**General Information**

* Humans are exposed to a learning history that transforms them into ‘symbolic beings’ (e.g., Hughes, De Houwer, & Barnes-Holmes, 2016).
* For these organisms any cue in the environment, proximal or distal, can serve as a ‘symbol’ or be imbued with symbolic meaning (e.g., De Houwer & Hughes, 2016). Thus the topographical barrier between words and regularities melts away. Pairings, actions, or frequency can all function as symbols or contextual cues.
* Any common feature shared by stimuli can function as a symbol indicating that those stimuli are equivalent/similar to one another, and as a result, a transfer of valence may take place from one stimulus to another.
* In most EC studies the common feature is *contiguity*: the CS and US are similar with regard to their spatio-temporal properties. However – *in principle* – any common feature may be enough for people to treat the stimuli as equivalent.
* We will explore this idea using *color* as a common feature. Within the same learning procedure, CSs and USs are presented in either same or different colors.

We assume that CSs and USs that share a common color will produce larger EC effects than those that are presented in different colors.

**Design of the Experiment**

**Between-subjects design:**

**Design**: 2 (*CS-US color matching:* CS1[CS2] matching positive[negative]USs vs. CS2[CS1] matching positive[negative]USs) between subject design. Method factors varied between participants:

* + - *Stimulus assignment*: CS1/CS2 identity assigned to same color as positive/negative words
    - *US identity*: set1 vs. set2 of positive and negative USs presented in CS1[CS2] trials.
    - *Order of measures*: IAT first vs. after self-reports
    - *IAT block order* (consistent vs. inconsistent with learning phase).
* EC 🡪 Evaluative measures 🡪 Exploratory Questions

- Stimulus:

Two nonsense words (MORAG and STRUAN) will serve as CS1 and CS2.

Six positive (Rainbow, pleasure, smile, love, paradise, joy) and six negative adjectives (war, cancer, hate, hell, misery, vomit), divided in four sets (two sets of positive words and two sets of negative words) will serve as USs.  
**Participants:**

Data-collection will be via the Prolific website (prolific.achttps://prolific.ac/). We will stop data-collection as soon as 110 participants have completed the experiment on the Prolific website. This will allow us to have good power (> 0.80) to observe an EC effect (*d* = 0.50) driven by US-CS color matching, at alpha = 0.05.

**Procedure:**

**EC training phase**: Participants receive three blocks of 16 trials (48 total) consisting of two different types of trials: one type of trials wherein CS1 is presented in the same color as positive words, and another trial in which CS2 is presented in the same color as negative words. Note that each trial will contain three stimuli simultaneously presented onscreen: a neutral word (MORAG or STRUAN) and a positive and negatively valenced adjective. All three stimuli will initially be presented in white. Then after 3000ms the CS will change to one color (e.g., blue). Depending on the CS present on that trial, one US will also turn that same color (e.g., blue) whereas the other will change to a different color (e.g., purple). The stimuli will remain onscreen for another 3000ms before all stimuli being removed, an inter-trial interval of 1250ms and the next trial. Stimuli color will varied across each trial, so that none of the colors can assume any specific positive or negative value. Four different colors (i.e., blue, green, yellow and purple) will be used.

*Same Color (CS1 trial) Same Color (CS2 trial)*

**JOY HELL**

**MORAG STRUAN**

**SMILE**

**CANCER**

*IAT.* Participants perform an IAT measuring implicit evaluations of CS1 vs. CS2:   
The IATs involve categories “CS1”[“CS3”] and “CS2” [“CS4”] and “Good” and “Bad”  
  
IAT Procedure:

a. Instructions: “In In the next part you will have to categorize items into groups as fast as you can.”

b. 20 practice trials sorting CS1 and positive words using one key.   
  
c. 20 practice trials sorting CS2 and positive words using one key.

d. 20 test trials CS1 and positive words using one key.

e. 40 test trials CS2 and positive words using one key.

f. 20 test trials CS1 and positive words using one key.

g. 40 test trials CS2 and positive words using one key.

NOTE: IAT stimuli are:

|  |  |
| --- | --- |
| CS1 |  |
| CS2 |  |
| Positive | /1 = "Fantastic"  /2 = "Great"  /3 = "Nice"  /4 = "Good"  /5 = "Pleasant"  /6 = "Wonderful"  /7 = "Amazing"  /8 = "Happy" |
| Negative | /1 = "Terrible"  /2 = "Disgusting"  /3 = "Nasty"  /4 = "Horrible"  /5 = "Sick"  /6 = "Awful"  /7 = "Sad"  /8 = "Unpleasant" |

*Explicit Attitude:* Participants give explicit ratings for the two CSs by answering the question:

*“Please rate the above item using the scale below*  
options: -5 =Negative, 5= Neutral, +5= Positive

options: -5 =I Dislike it, 5= Neutral, +5= I Like it

options: -5 =Bad, 5= Neutral, +5= Good

options: -5 =Unpleasant, 5= Neutral, +5= Pleasant

*Intention Ratings:* Participants are presented with two brand products labeled with either CS1 or CS2. They are asked to indicate which of these products they would try and given the following options: “I would try CS1, I would try CS2, I would try CS1 and CS2, I would try neither, I don’t know”.

Finally, participants answer the following questions about the EC task:

*Contiguity memory:* CS1, CS2, was presented onscreen and participants asked: “In the first part of the experiment (when words appeared initially in white and then switched their color) MORAG/STRUAN was always presented with two words. What was the meaning of those words?” ("Both words always had a positive meaning", " Both words always had a negative meaning", " One words always had a positive meaning and the other one a negative meaning" "I don’t remember")

*Color memory:* CS1, CS2, was presented onscreen and participants asked: “In the first part of the experiment (when words appeared initially in white and then switched their color) did MORAG/STRUAN switch to the same color as” ("The positive word that was also on the screen", "The negative word that was also on the screen", "I don’t remember")

*Manipulation check* to ensure that participants did not write down the contingencies during the learning phase: “Think back to the first part of the experiment (i.e., when three words were paired onscreen). Did you ever take notes (or write down) what happened in order to help you figure out what was going on? Please be honest here (you will receive payment regardless of what you say).”

*Demand Compliance (explicit):* Earlier you rated MORAG and STRUAN as being either positive, neutral, or negative. Did you base your ratings NOT on how you actually felt about those words but ONLY on what you thought the researchers wanted you to say?" ("Yes", "No", "I don’t know")

*Demand compliance (implicit).* Earlier you completed the Implicit Association Test (see below). Did you base your performance in that task NOT on your best efforts to perform the categorizations as quickly and accurately as possible but on your attempt to influence your speed or accuracy in order to go along with what you thought the researchers wanted you to feel about the words? ("Yes", "No", "I don’t know")

*Reactance. (Explicit).* Earlier you rated MORAG and STRUAN as being either positive, neutral, or negative. Did you consciously resist what you thought the researchers wanted you to feel about those words?" ("Yes", "No", "I don’t know")

*Reactance (implicit).* Earlier you completed the Implicit Association Test (see below). Did you try to influence your speed or accuracy in order to consciously resist what you thought the researchers wanted you to feel about those words" ("Yes", "No", "I don’t know")

*Hypothesis awareness*. During the first part of the study, did you notice that the color of MORAG and STRUAN switched to the same color as either positive or negative words? Please be honest here"

*Influence awareness*. Did this influence how you responded to question about your liking of MORAG and STRUAN? Please be honest here"

**Data preparation**

107 participants (59 females, *Mage =* 33.39*, SD =* 8.47) took part to the study on Prolific. We excluded data from one participants who did not complete the entire session. Moreover the data of participants who had IAT error rates for any of the IATs above 30% across the entire task, or above 40% for any one of the four critical blocks or for participants who complete more than 10% of IAT trials faster than 400 ms (*N* = 3) were excluded from the analyses. This led to a final sample of 103 participants.

**Results**

We first looked at the effect of CS-US color matching on implicit attitude change. We ran a one-way ANOVA and found a significant effect of color matching on the IAT score, *F*(1, 102) = 44.19, *p* < .001, η2partial **=** .30. Participants that saw CS1 appearing in the same color as positive words showed higher IAT score (revealing a preference for CS1 over CS2). We conducted the same analysis using the differential explicit score as dependent variable. As we did for the IAT score, also for explicit attitude higher scores indicated an explicit preference for CS1 over CS2. We found a main effect of CS-US color matching on explicit attitudes, *F*(1, 102) = 69.72, *p* < .001, η2partial **=** .41. Again, participants expressed higher preference for the CS that was presented in the same color as positive USs. Then, we checked whether the color matching manipulation also resulted in a significant effect on intentions towards the two CSs. We looked at the difference in the proportion of participants who intended to purchase CS1 and CS2 in the two conditions. The proportion of responses in favor of CS1 was higher when CS1 matched the color of the positive USs (.40) than when it matched the negative ones (.15, *z* = 2.88, *p* = 0.004). The opposite pattern emerged for the proportion of choices in favor of CS2 (.08 vs. .42, *z* = -3.86, *p* < 0.001).

*Color Matching memory*. A color memory score that ranged from 0 to 2 was calculated. A 0 score indicated that participants response was incorrect to both CS1 and CS2 color memory question (*N* = 23), 1 indicated at least a correct response (*N* = 6) and 2 indicated that both the questions were answered correctly (*N* = 74). We conducted a moderation analysis to see whether color memory score qualified the impact of our manipulation on implicit and explicit attitude change. We found that color memory moderated the impact of the manipulation on both implicit and explicit attitude change, *b* = .27, *p* < .001 and *b* = .34, *p* < .001. In both cases, the effect of the manipulation increased as a function of correct color memory.

*Contiguity awareness*. We found that 65% of participants (*N* = 67) responded correctly to the contiguity questions about CS1 and CS2 (i.e., “One word always had a positive meaning and the other one a negative meaning”). 23 participants had contiguity responses in which at least one of the two answers (CS1- and CS2-USs contiguity) indicated the opposite contiguity (e.g., “Both words always had a negative meaning” when the CS was matched with positive stimuli). Six participants did not remember at least one of the two contiguities. We noticed however that another type of incorrect contiguity response emerged for a considerable proportion of participants (23%): 24 participants remembered that both the CSs were paired with 2 US stimuli of the same valence (i.e., “Both words always had a negative meaning” for CS matched in color with negative stimuli; “Both words always had a positive meaning” for CS matched in color with positive stimuli), and 1 participant did so for one of the CS while they responded correct to the other one. Comparing the effect of the manipulation across participants with either correct contiguity or color-matching-driven contiguity memory resulted in a significant interaction only on explicit attitude change,  *F*(2, 100) = 8.91, *p* < .001, η2partial **=** .15, such that the effect was stronger for participants with color-matching-driven contingency. Therefore, participants memory concerning the valence of the two USs presented on screen was affected by the valence of the US that matched the color of the CS at issue. This might imply that, at least for some participants, color matching affect evaluative scores by influencing how stimuli-pairings are processed by the individuals.

*Hypothesis (color) and influence Awareness.* We looked at participants’ response to the color awareness question (i.e., During the first part of the study, did you notice that the color of MORAG and STRUAN switched to the same color as either positive or negative words?). We found that 28% of the participants did not notice this. We then re-ran the analyses considering hypothesis awareness as an additional factor in a 2x2 ANOVA. We found no significant interaction on implicit,  *F*(1, 101) < 1, *p* = .32, and a significant one on explicit, *F*(1, 101) = 9.36, *p* = .003, η2partial **=** .09. Among participants who did actually notice the switching in color, we found that 66% of them reported that the color switching influenced the way the evaluated the CSs, while for the remaining 34% it did not. Results confirmed that on those who explicitly indicated they have been influenced by the color switching (*N =* 49), the impact of our manipulation was stronger on both implicit, *F*(1, 48) = 40.46, *p* < .001, η2partial **=** .46, and explicit attitude change, *F*(1, 48) = 189.80, *p* < .001, η2partial **=** .80.

*Reactance.* We had 17% of reactant participants for the explicit measures and 19% for the IAT. The exclusion of reactant participants did not affect the magnitude of the effect on either implicit or explicit attitude change.