

## S1. Supplementary Materials

Easier non-symbolic approximate addition values used for training task in Experiments 1 and 2.

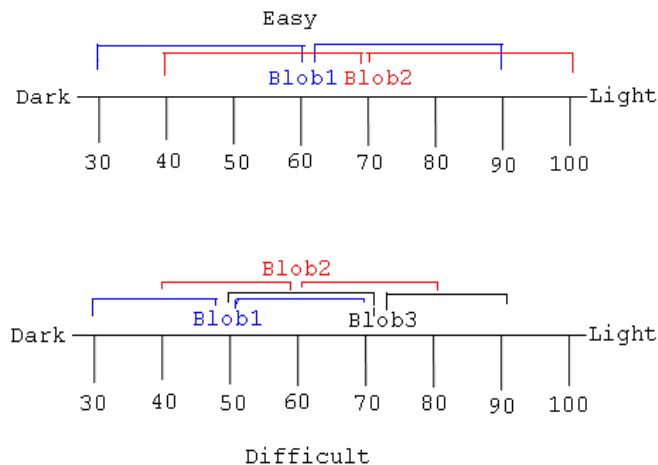
| 7:4 RATIO |          |            |      |                  |       |
|-----------|----------|------------|------|------------------|-------|
| Addend 1  | Addend 2 | Actual Sum | Test | Correct Response | Ratio |
| 13        | 43       | 56         | 32   | Less             | 0.57  |
| 26        | 30       | 56         | 32   | Less             | 0.57  |
| 21        | 11       | 32         | 56   | More             | 0.57  |
| 15        | 17       | 32         | 56   | More             | 0.57  |
| 40        | 9        | 49         | 28   | Less             | 0.57  |
| 22        | 27       | 49         | 28   | Less             | 0.57  |
| 18        | 10       | 28         | 49   | More             | 0.57  |
| 13        | 15       | 28         | 49   | More             | 0.57  |
| 30        | 12       | 42         | 24   | Less             | 0.57  |
| 19        | 23       | 42         | 24   | Less             | 0.57  |
| 16        | 8        | 24         | 42   | More             | 0.57  |
| 12        | 12       | 24         | 42   | More             | 0.57  |
| 24        | 11       | 35         | 20   | Less             | 0.57  |
| 16        | 19       | 35         | 20   | Less             | 0.57  |
| 13        | 7        | 20         | 35   | More             | 0.57  |
| 9         | 11       | 20         | 35   | More             | 0.57  |
| 19        | 9        | 28         | 16   | Less             | 0.57  |
| 13        | 15       | 28         | 16   | Less             | 0.57  |
| 9         | 7        | 16         | 28   | More             | 0.57  |
| 8         | 8        | 16         | 28   | More             | 0.57  |

**More difficult non-symbolic approximate addition values used for training task in Experiments 1 and 2.**

| 7:5 RATIO |         |     |      |                  |       |
|-----------|---------|-----|------|------------------|-------|
| Addend1   | Addend2 | Sum | Test | Correct Response | Ratio |
| 40        | 16      | 56  | 40   | Less             | 0.71  |
| 28        | 28      | 56  | 40   | Less             | 0.71  |
| 27        | 13      | 40  | 56   | More             | 0.71  |
| 21        | 19      | 40  | 56   | More             | 0.71  |
| 35        | 14      | 49  | 35   | Less             | 0.71  |
| 23        | 26      | 49  | 35   | Less             | 0.71  |
| 23        | 12      | 35  | 49   | More             | 0.71  |
| 17        | 18      | 35  | 49   | More             | 0.71  |
| 30        | 12      | 42  | 30   | Less             | 0.71  |
| 20        | 22      | 42  | 30   | Less             | 0.71  |
| 20        | 10      | 30  | 42   | More             | 0.71  |
| 15        | 15      | 30  | 42   | More             | 0.71  |
| 25        | 10      | 35  | 25   | Less             | 0.71  |
| 16        | 19      | 35  | 25   | Less             | 0.71  |
| 17        | 8       | 25  | 35   | More             | 0.71  |
| 11        | 14      | 25  | 35   | More             | 0.71  |
| 20        | 8       | 28  | 20   | Less             | 0.71  |
| 13        | 15      | 28  | 20   | Less             | 0.71  |
| 13        | 7       | 20  | 28   | More             | 0.71  |
| 10        | 10      | 20  | 28   | More             | 0.71  |

### Brightness training stimuli used in training tasks of Experiments 1 and 2.

Eight, equally spaced degrees of brightness were created (ranging from dark to light) in Adobe Photoshop by changing the brightness scale from 30-100 (brightness values were the default values used in the Photoshop scale). Hue and saturation were kept constant so that difficulty of comparisons would be based on relative brightness rather than changes in color. The brightness values of 50, 60, and 70 were used as the standard values for the object presented at the start of brightness training problems. Comparison (or test objects) ranged in brightness from 30-100. We manipulated ratio in a similar way as we did in numerical and other non-numerical magnitude training conditions. In a similar way as the numerical problems, we manipulated the ratio relationship between the brightness value of the initial object and the test object. Easier problems involved comparisons of 30 or 90 to 60 and 40 or 100 to 70; harder problems involved comparison of 30 or 70 to 50 and 40 and 80 to 60 (see figures below).



**Easier line length addition values (in pixels) used in Experiment 1.**

| 7:4 RATIO |          |            |      |                  |       |
|-----------|----------|------------|------|------------------|-------|
| Addend 1  | Addend 2 | Actual Sum | Test | Correct Response | Ratio |
| 84        | 84       | 168        | 96   | Less             | 0.57  |
| 85        | 83       | 168        | 96   | Less             | 0.57  |
| 41        | 55       | 96         | 168  | More             | 0.57  |
| 60        | 36       | 96         | 168  | More             | 0.57  |
| 68        | 79       | 147        | 84   | Less             | 0.57  |
| 75        | 72       | 147        | 84   | Less             | 0.57  |
| 35        | 49       | 84         | 147  | More             | 0.57  |
| 60        | 24       | 84         | 147  | More             | 0.57  |
| 61        | 65       | 126        | 72   | Less             | 0.57  |
| 70        | 56       | 126        | 72   | Less             | 0.57  |
| 32        | 40       | 72         | 126  | More             | 0.57  |
| 47        | 25       | 72         | 126  | More             | 0.57  |
| 33        | 72       | 105        | 60   | Less             | 0.57  |
| 55        | 50       | 105        | 60   | Less             | 0.57  |
| 30        | 30       | 60         | 105  | More             | 0.57  |
| 35        | 25       | 60         | 105  | More             | 0.57  |
| 40        | 44       | 84         | 48   | Less             | 0.57  |
| 55        | 29       | 84         | 48   | Less             | 0.57  |
| 20        | 28       | 48         | 84   | More             | 0.57  |
| 26        | 22       | 48         | 84   | More             | 0.57  |

**More difficult line length addition values (in pixels) used in Experiment 1.**

| 7:5 RATIO |         |     |      |                  |       |
|-----------|---------|-----|------|------------------|-------|
| Addend1   | Addend2 | Sum | Test | Correct Response | Ratio |
| 84        | 84      | 168 | 120  | Less             | 0.71  |
| 85        | 83      | 168 | 120  | Less             | 0.71  |
| 59        | 61      | 120 | 168  | More             | 0.71  |
| 71        | 49      | 120 | 168  | More             | 0.71  |
| 68        | 79      | 147 | 105  | Less             | 0.71  |
| 82        | 65      | 147 | 105  | Less             | 0.71  |
| 40        | 65      | 105 | 147  | More             | 0.71  |
| 55        | 50      | 105 | 147  | More             | 0.71  |
| 57        | 69      | 126 | 90   | Less             | 0.71  |
| 73        | 53      | 126 | 90   | Less             | 0.71  |
| 30        | 60      | 90  | 126  | More             | 0.71  |
| 50        | 40      | 90  | 126  | More             | 0.71  |
| 47        | 58      | 105 | 75   | Less             | 0.71  |
| 68        | 37      | 105 | 75   | Less             | 0.71  |
| 35        | 40      | 75  | 105  | More             | 0.71  |
| 45        | 30      | 75  | 105  | More             | 0.71  |
| 42        | 42      | 84  | 60   | Less             | 0.71  |
| 50        | 34      | 84  | 60   | Less             | 0.71  |
| 28        | 32      | 60  | 84   | More             | 0.71  |
| 30        | 30      | 60  | 84   | More             | 0.71  |

**Approximate number comparison values used in Experiment 1.**

| Number 1 | Number 2 | Correct Response | Ratio |
|----------|----------|------------------|-------|
| 56       | 32       | Less             | 0.57  |
| 32       | 56       | More             | 0.57  |
| 49       | 28       | Less             | 0.57  |
| 28       | 49       | More             | 0.57  |
| 42       | 24       | Less             | 0.57  |
| 24       | 42       | More             | 0.57  |
| 35       | 20       | Less             | 0.57  |
| 20       | 35       | More             | 0.57  |
| 28       | 16       | Less             | 0.57  |
| 16       | 28       | More             | 0.57  |
| 56       | 40       | Less             | 0.71  |
| 40       | 56       | More             | 0.71  |
| 49       | 35       | Less             | 0.71  |
| 35       | 49       | More             | 0.71  |
| 42       | 30       | Less             | 0.71  |
| 30       | 42       | More             | 0.71  |
| 35       | 25       | Less             | 0.71  |
| 25       | 35       | More             | 0.71  |
| 28       | 20       | Less             | 0.71  |
| 20       | 28       | More             | 0.71  |

Symbolic addition problems from Experiment 1.

| Experiment 1 |               |        |     |
|--------------|---------------|--------|-----|
| First Addend | Second Addend | Answer | Set |
| 12           | 3             | 15     | 1   |
| 14           | 2             | 16     | 1   |
| 9            | 3             | 12     | 1   |
| 11           | 4             | 15     | 1   |
| 8            | 6             | 14     | 1   |
| 7            | 4             | 11     | 1   |
| 6            | 5             | 11     | 1   |
| 13           | 3             | 16     | 1   |
| 7            | 7             | 14     | 1   |
| 9            | 6             | 15     | 1   |
| 16           | 3             | 19     | 2   |
| 17           | 3             | 20     | 2   |
| 15           | 5             | 20     | 2   |
| 15           | 3             | 18     | 2   |
| 8            | 8             | 16     | 2   |
| 12           | 8             | 20     | 2   |
| 9            | 7             | 16     | 2   |
| 13           | 6             | 19     | 2   |
| 9            | 8             | 17     | 2   |
| 15           | 6             | 21     | 2   |
| 18           | 4             | 22     | 3   |
| 19           | 6             | 25     | 3   |
| 15           | 9             | 24     | 3   |
| 17           | 5             | 22     | 3   |
| 19           | 9             | 28     | 3   |
| 16           | 14            | 30     | 3   |
| 17           | 13            | 30     | 3   |
| 15           | 12            | 27     | 3   |
| 16           | 8             | 24     | 3   |
| 14           | 14            | 28     | 3   |
| 20           | 15            | 35     | 4   |
| 17           | 14            | 31     | 4   |
| 18           | 16            | 34     | 4   |
| 19           | 18            | 37     | 4   |
| 17           | 17            | 34     | 4   |
| 37           | 28            | 65     | 4   |
| 46           | 38            | 84     | 4   |
| 58           | 23            | 81     | 4   |
| 25           | 13            | 38     | 4   |
| 64           | 36            | 100    | 4   |

Note: Color designates problem set

-  1<sup>st</sup> Set
-  2<sup>nd</sup> Set
-  3<sup>rd</sup> Set
-  4<sup>th</sup> Set

Sample symbolic addition problem set (Set 4 used for Experiment 1).

Set 4. Solve the problems by adding

|   |
|---|
| $\begin{array}{r} 20 \\ + 15 \\ \hline \end{array}$ |
|   |

|   |
|---|
| $\begin{array}{r} 17 \\ + 14 \\ \hline \end{array}$ |
|   |

|   |
|---|
| $\begin{array}{r} 18 \\ + 16 \\ \hline \end{array}$ |
|   |

|   |
|---|
| $\begin{array}{r} 19 \\ + 18 \\ \hline \end{array}$ |
|   |

|   |
|---|
| $\begin{array}{r} 17 \\ + 17 \\ \hline \end{array}$ |
|   |

|   |
|---|
| $\begin{array}{r} 37 \\ + 28 \\ \hline \end{array}$ |
|   |

|   |
|---|
| $\begin{array}{r} 46 \\ + 38 \\ \hline \end{array}$ |
|   |

|   |
|---|
| $\begin{array}{r} 58 \\ + 23 \\ \hline \end{array}$ |
|   |

|   |
|---|
| $\begin{array}{r} 25 \\ + 13 \\ \hline \end{array}$ |
|   |

|   |
|---|
| $\begin{array}{r} 64 \\ + 36 \\ \hline \end{array}$ |
|   |



Symbolic addition problems used in Experiment 2.

| Experiment 2 |               |        |     |
|--------------|---------------|--------|-----|
| First Addend | Second Addend | Answer | Set |
| 6            | 5             | 11     | 1   |
| 14           | 8             | 22     | 1   |
| 8            | 6             | 14     | 1   |
| 13           | 6             | 19     | 1   |
| 15           | 6             | 21     | 1   |
| 12           | 7             | 19     | 1   |
| 14           | 14            | 28     | 1   |
| 13           | 11            | 24     | 1   |
| 46           | 38            | 84     | 1   |
| 878          | 47            | 925    | 1   |
| 8            | 8             | 16     | 2   |
| 19           | 6             | 25     | 2   |
| 9            | 6             | 15     | 2   |
| 16           | 8             | 24     | 2   |
| 16           | 14            | 30     | 2   |
| 15           | 12            | 27     | 2   |
| 17           | 17            | 34     | 2   |
| 19           | 18            | 37     | 2   |
| 77           | 65            | 142    | 2   |
| 987          | 79            | 1066   | 2   |

Note: Color designates problem set



1<sup>st</sup> Set



2<sup>nd</sup> Set

### Sentence completion problem sets 1-2 for Experiment 2.

Set 1. Please fill in the blanks by completing the one word

1. Planes land at the A\_\_\_\_\_.
2. Bees live together in a H\_\_\_\_\_.
3. A square has four corners and four S\_\_\_\_\_.
4. We keep our pants around our waist with a B\_\_\_\_\_.
5. The birds all gathered together in a single F\_\_\_\_\_.
6. To enter a movie theater you first need to purchase a T\_\_\_\_\_.
7. To draw straight lines you need a pencil and a R\_\_\_\_\_.
8. The Porcupine has defensive Q\_\_\_\_\_.
9. Poisonous mushrooms are bad to eat because they are T\_\_\_\_\_.
10. Lavender is a shade of P\_\_\_\_\_.

Set 2. Please fill in the blanks by completing the one word

1. A blizzard is a very large snow S\_\_\_\_\_.
2. Animals will starve if they cannot find any F\_\_\_\_\_.
3. Pirates use maps to look for buried T\_\_\_\_\_.
4. If an animal has a fatal disease, it will D\_\_\_\_\_.
5. No matter how hard Jenny tried to find her missing lunch box, it was impossible to L\_\_\_\_\_.
6. A chameleon uses camouflage to blend in with its environment by changing its skin C\_\_\_\_\_.
7. Jimmy limped because he had injured his F\_\_\_\_\_.
8. Animals that are raised in captivity live in C\_\_\_\_\_.
9. The brave soldier who never won battles and never gave up was V\_\_\_\_\_.
10. Amy felt so fatigued that she went to S\_\_\_\_\_.