# Using the Implicit Association Test to Investigate the Strength of Synesthetic Associations

Margaret Martinez, *Rowan University*
Nicole Steiner, *Emory University*
Simon Lacey, *Penn State College of Medicine*
Lynne Nygaard, *Emory University*
K. Sathian, *Penn State College of Medicine*

**Conference Name:** Rowan-Virtua Research Day

**Publication Date:** 2019-05-02

**Type of Work:** Poster

**Permanent URL:** http://pid.emory.edu/ark:/25593/w9sgt

Final published version:
https://rdw.rowan.edu/stratford_research_day/2019/may2/28/

May 2nd, 12:00 AM

# Using the Implicit Association Test to Investigate the Strength of Synesthetic Associations

Margaret Martinez
*Rowan University*

Nicole Steiner
*Emory University*

Simon Lacey
*Penn State College of Medicine - Hershey*

Lynne C. Nygaard
*Emory University*

K. Sathian
*Penn State College of Medicine - Hershey*

# Using the Implicit Association Test to Investigate the Strength of Synesthetic Associations

**Margaret Martinez[1], Nicole Steiner[2], Simon Lacey[4,5], Lynne C. Nygaard[3] & K. Sathian[4,5,6]**

Rowan School of Osteopathic Medicine[1], Rowan University, Stratford, NJ; Departments of Neurology[2] & Psychology[3], Emory University, Atlanta, GA; Departments of Neurology[4], Neural & Behavioral Sciences[5] & Psychology[6], Milton S. Hershey Medical Center, Penn State College of Medicine, Hershey, PA.

## Introduction

Synesthesia is a phenomenon in which experiences in one domain are associated with additional, involuntary experiences in another [1].

This study investigated grapheme-color synesthesia, in which a specific color is experienced when seeing a particular letter or number.

Synesthetic status is typically validated using the **Synesthesia Battery** (SB:[1]). However, this only tests the consistency of associations.

T**he Implicit Association Test** (IAT) measures the strength of associations between a pair of concepts [2]. The IAT has been used to test synesthetes' and non-synesthetes' sensitivity to crossmodal correspondences [3].

Here, we tested whether consistency and strength of associations are related using IAT tests specific to each synesthete's grapheme-color associations.

**HYPOTHESES**

**1:** Response times (RTs) should be faster when response key pairings are congruent compared to incongruent for synesthetes, whose synesthetic experiences will interfere on incongruent trials, but not non-synesthetes who lack these additional experiences.
**2:** The magnitude of this congruency effect should be larger in synesthetes than non-synesthetes.
**3:** To the extent that strong asssociations should also be consistent, IAT congruency magnitudes should be correlated with SB scores for synesthetes.

## Methods

36 people took part (6m, 30f; mean age 21 years, 2 months); 18 synesthetes and 18 age-and gender-matched controls. All procedures were approved by the Emory University Institutional Review Board.

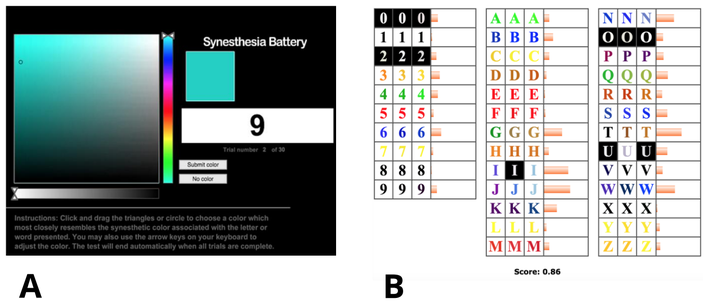



**Figure 1:** (A) Example of the SB color-picker task and (B) SB output and synesthesia score.

### Synesthesia Battery

Synesthetes pick the specific color they associate with a grapheme (A to Z and 0 to 9) three times in random order (Fig 1A) and also perform a speeded congruency test of these associations. For the IAT, we chose the two graphemes with the most consistent associations.

## Methods (cont.)

This results in a synesthesia score (Fig 1B): SB scores < 1 = synesthete, > 2 = non-synesthete, 1-2 = synesthetic status cannot be unambiguously determined.

### Implicit Association Test

Participants associated the grapheme-color pair with one of two response keys that could be either congruent or incongruent based on the synesthetes' associations chosen from the SB (Fig 2). Non-synesthetes were tested with the graphemes and colors of their matched synesthete.

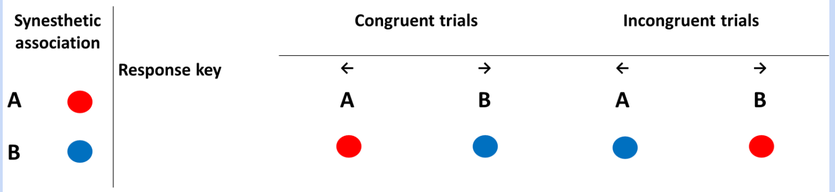



**Figure 2:** Example of grapheme-color associations (left) and the congruent-incongruent response key pairings for these on the IAT (right). On any one trial, participants only saw either a grapheme or a color and pressed the appropriate response key.

We calculated the magnitude of the congruency effect for RTs (Eq 1) excluding incorrect responses and RTs ± 3 standard deviations away from the mean.

**Equation 1:**

[(incongruent RT – congruent RT)/(incongruent RT + congruent RT)]

## RESULTS

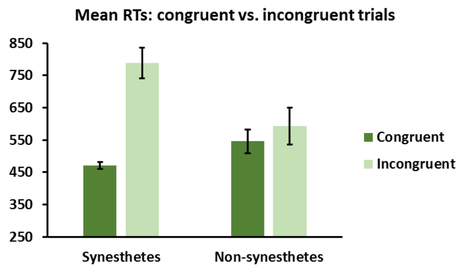



**Figure 3:** Synesthesia x trial type interaction ($F_{1,33}$ = 22.1, p < .001); synesthetes were faster on congruent, compared to incongruent, trials ($t_{16}$ = -7.1, p < .001) but there was no significant difference for non-synesthetes ($t_{16}$ = -7.1, p = .2).

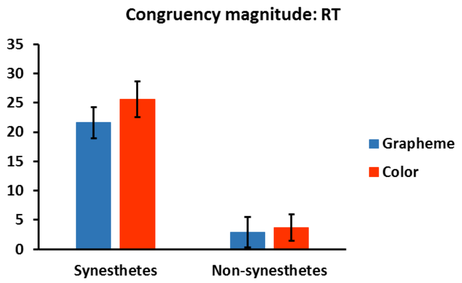
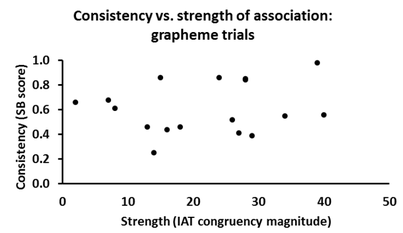



**Figure 4:** RT congruency magnitudes were larger for synesthetes than non-synesthetes ($F_{1,33}$ = 32.0, p < .001); but there was no interaction between synesthetic status and magnitudes for either graphemes or colors ($F_{1,33}$ = 2.0, p = .2).

## Results (cont.)



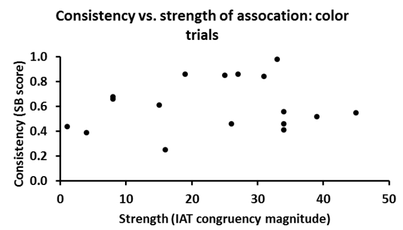




**Figure 5:** Consistency of synesthetic associations (SB scores) was uncorrelated with the strength of associations (IAT magnitudes) for either grapheme trials (top: r = .2, p = .5) or color trials (bottom: r = -.02, p = .9)

## DISCUSSION

Synesthetes had significantly larger RT congruency magnitudes than non-synesthetes when their grapheme-color associations were tested using the IAT.

Thus, the IAT may be an effective way of testing for synesthesia, especially since it is an 'in-person' test and could therefore be used to test for sub-types of synesthesia that cannot be tested online (for example, those involving taste or smell).

There was no correlation between the consistency and strength of synesthetic associations even though we chose the most consistent associations from the SB. This may indicate that these are separable aspects of synesthetic experience.

Thus, the strength of associations may be an effective way of testing synesthetic status where this cannot be unambiguously determined using the SB.

### References

**1.** Eagleman, D.M. et al. (2007). A standardized test battery for the study of synesthesia. J Neurosci Methods 159:139-145.
**2.** Parise, C.V. & Spence, C. (2012). Audiovisual crossmodal correspondences and sound symbolism: a study using the implicit association test. Exp Brain Res 220:319-333.
**3.** Lacey, S. et al. (2016). Synesthesia strengthens sound-symbolic cross-modal correspondences. Eur J Neurosci 44:2716-2721.

### Acknowledgements

Funded by NIH R01 EY025978 (KS) and a Emory University SIRE program Independent Research Grant (MM). I would like to thank Drs Sathian, Nygaard, and Lacey for their advice and mentorship.