

**INSTRUCTION MANUAL:**

**TRAINING RELATIONAL REASONING TO  
UNDERGRADUATE STUDENTS**

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## **INTRODUCTION TO THIS TRAINING MANUAL**

What follows is a manual for instructing secondary or college students in four forms of relational reasoning (RR): analogical, anomalous, antinomous, and antithetical reasoning. The training is presented in 6 sessions that includes a pre-assessment (Session I), followed by an overview of RR (Session II), and then multiple sessions devoted to each of the four RR forms (Sessions III–V), ending with a post-assessment of individuals' RR abilities (Session VI). The manual also contains sample slides that overview the content for each session and specific activities meant to reinforce individuals' understanding of RR and its specific forms, and to apply that understanding in various ways.

### **SESSION I: PRE-ASSESSMENT OF RELATIONAL REASONING**

Students will be given 50 minutes to complete the Test of Relational Reasoning (TORR) online via Qualtrics®. Once they submit their responses, they will automatically receive their total score and the corresponding Relational Reasoning Quotient (RRQ; see Appendix A), which converts raw scores into standard scores with a mean of 100 and a standard deviation of 15. They will also receive their scores for each scale of the TORR that corresponds to one of the four forms. Students are to record those scores for later reference. This pre-assessment can either be completed in person or online such that the learner can progress at their own pace. For this training, the TORR will be completed outside of class so that there are no time constraints. Students will be informed that the test needs to be completed in one sitting; there is no stopping and restarting of the test once it is begun.

**SESSION II: TORR DEBRIEFING AND OVERVIEW OF RELATIONAL REASONING**

This session begins with an introduction to relational reasoning as a complex cognitive ability that is essential for learning and performance; core to general and domain-specific problem solving; and a key to knowledge transfer (see Session II slides). Following this brief explanation of RR, the TORR is overviewed, starting with the rationale for its creation. The TORR is contrast to more traditional measures of cognitive ability (intelligence tests) along a number of dimensions, especially noting that the TORR is a fluid versus crystallized measure and the forms are malleable and trainable. Then, the descriptive data from the class and discuss what those data indicate about the group's RR abilities is presented, with emphasis on the importance of the RRQ, which allows for a normative comparison. Students also reflect on their individual performance relative to the class scores and the normative data.

To overview the TORR, each of the four forms will be briefly introduced: analogy, anomaly, antinomy, and antithesis (see the relevant slides for each). Each form is defined and illustrated with a sample item from the TORR, a sample item from the Verbal Test of Relational Reasoning (vTORR), a pictorial or graphic example. At the session's end, the class will be informed that they will be receiving explicit training in each of the four forms over the next class sessions to promote their RR abilities.

**SESSION III: TRAINING IN ANALOGICAL AND ANOMALOUS REASONING****Analogy**

Ask students to recall the definition of analogy from Session II. Then begin Session III by having students complete the Analogy Anchor Activity with the initial problem, HERD : COW:: FLOCK : \_\_\_\_\_ (Activity 1). Instruct students to share all the possible responses they produced. Use those responses to introduce the four key processes to solving analogies and all other forms: encode, infer, map, and apply.

**Encode:** Is the process whereby each component of a problem is richly characterized. For example, “herd” is a specific name for a group of animals such as sheep, cows, or goats, and “cow” is a single, female, domesticated, four-legged, milk-producing bovine that provides us with meat, cheese, milk, and hides.

**Infer:** Is the process of generating a relation between the first two terms, herd and cow. Herd is the animal group to which a cow belongs.

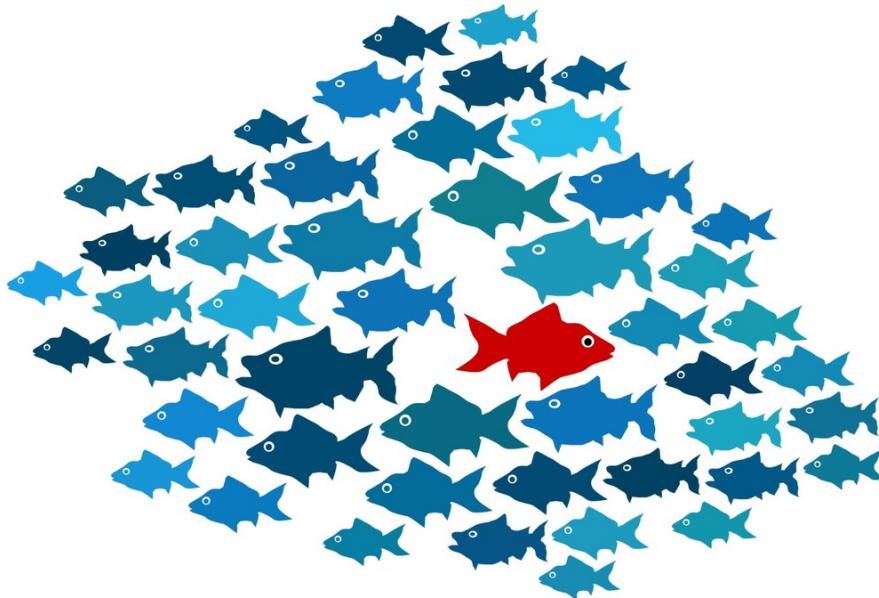
**Map:** The mapping process requires forming a connection between the two parts of the analogy. In this case, what is the link between “herd” and “flock”? The answer is that both are specific animal groupings.

**Apply:** For the final step, the analogy is completed by finding a term that has the same association with flock that cow has to herd AND importantly that is as attributionally similar to cow as possible. So, to complete the analogy, the response must be a member of a flock that is a single, female, domesticated, four-legged, milk-producing animal that provides us with meat, cheese, milk, and hides. The answer is EWE.

To reinforce this understanding, students should correct several of their answers on the Analogy Anchor Activity and explain their reasons for the corrections.

## Anomaly

As with analogy, ask students to recall the meaning of an anomaly. Proceed by overviewing how the processes of encoding, inferring, mapping, and applying pertain to anomalies. *Encoding* involves richly describing the set of objects that are included in a given set and *inferring* means determining how each element in the set corresponds to other elements in the set. *Mapping* requires the individual to identify specific attributes that differentiate elements in the set (e.g., size, color, category). Finally, when applying, the respondent needs to select the object within the set that is aberrant on the most attributes. For the fish slide from Session 2, only one large fish was red and swimming in the other direction. To reinforce the learning, have students complete the short anomaly activity (see Activity 2).



**SESSION IV: TRAINING IN ANTITHETICAL AND ANTINOMOUS REASONING**

As an anchor activity for Session IV, have students complete the Anchor Activity, *What Comes to Mind?* (see Activity 3, 5 minutes approximately). Once students have completed the activity, explain that such an exercise demonstrates that humans often think in terms of two conflicting or contrasting ideas. The two forms of relational reasoning that the students will learn about in this session represent such conflicting or contrasting ideas, objects, or events; that is, antithetical reasoning and antinomous reasoning. However, these two forms of RR differ from one another in a VERY critical way that often gets overlooked. As graphically shown in Figure 1, an antinomy represents a binary relation, where the ideas, objects, or events can only belong to one category or the other—with nothing between them. For example, in medicine, doctors can certify that someone is alive or dead. There is nothing between these two states.

**ANTINOMY?****OR****ANTITHESIS?****Figure 1**

*A Graphic Representation of Antinomy and Antithesis*

In contrast, an antithesis represents a continuum marked by two polarities or opposites. Unlike antinomies, we can identify many other ideas, objects, or events that fall between two endpoints. For example, consider the opposing terms enormous vs. microscopic.

**Enormous****Microscopic**

Now, see how many words you can position between those two extremes in size.

In order to test students' grasp of the difference between antinomy and antithesis, have them go back to Activity 3, *What Comes to Mind?*. Then, allow them time to work in groups to decide whether the answers they produced were examples of antinomous or antithetical reasoning. Responses will vary depending on what answers they give. Students should provide justification for their determinations of antimony or antithesis using the process of encode, infer, map, and apply.

## SESSION V: CULMINATING ACTIVITIES

### Constructing Novel Relational Items

For the last training session in relational reasoning, the student will be given the opportunity to create their own items that represent relational reasoning. This can provide you with another form of assessment along with the TORR where the students assess their understanding of each of the relational forms.

Explain to the students that they should create their own item that they believe assesses for each analogy, anomaly, antinomy, and antithesis. Let the students know that the examples they create can be spatial with shapes or diagrams, like the ones they were exposed to in the TORR; pictorial using pictures or much more detailed photos, like the ones they were exposed to during the anomaly and analogy training session; or they can be verbal items, where the learner may write out sentence or mix words together in a list, like the examples they were exposed to during the antinomy and antithesis training.

After the students have been given time to create their own example items for each relational form individually, tell them they will now pair up with a peer to share their items. Demonstrate for the students how they are to explain the item they created, what form of relational reasoning they are attempting to assess for, and the instructions for how their peer should choose what they believe is the right answer to the item question. Then, provide the students time to share their items with their peers and work through each novel example.

Bring the students back together for a large group discussion and have them share what their experience was like creating a novel relational reasoning item and attempting to explain it to their peers. Make sure that as students share their experiences, you continue to refer students back to salient points from prior training sessions. In doing so, students will be continuously coached while they are considering specific challenges related to the relational reasoning forms

## **SESSION VI: POST-ASSESSMENT OF RELATIONAL REASONING**

Students will complete a post-assessment of relational reasoning. The post-assessment is the same version of the TORR that the students took in the pre-assessment during Session I. They will be given 50 minutes to complete the TORR online via Qualtrics®. Once they submit their responses, they will automatically receive their total score and the corresponding RRQ (see Appendix A), as well as their score for each scale of the TORR that corresponds to one of the four forms. Students are to record those scores in their journals for their comparison to the pre-assessment. This post-assessment can either be completed in person or online such that the learner can progress at their own pace.

**ACTIVITIES****SESSION III****Activity 1****ANALOGY ANCHOR ACTIVITY**

**Directions:** Complete each of the following analogy problems.

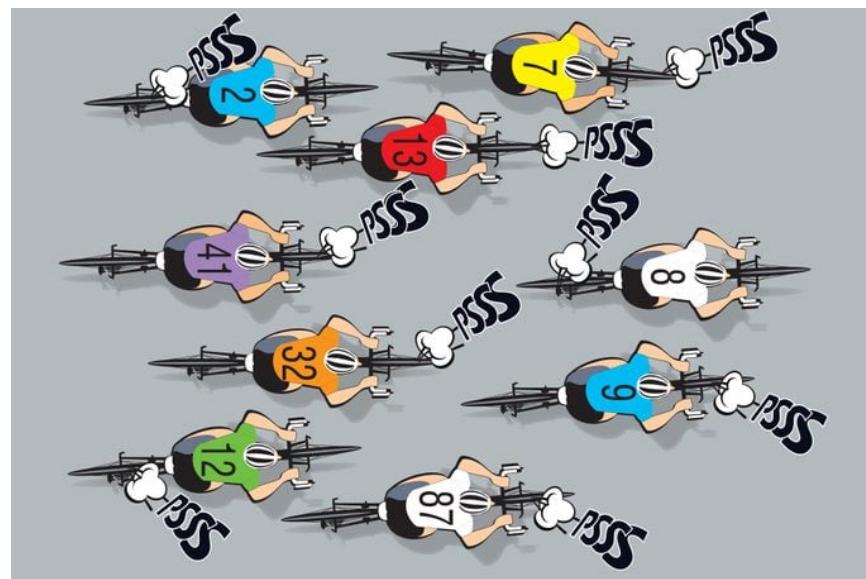
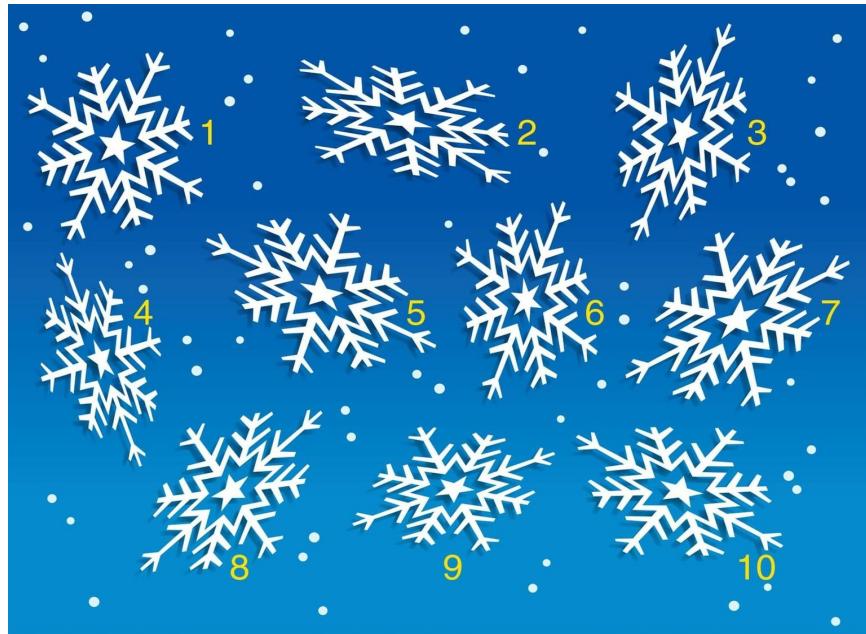
1. Herd : Cow :: Flock : \_\_\_\_\_
2. Ocean : Bay :: Continent : \_\_\_\_\_
3. Horse : Stable :: Dog : \_\_\_\_\_
4. Sing : Song :: Dream : \_\_\_\_\_
5. Quart : Gallon :: Week : \_\_\_\_\_
6. Hour : Our :: Where : \_\_\_\_\_
7. Verb : Action :: Adjective : \_\_\_\_\_
8. Suggest : Demand :: Take :: \_\_\_\_\_
9. Belt : Trousers :: Cable : \_\_\_\_\_
10. Hope : hopeful :: Gratitude : \_\_\_\_\_

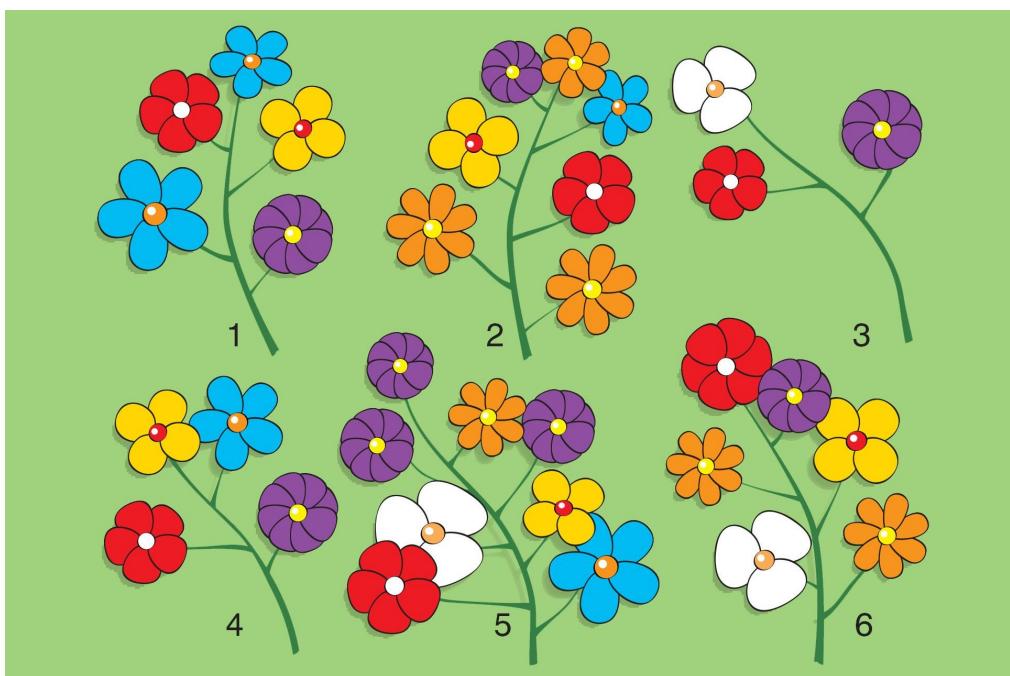
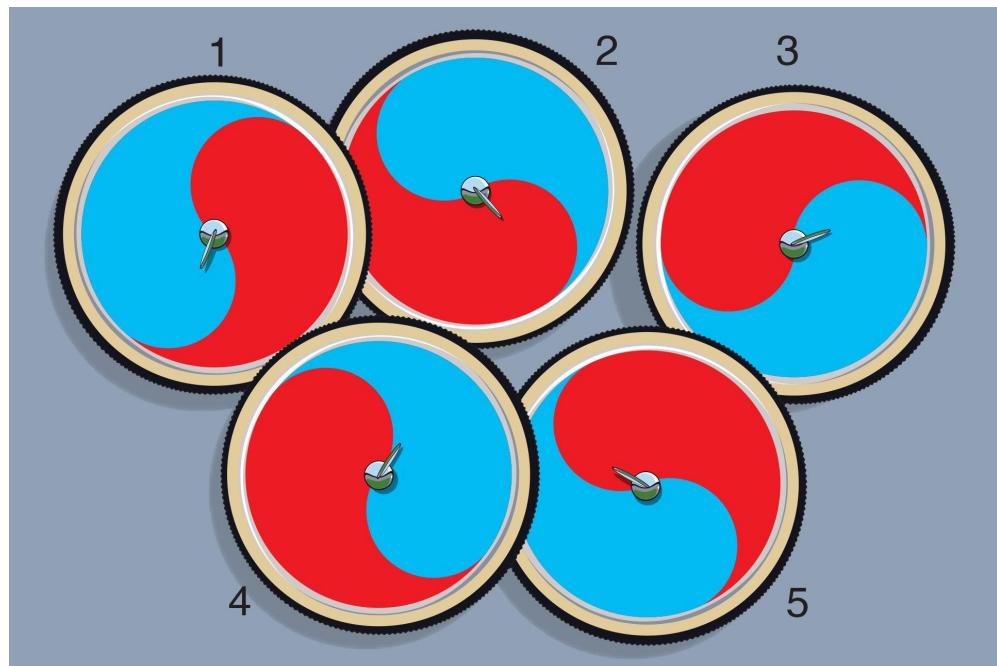
**ANALOGY ANCHOR ACTIVITY KEY**

1. Ewe
2. Peninsula
3. Kennel
4. Dream
5. Month
6. Wear or Were
7. Description
8. Seize or Confiscate
9. Elevator or Funicular
10. Grateful

**Activity 2****FINDING THE OUTLIER**

**Directions:** For each of the sets of objects displayed, identify the one that is aberrant; that is, it differs from all the others.





From: Reader's Digest

**ANOMALY ANSWER KEY**

1. 6
2. 32
3. 4
4. 2

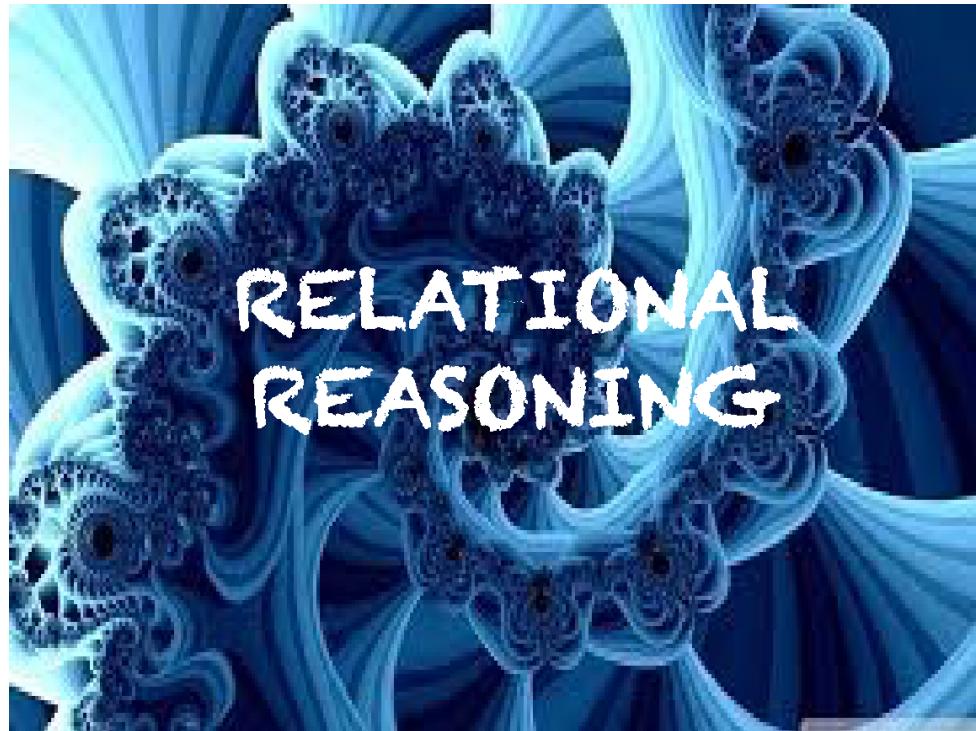
**SESSION IV****Activity 3****WHAT COMES TO MIND?**

**Directions:** For each of the words listed below, *immediately* write down the FIRST WORD that comes to mind.

1. UP \_\_\_\_\_
2. HEAVY \_\_\_\_\_
3. TO \_\_\_\_\_
4. TRUE \_\_\_\_\_
5. HAPPY \_\_\_\_\_
6. LEFT \_\_\_\_\_
7. WALK \_\_\_\_\_
8. FLOAT \_\_\_\_\_
9. CORRECT \_\_\_\_\_
10. BRAVE \_\_\_\_\_
11. INSIDE \_\_\_\_\_
12. ANIMAL \_\_\_\_\_

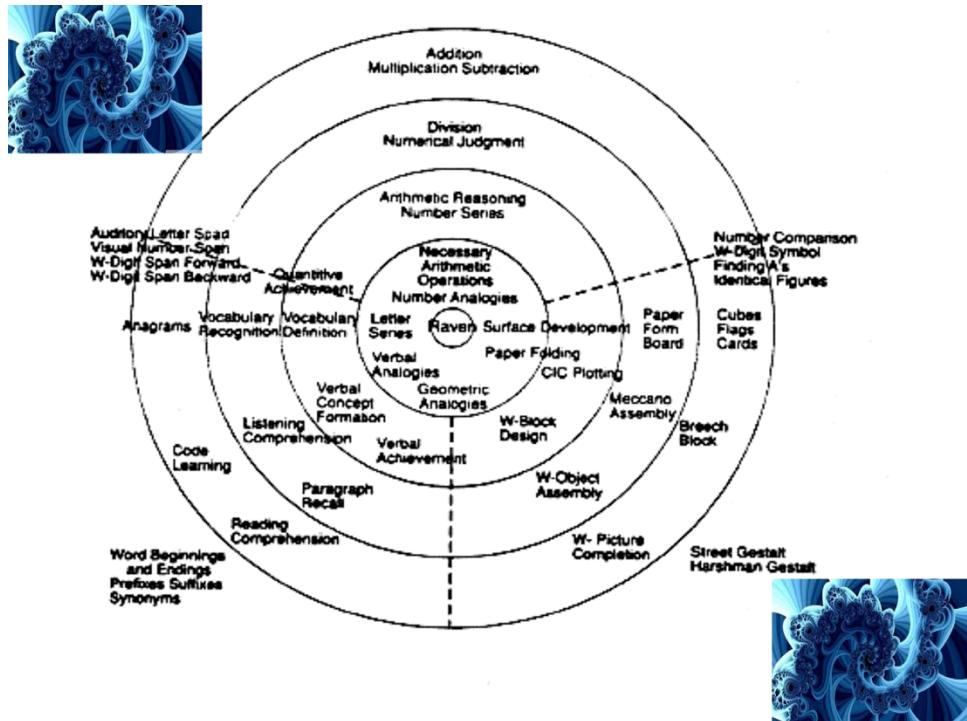
## SESSION SLIDES

## Session II



## RELATIONAL REASONING

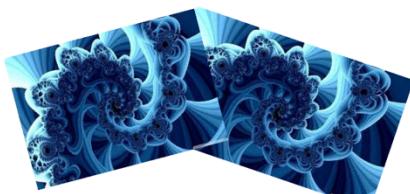
...can be broadly conceptualized as the ability to recognize or derive meaningful patterns within any informational stream be that information linguistic, graphic, or numeric in nature.

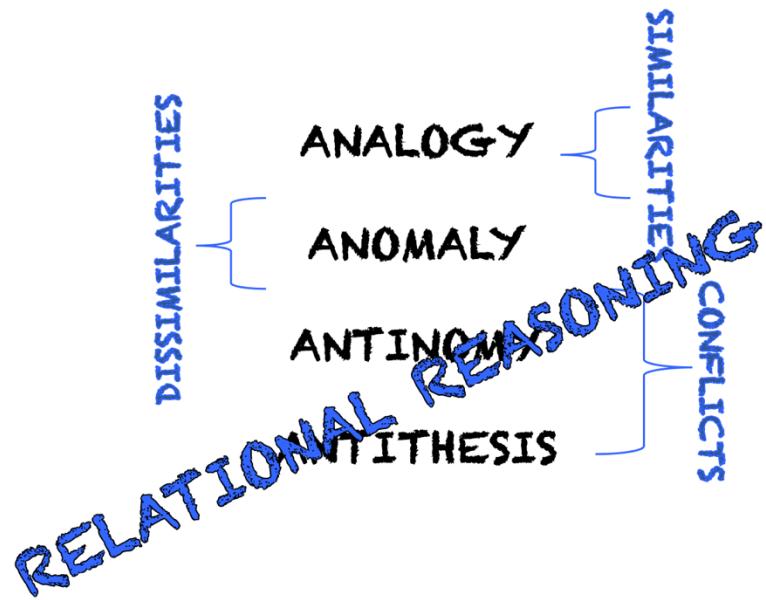


## TRADITIONAL IQ      RELATIONAL REASONING

### DIFFERENCES

- More about crystallized than fluid processing
  - Presumes perceptual/attentional abilities
  - Has more of a "schooled" character
  - Highly dependent on memory and recall
- More fluid than crystallized processing
  - Focuses on perceptual attentional abilities
  - Has more of a "non-schooled" character
  - Less reliant on memory and recall





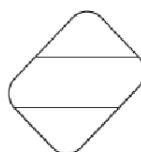
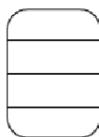
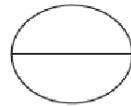
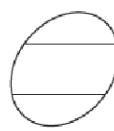
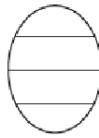
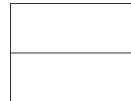
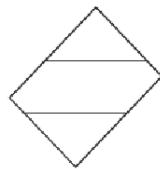
## ANALOGY

Involves the recognition of relational similarity between two seemingly disparate ideas, objects, or events

$$3 : 4 = 9 : \underline{\quad}$$

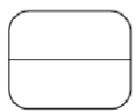
HERD : COW :: FLOCK :

Select the figure from those shown below that completes the pattern.

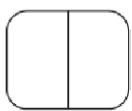


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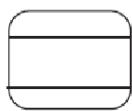
**A**



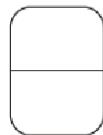
**B**



**C**



**D**



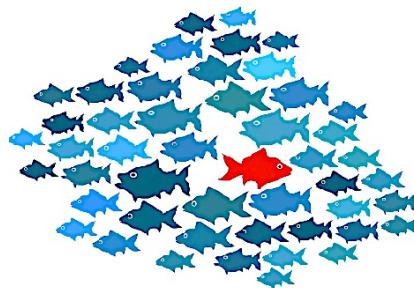
sentences from the answer choices below that describe the *most similar* situation.

The man breathed a sigh of disappointment when he opened his wife's gift.

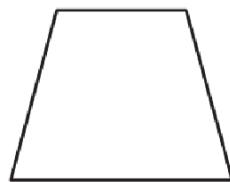
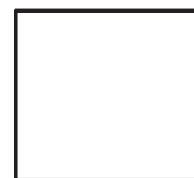
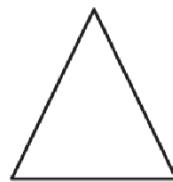
- A. The boy felt saddened as he packed up his old clothes to hand down to his younger brother.
- B. The mother couldn't hide her sense of defeat when she received her child's report card.
- C. The girl felt an immediate sense of relief after getting an invitation to the dance.
- D. The child's bafflement showed when his friend didn't share his dessert with him.

## ANOMALY

Any occurrence or object that is strange, unusual, or unique; a discrepancy or deviation from an established rule or trend



**Directions:** All these figures **but one** follow a particular pattern or rule.  
Find the one figure that does not follow the pattern.



A



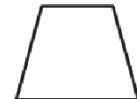
B



C



D



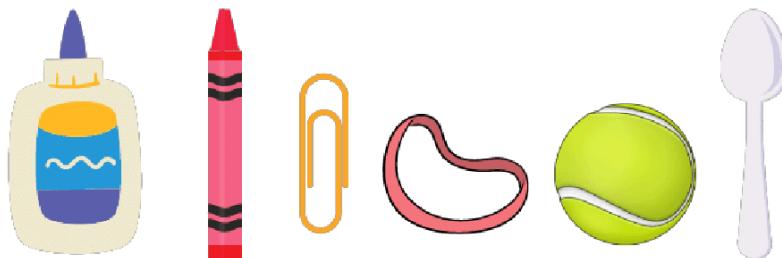
**Directions:** Three of these sentences follow a particular pattern or rule. Find this pattern or rule and select the sentence that **does not follow the pattern**.

- A. The pride of lions devoured a wildebeest.
- B. The school of piranhas feasted on the bird.
- C. The herd of buffalo munched on the grass.
- D. The pod of killer whales gobbled up a seal.

## ANTINOMY

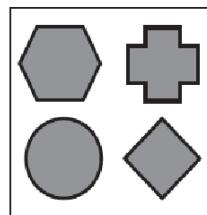
Refers to the mutual incompatibility, real or apparent, of two laws, rules, or principles

SINK      or      FLOAT

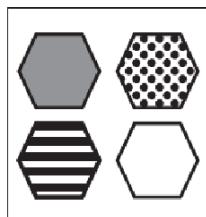


Which ONE of the four sets (A, B, C, and D) below could NEVER have an object in common with the Given set?

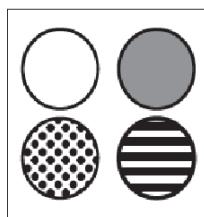
**GIVEN**



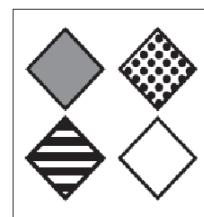
**A**



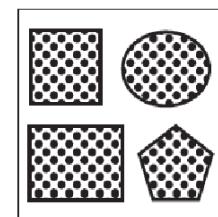
**B**



**C**



**D**



**Directions:** Read the two paragraphs below. Then select the sentence that includes an idea that could be reflected in **one paragraph, but not the other**.

Running is a great way to get in shape and relieve stress. Long runs leave me feeling energized and excited for the day. They also boost my self-confidence and make me feel like I can accomplish anything.

Team sports provide opportunities to spend time with friends, with the added benefit of exercise! I enjoy bonding with my friends during a Saturday morning soccer game or Wednesday night kickball tournament.

Exercise is valuable for your body.

Running can be exhausting.

Exercise should be done socially.

Kickball isn't really a sport.

## ANTITHESIS

**Arises when two ideas, propositions, principles, or explanations are set in direct contrast or direct opposition with infinite gradations between them**

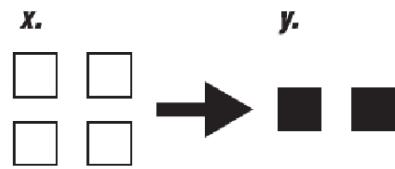


**Directions:** The given figure below depicts a *process* in which X becomes Y. In the figure, the arrow represents the rule by which the change occurs. Select the answer choice that shows the *opposite* of the given process.

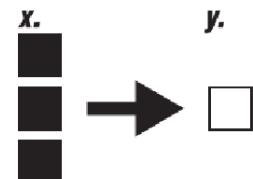
**GIVEN**   *x.*                      *y.*



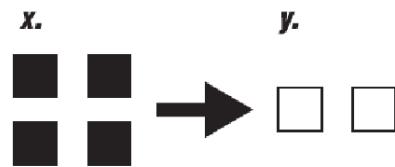
**A**



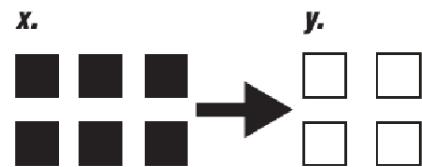
**B**



**C**



**D**



**Directions:** The sentence below describes a situation. Select the sentence from the answer choices below that describes the **opposite** situation.

The woman was pleased with the dollhouse she built.

- A. The child was satisfied with the blocks he had stacked into a tower.
- B. The boy was amused when he broke his dinner plate.
- C. The girl was frustrated that she had to put together a bookshelf.
- D. The man was angry that he destroyed his painting.

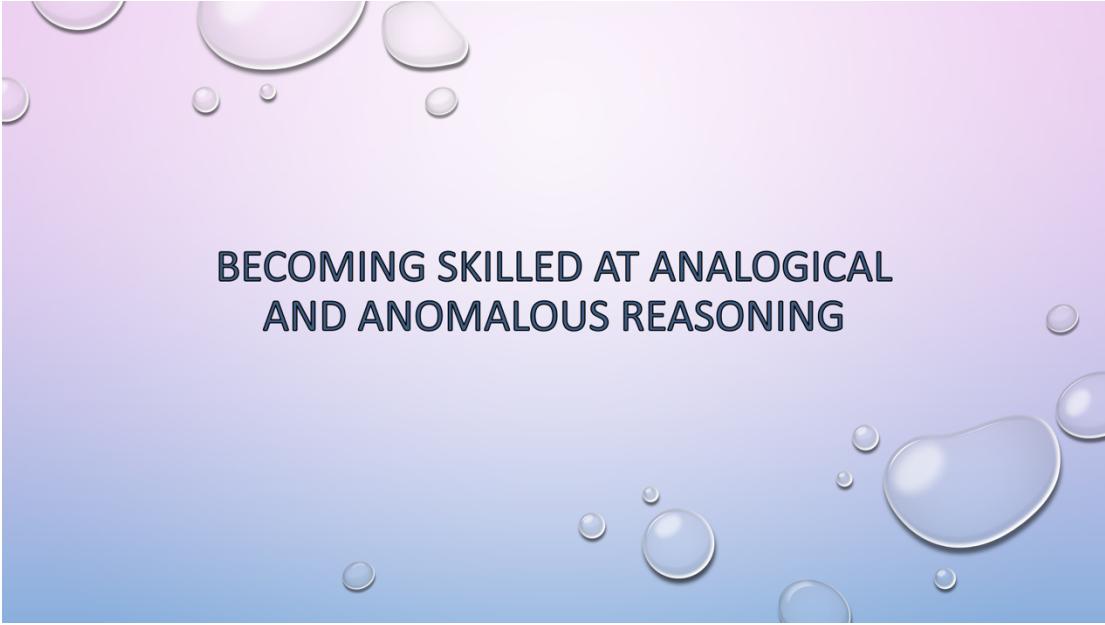
### SO, WHAT IS YOUR RELATIONAL REASONING PROFILE?

- How did the class perform overall?  
[insert graph of the means for the TORR total and by each scale here]
- How do your scores compare to the overall scores for the class?
- What do these data mean for your RR abilities?

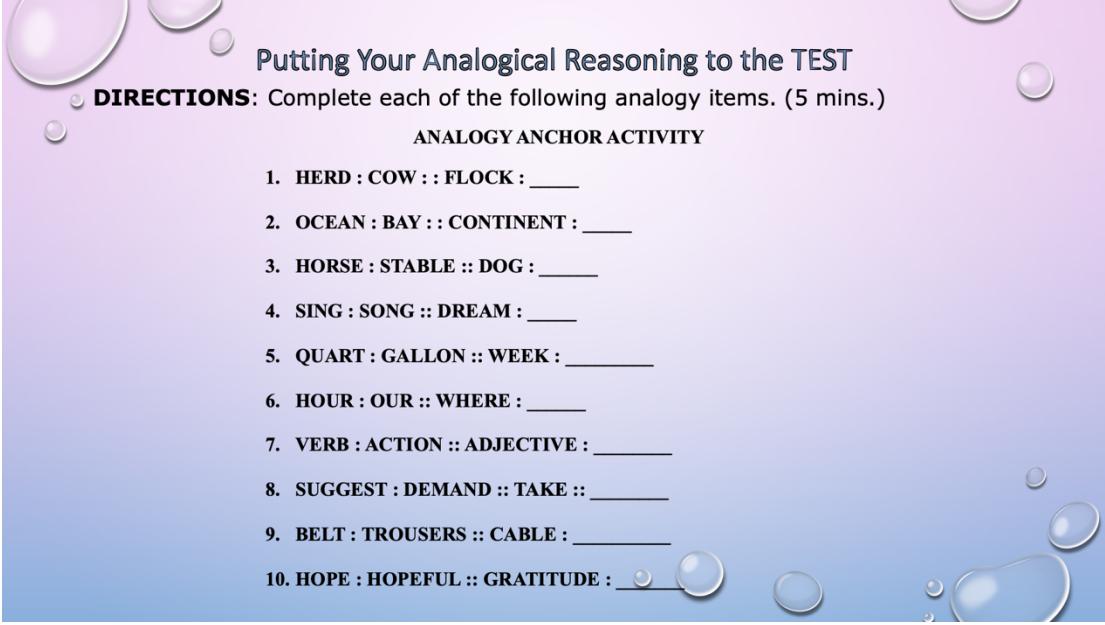
**Table 6**  
*Summed Scores, EAP Scores, and RRQ Scores for the General Relational Reasoning Dimension of the TORR*

Summed score	EAP score	RRQ score
1	-2.05	69
2	-1.97	70
3	-1.90	71
4	-1.82	73
5	-1.73	76
6	-1.63	77
7	-1.52	79
8	-1.40	81
9	-1.27	83
10	-1.14	85
11	-0.99	87
12	-0.85	90
13	-0.69	91
14	-0.55	94
15	-0.41	96
16	-0.26	98
17	0.01	100
18	0.14	102
19	0.27	104
20	0.39	106
21	0.52	108
22	0.65	110
23	0.77	112
24	0.91	114
25	1.05	116
26	1.19	118
27	1.35	120
28	1.52	123
29	1.71	126
30	1.92	129
31	2.15	132
32	2.40	135

*Note.* EAP = expected a posteriori; RRQ = relational reasoning quotient; TORR = Test of Relational Reasoning.

**Session III**

## BECOMING SKILLED AT ANALOGICAL AND ANOMALOUS REASONING



### Putting Your Analogical Reasoning to the TEST

**DIRECTIONS:** Complete each of the following analogy items. (5 mins.)

**ANALOGY ANCHOR ACTIVITY**

1. HERD : COW :: FLOCK : \_\_\_\_\_
2. OCEAN : BAY :: CONTINENT : \_\_\_\_\_
3. HORSE : STABLE :: DOG : \_\_\_\_\_
4. SING : SONG :: DREAM : \_\_\_\_\_
5. QUART : GALLON :: WEEK : \_\_\_\_\_
6. HOUR : OUR :: WHERE : \_\_\_\_\_
7. VERB : ACTION :: ADJECTIVE : \_\_\_\_\_
8. SUGGEST : DEMAND :: TAKE : \_\_\_\_\_
9. BELT : TROUSERS :: CABLE : \_\_\_\_\_
10. HOPE : HOPEFUL :: GRATITUDE : \_\_\_\_\_

**What were your responses to the following item?**

Herd : Cow :: Flock : \_\_\_\_\_

- There are 4 processes that are essential to solving any analogy problem correctly: **ENCODE**, **INFER**, **MAP**, and **APPLY**
- When you **encode**, you deeply describe or analyze each of the terms in the problem. *Herd* means \_\_\_\_\_  
*Cow* is \_\_\_\_\_  
*Flock* means \_\_\_\_\_
- You **infer** when you establish one or more meaningful relations between the first two terms, Herd and Cow.  
How do herd and cow go together \_\_\_\_\_?
- **Mapping** requires you to find core associations between the first and third terms, linking the two parts of the analogy problem.  
Herd and flock are related because \_\_\_\_\_?
- Finally, when you **apply**, you are trying to find a term that keeps both sides of the analogy problem as balanced as possible on as many attributes as possible. Any difference will result in an error.

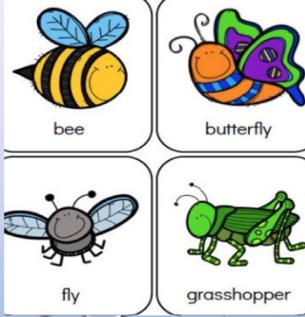
**Now, take what you learned and rethink your responses**

**ANALOGY ANCHOR ACTIVITY**

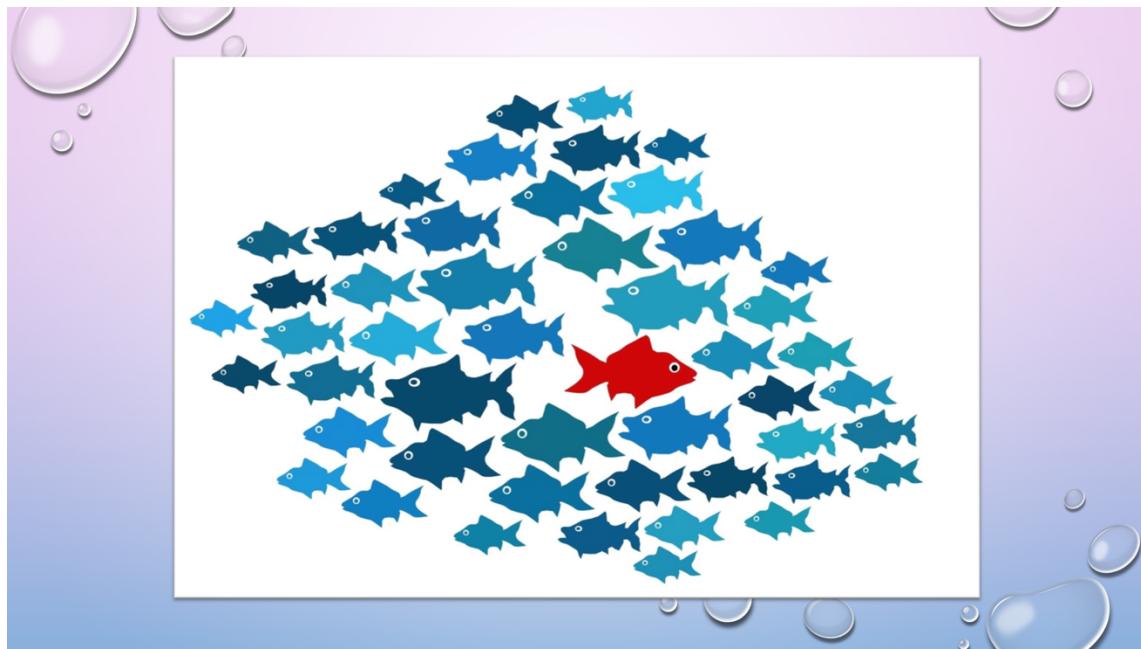
1. HERD : COW :: FLOCK : \_\_\_\_\_
2. OCEAN : BAY :: CONTINENT : \_\_\_\_\_
3. HORSE : STABLE :: DOG : \_\_\_\_\_
4. SING : SONG :: DREAM : \_\_\_\_\_
5. QUART : GALLON :: WEEK : \_\_\_\_\_
6. HOUR : OUR :: WHERE : \_\_\_\_\_
7. VERB : ACTION :: ADJECTIVE : \_\_\_\_\_
8. SUGGEST : DEMAND :: TAKE : \_\_\_\_\_
9. BELT : TROUSERS :: CABLE : \_\_\_\_\_
10. HOPE : HOPEFUL :: GRATITUDE : \_\_\_\_\_

## Exploring Anomalous Reasoning

- What is an anomaly?
- To reason anomalously, all the elements of the problem must belong to an identifiable set.



- As with analogies, 4 processes of **ENCODE**, **INFER**, **MAP**, and **APPLY** are essential to solving anomalous reasoning problems.
- When you **encode** in an anomaly problem, you must carefully examine each element in the set.
- You then **infer** what are all the elements have in common with each other that makes them part of a meaningful set
- In **mapping** you then investigate what is different about various elements in the set; along what dimensions do they vary
- Finally, when you **apply**, you determine which of the set members is markedly different from the others based on one or more key attributes

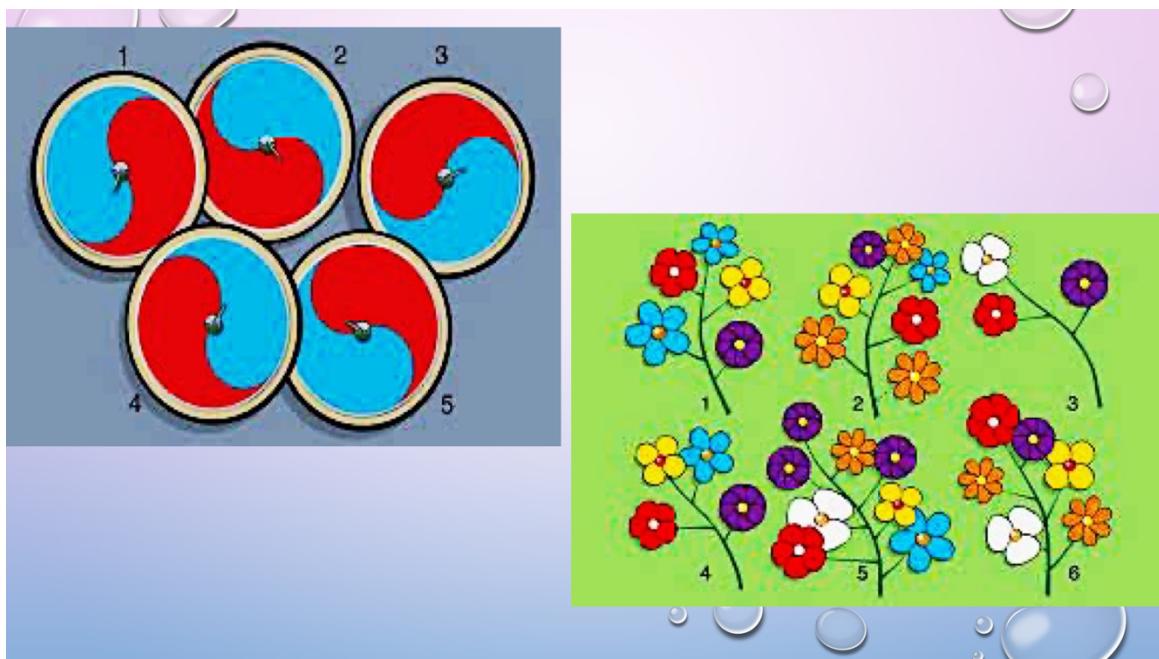


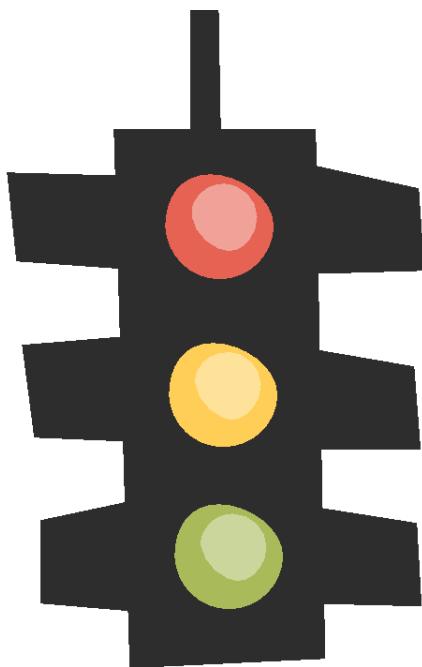
Putting Your Anomalous Reasoning to the TEST

**DIRECTIONS:** Find the outlier in each problem set.

A collection of ten snowflakes of varying sizes and shapes, numbered 1 through 10.

A group of ten people riding bicycles, each wearing a different colored shirt (blue, yellow, red, purple, orange, green, black, white, pink, brown) and numbered 1 through 10. The person in the red shirt is the outlier.



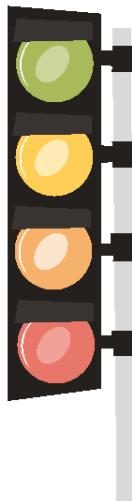
**Session III**

# **ANTINOMOUS and ANTITHETICAL REASONING**

**LEARNING TO READ THE  
SIGNALS**

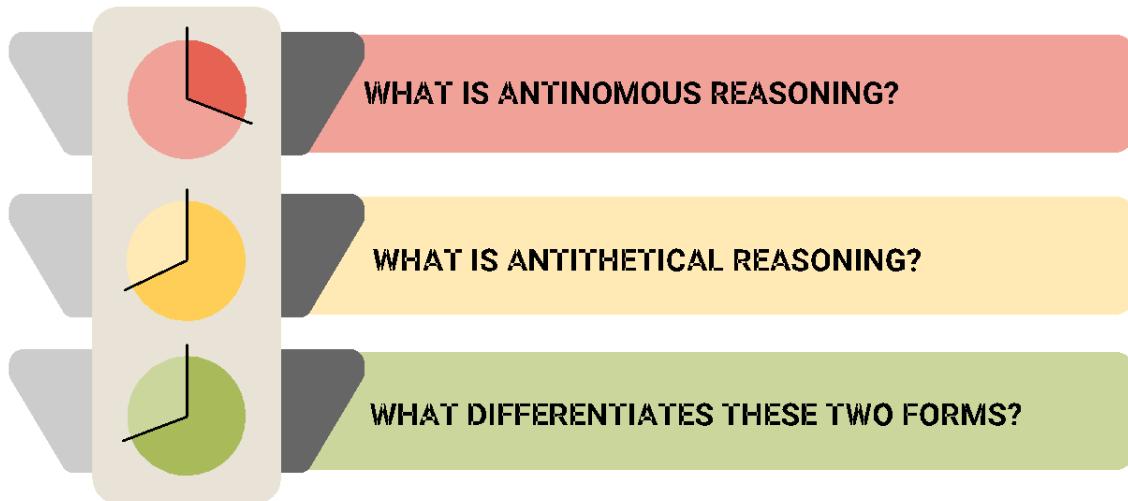
## **WHAT COMES TO MIND?**

**DIRECTIONS:** For each of the following words, write down the *first word that comes to mind*

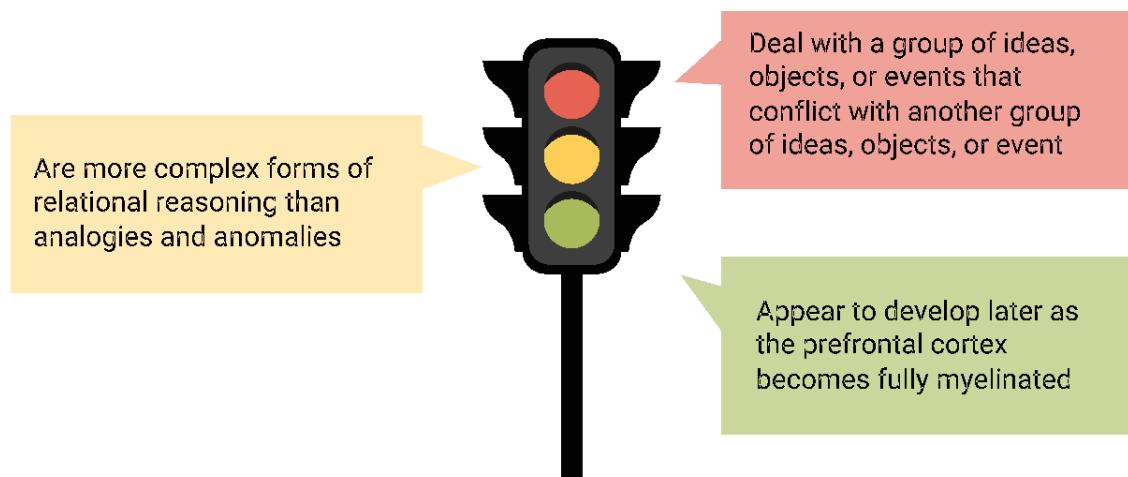


1. UP \_\_\_\_\_
2. HEAVY \_\_\_\_\_
3. TO \_\_\_\_\_
4. TRUE \_\_\_\_\_
5. HAPPY \_\_\_\_\_
6. LEFT \_\_\_\_\_
7. WALK \_\_\_\_\_
8. FLOAT \_\_\_\_\_
9. CORRECT \_\_\_\_\_
10. BRAVE \_\_\_\_\_
11. INSIDE \_\_\_\_\_
12. ANIMAL \_\_\_\_\_

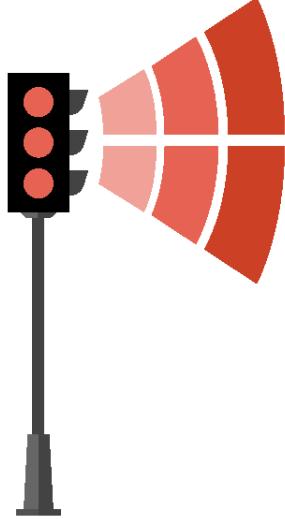
## GOALS



## BOTH ANTINOMOUS AND ANTITHETICAL REASONING...



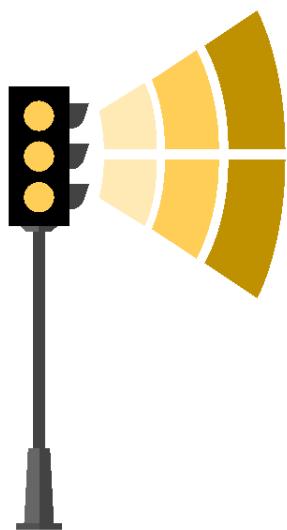
## BUT...ANTINOMIES AND ANTITHESES DIFFER IN IMPORTANT WAYS



### ANTINOMY



### ANTITHESIS



- ☞ Antinomies represent ***binary relations***
- ☞ Ideas, objects, or events can ***only*** belong to one set or category or the other
- ☞ There is ***nothing between*** the two sets
- ☞ For example, in medicine, a person can only be certified as ***alive*** or ***dead***

## HOW TO SOLVE ANTINOMY PROBLEMS

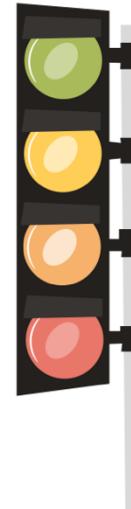
- When you **encode** these problems, you first carefully examine each element in Set A. Then, encode the elements in Set B.

2, 19,  
41, 11

Set A

22, 4,  
63, 12

Set B



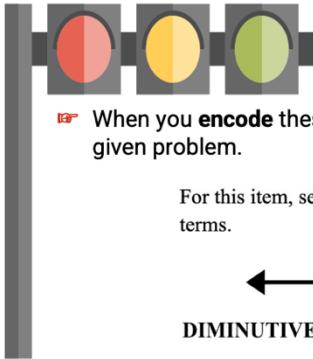
- When you **infer**, you determine what all the elements in Set A have in common. Then, repeat this process for Set B.
- What you decide when you attempt to **map** Set A to Set B is that their defining characteristics are in direct opposition (prime versus non-prime numbers)
- Thus, when you **apply** you need to decide to which set any new element can belong.

7, 54,  
82, 19



- Antitheses** represent a **continuum** marked by two polarities or opposites
- There can be many other ideas, objects, or events that **fall between the two endpoints**
- For example, consider the opposite terms, **diminutive** vs. **colossal**
- How many words can you place on the continuum between them

DIMINUTIVE COLOSSAL



## HOW TO SOLVE ANTITHESIS PROBLEMS

- ☞ When you **encode** these problems, you first carefully examine what you know about each feature of the given problem.

For this item, select the word with *the meaning that fits somewhere between* the two opposite terms.



DIMINUTIVE

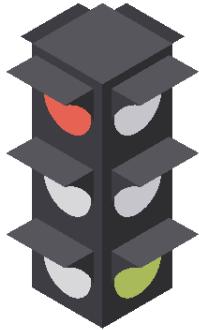
COLOSSAL

- A. PETITE
- B. HEAVY
- C. BONY
- D. MICROSCOPIC

- ☞ When you **infer**, you determine the nature of the **continuum** for which the given terms serve as polar opposites. For the above example, *diminutive* and *colossal* are extremes for the attribute of **size**.  
☞ To **map**, you need to recognize the subtleties of the contrast represented, such as its magnitude, strength, or contextual differences.  
☞ When you **apply**, you complete the problem by using the knowledge gained to respond accurately.

## NOW...Return to your answers to "What comes to mind"

**DIRECTIONS:** Work in groups to sort each of the 12 items into the right category. Differences of opinion may exist so be ready to justify your answer.



Antinomies



Antitheses

## CONCLUDING THOUGHTS ABOUT RELATIONAL REASONING



☞ BEWARE false dichotomies!!

- ☞ The four forms of relational reasoning often work together in systematic ways
- ☞ The pattern that the forms of relational reasoning follow can vary according to the nature of the problem or the domain

