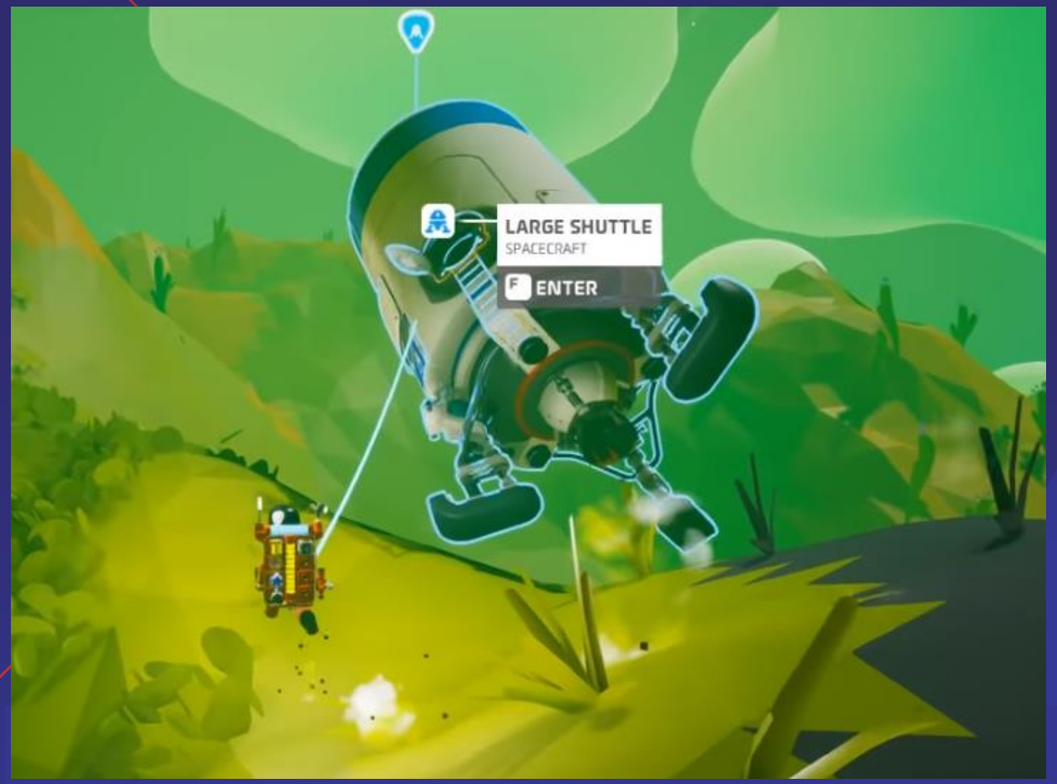


Predicting Knowledge Formation – Mental Rotation



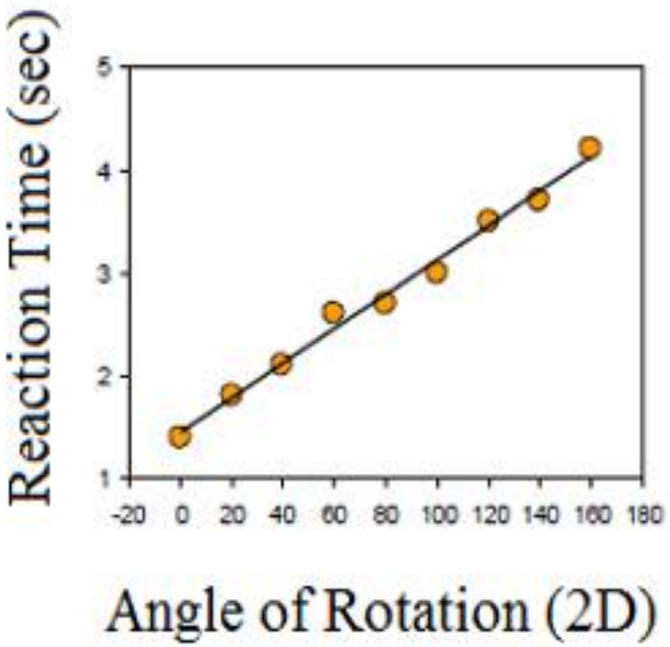
Astroneer

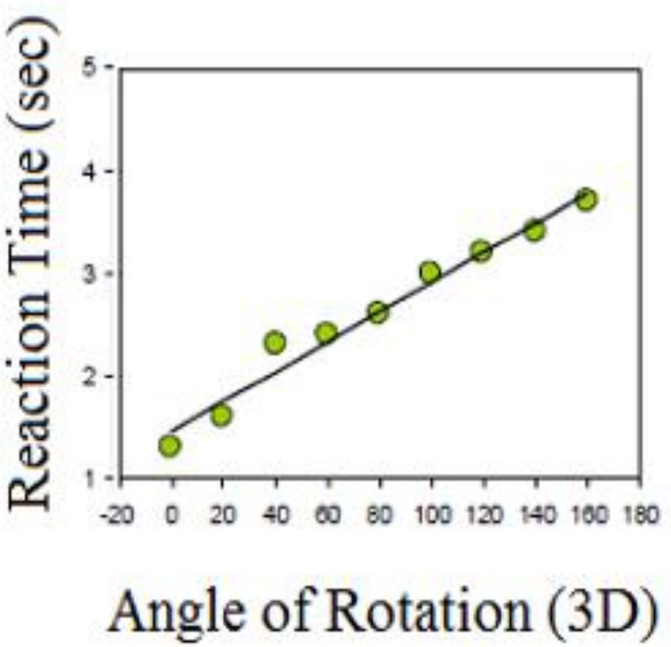
Predicting Knowledge Formation – Mental Rotation

Metroid Prime

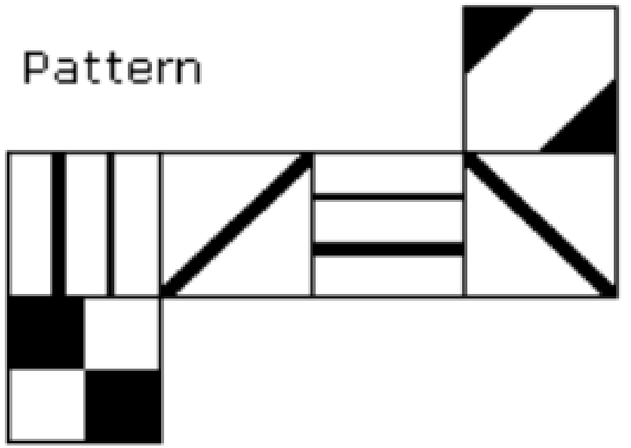
Predicting Knowledge Formation – Mental Rotation

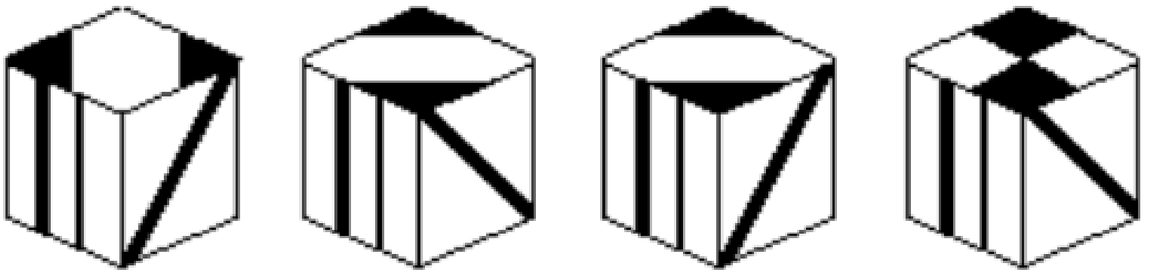
Reaction times increase linearly as angle of rotation increases, whether the drawings rotate in 2-D or 3-D





Which of the cubes shown could be made from the pattern?





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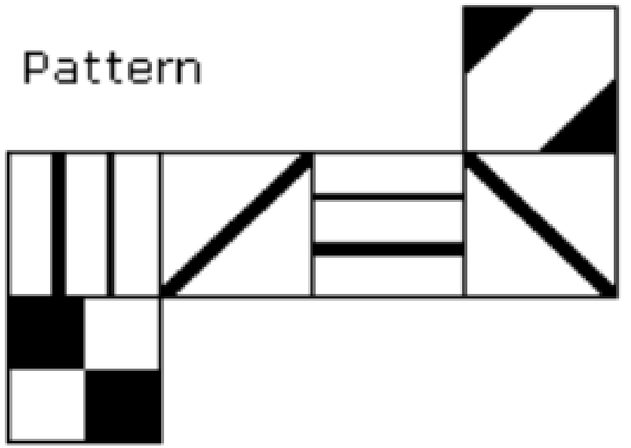

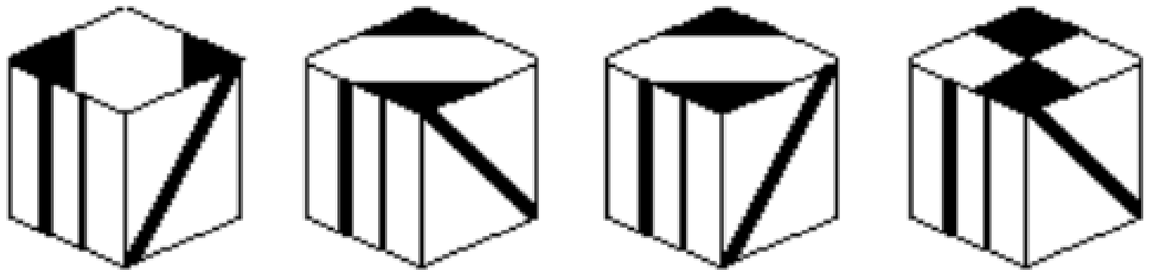

Predicting Player Attention – The Role of Schemas

Treisman's Feature Integration Theory

Perception involves analyzing target stimulus properties (shape, color, size, movement) to combine features

→ This **feature search** generates what researchers call a "pop out" effect

Predicting Player Attention – The Role of Schemas

Treisman's Feature Integration Theory

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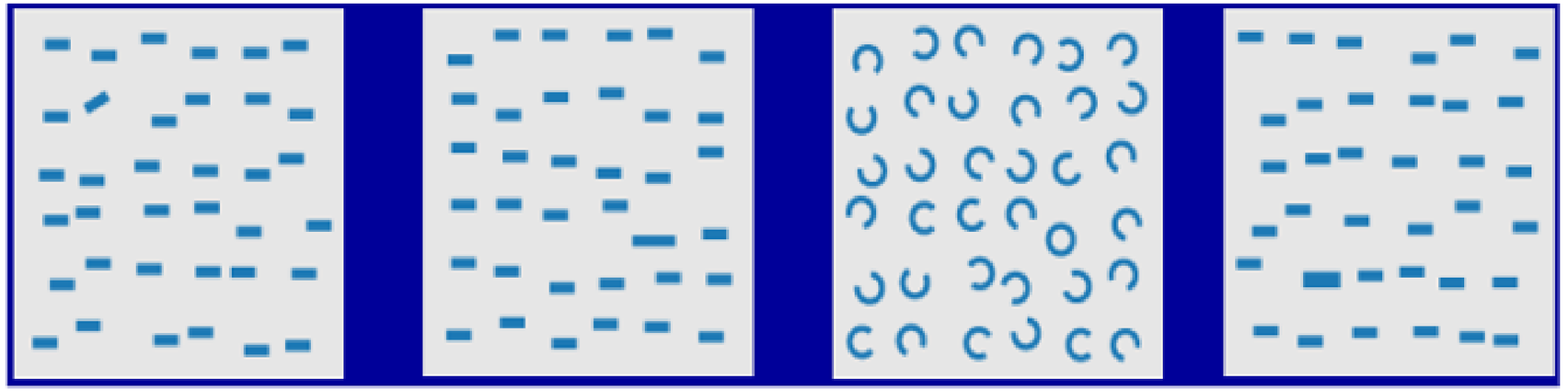
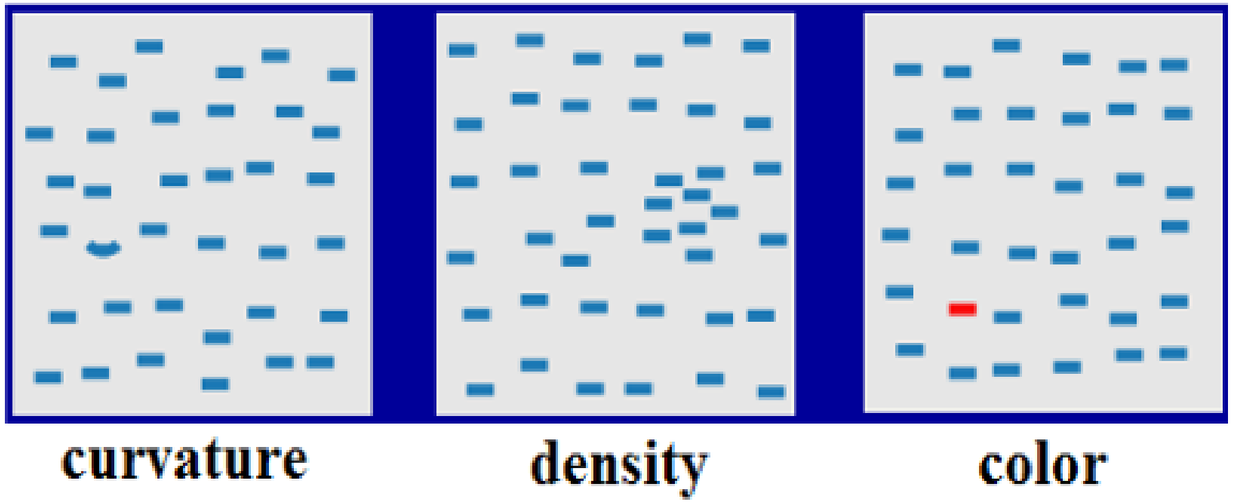
- This **feature search** generates what researchers call a "pop out" effect
- Higher levels of attention required generates **conjunctive search**

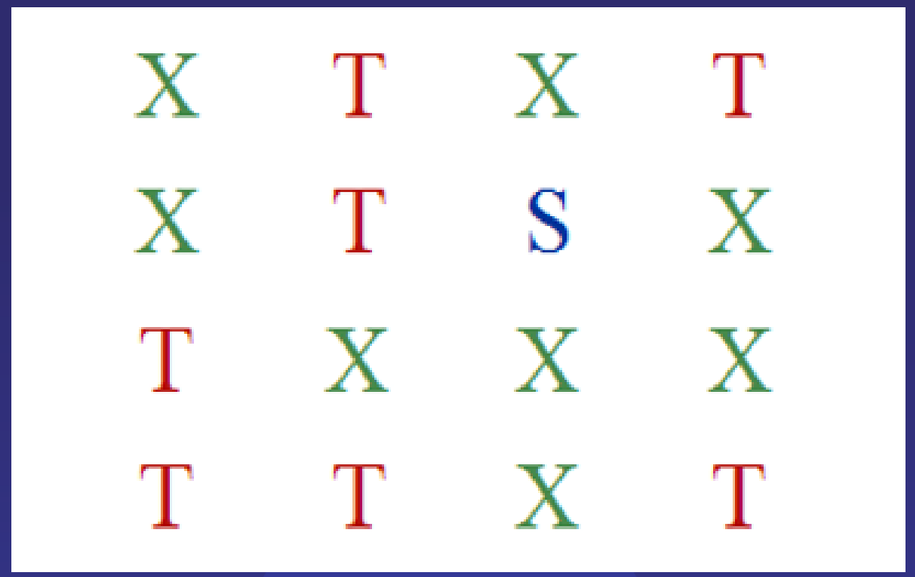




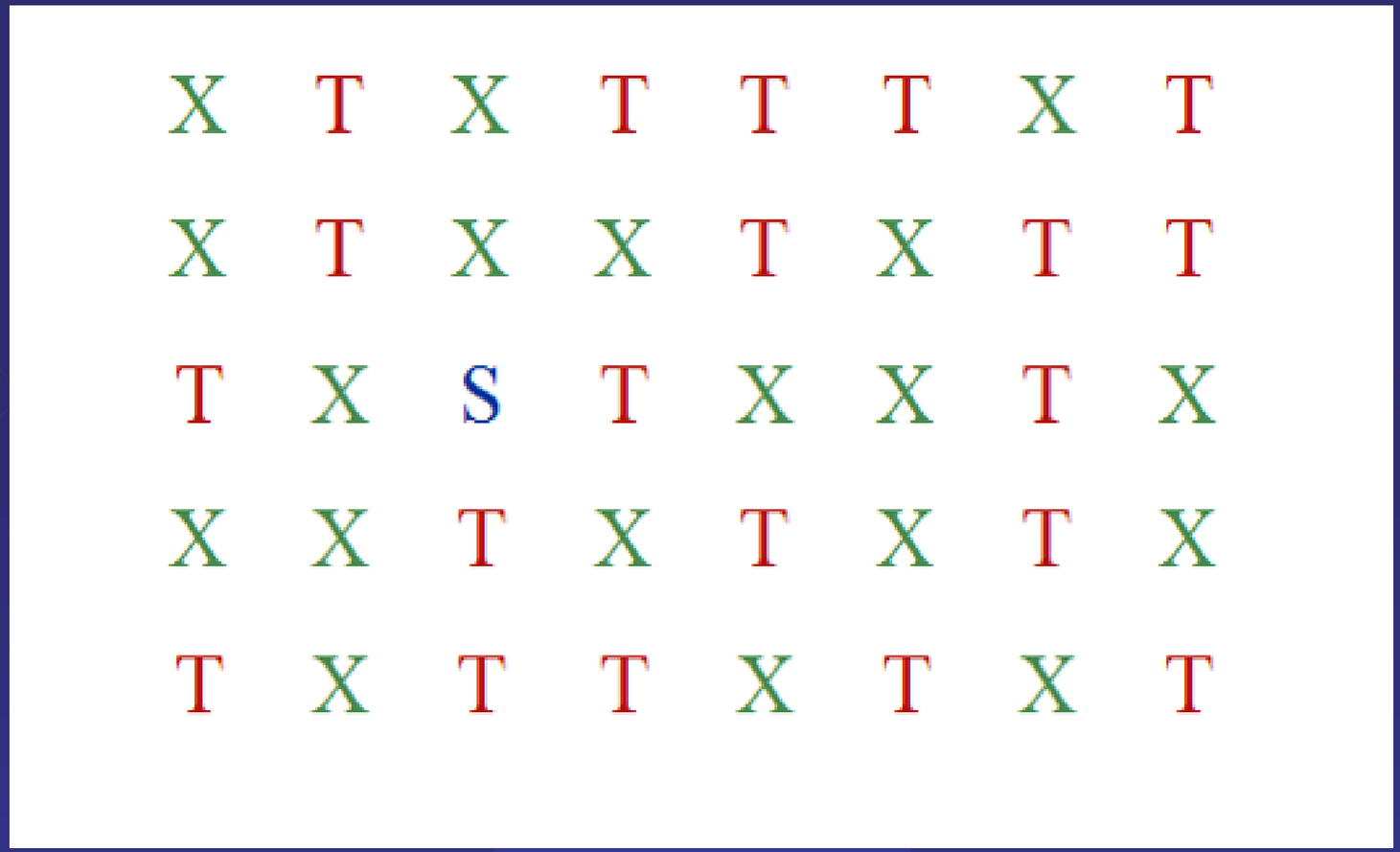
Feature search

Predicting Player Attention – The Role of Schemas

Feature search



Feature search



Predicting Player Attention – The Role of Schemas

Hellblade

Predicting Player Attention – The Role of Schemas

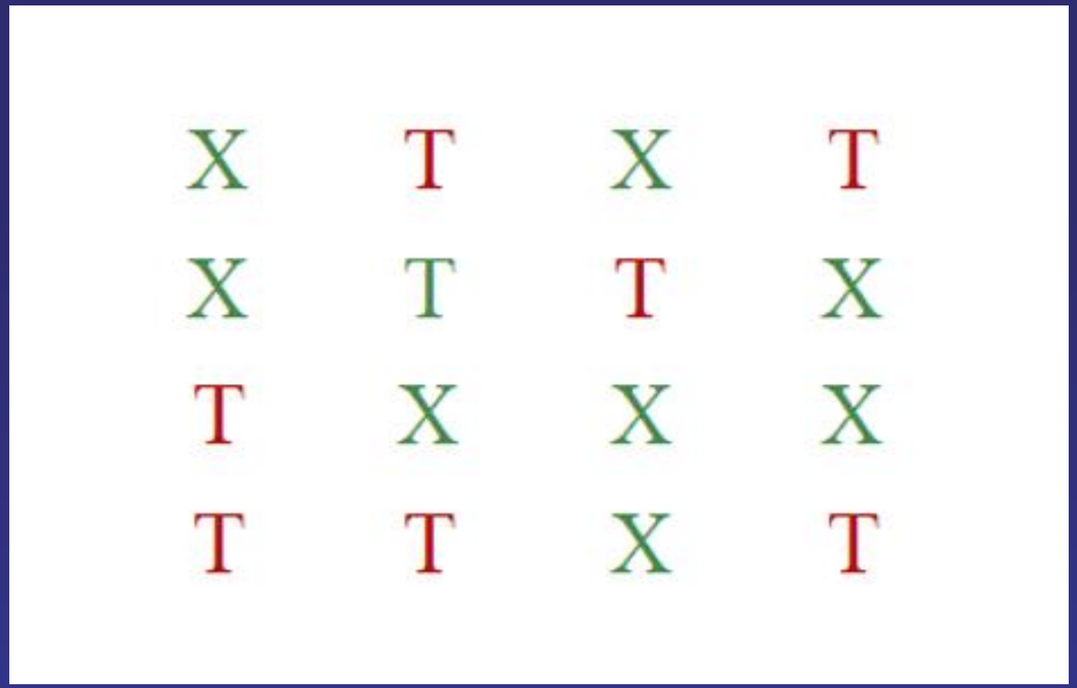
Destiny 2

Predicting Player Attention – The Role of Schemas

God of War

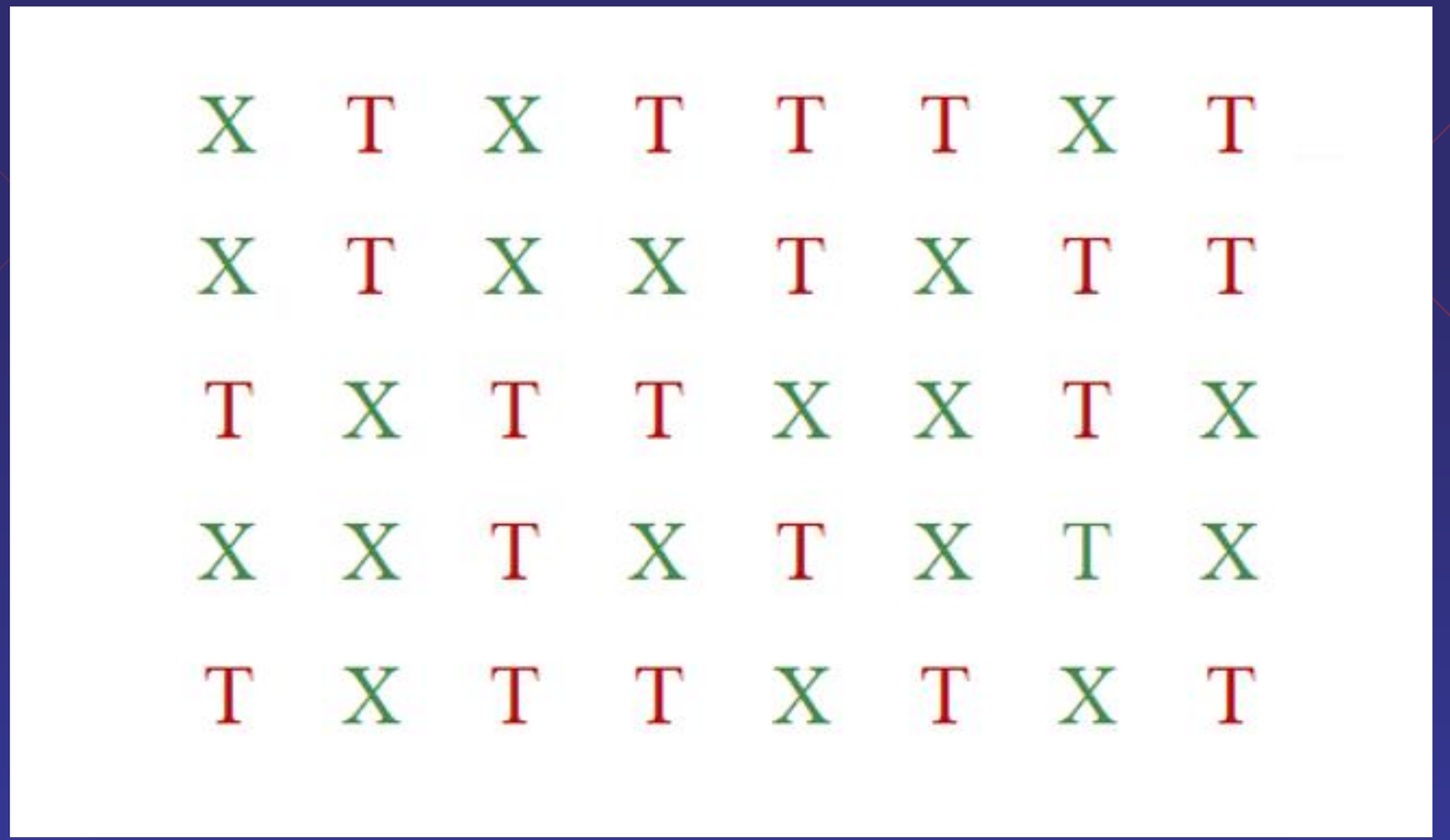
Predicting Player Attention – The Role of Schemas

Conjunctive search



Predicting Player Attention – The Role of Schemas

Conjunctive search



3 FORTS
11 KILLS
18:11
20
20
6 FORTS
17 KILLS
MileyCyrus
Ryzen
Dagerius
264
140
140
Right-Click to Gather
Ryzen
Cyan007
Krem
140
140
Dayvon
183
COLLECT THE TRIBUTE
18:50 / 20:24
Normal
2/3
2/3

TheLynata
47
5
156/725
22
+4
PIZZA

N L N V Y W L F H K Z M Y W N X V M L H W L Y F N Z L M X F
H Y W F H L Z N V M X L H F W F K M Z F K F L N F W M X W Y
F Z N L K Z Y F H W M L N F Y L N K M V X W Z K H F X V H K L
K F W Y L K M Z N X Y W F H K N M H F L W Y Z N X F Y K H W
L F H K L T X V M W Z G H F L M K N Z V X W Y H X Y W Y L M
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T X V M W Z G H F L M K N Z V X W Y H X Y W Y L M F V Y W X
L M K F V K M F H M K X W Z L M W Z L H F Y V N Z W K L M N
A F Z W X F H K L M F Y V F X W F Z N F M L H W X Y K N L H
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H W X Y K N L H W X H Z F N L M K Y H W X F Z V Y N K L W F
Z M W X F H L N K Y W Z N K F Y L W Z N V H F K M V F Y L X
W V Z L W Z L M W Z L H F Y V N Z W K L M N A F Z W X F H K
L M F Y V F X W F Z N F M L H W X Y K N L H W X H Z F N L M
K Y H W X F Z V Y N K L W F Z M W X F H L N K Y W Z N K F Y
L W Z N V H F K M V F Y L X W V Z L Z L H F Y V N Z W K L M N
A F Z W X F H K L M F Y V F X W F Z N F M L H W X Y K N L H
W X H Z F N L M K Y H W X F Z V Y N K M T F Z M W X F H L N
K Y W Z N K F Y L W Z N V H F K M Y W N X V M L H W L Y F N
Z L M X F H Y W F H L Z N V M X L H F W F K M Z F K F L N F W
M X W Y F Z N L K Z Y F H W M L N F Y L N K M V X W Z K H F
X V H K L K F W Y L K M Z N X Y W F H K N M H F L W Y Z N X
K X W Z L M W Z L H F Y V N Z W K L M N A F Z W X F H K L M
F Y V F X W F Z N F M L H W X Y K N L H W X H Z F N L M K Y
H W X F Z V Y N K L W F Z N V L K Y H F K W F N L M H K Z X F

Feature search?

Conjunctive search?

Predicting Player Attention – The Role of Schemas

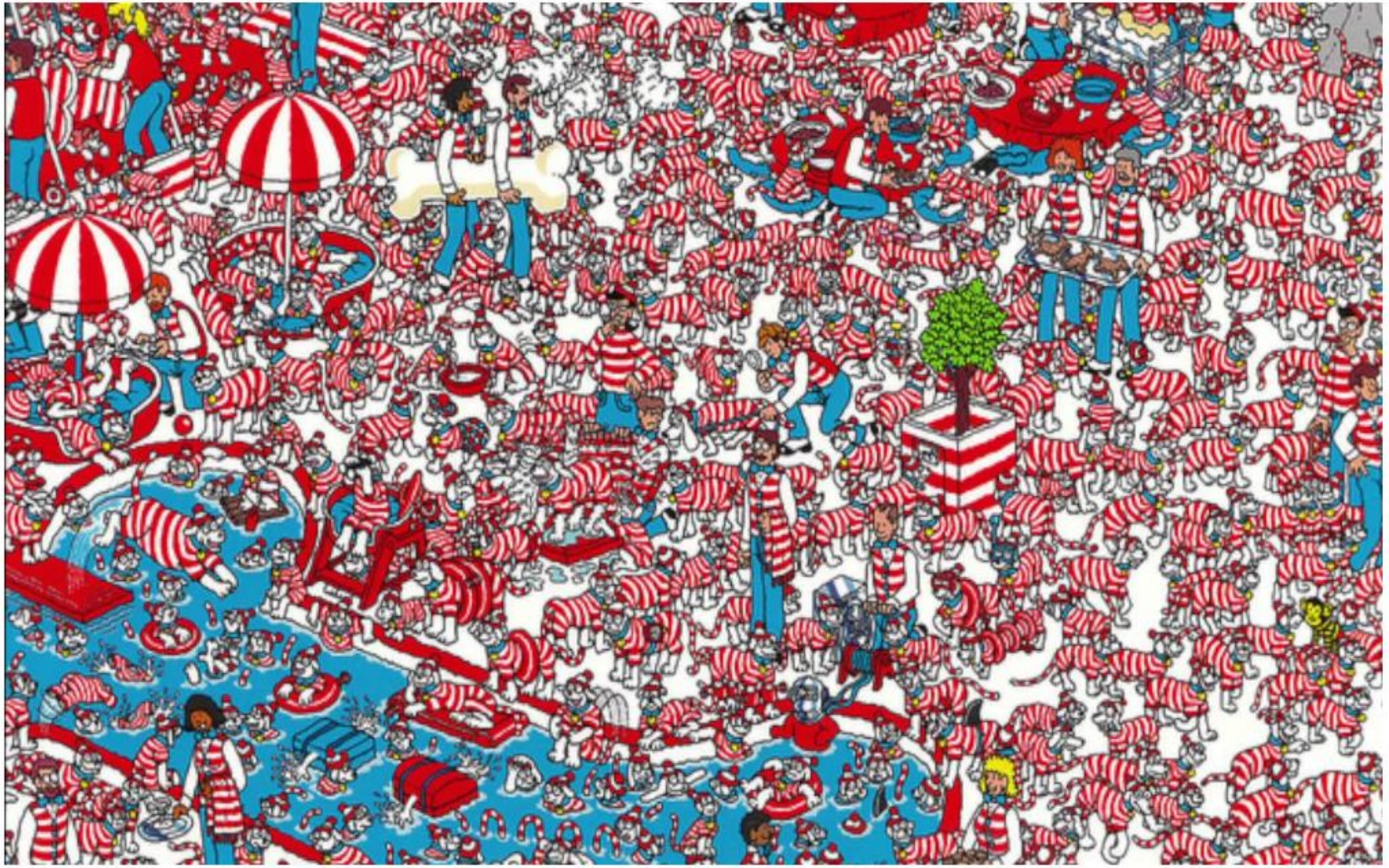
Treisman's Attenuation Model

- Shifting player attention to non-target stimuli can happen…..just crank up the "loudness" (this explains the cocktail party phenomenon)

Predicting Player Attention – The Role of Schemas

Treisman's Attenuation Model

- Shifting player attention to non-target stimuli can happen…..just crank up the "loudness" (this explains the cocktail party phenomenon)
- But how much is too much?



World of Warcraft

Final Thoughts and Take-Aways

There are many ways to anticipate player behavior and information processing

1. Understanding the psychological science of schemas helps to predict and better understand user experiences

2. Schemas streamline spatial coding, mental rotation and is tied to player attention, learning, response time, and decision making

3: Design choices should support schema activation for users, not get in the way (hint: invest in good UX)

UI
UX

The Schema is (Still) Mightier Than the Sword – Part 2

How Cognition Predicts Player Spatial Coding Systems

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