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Dramatically Larger Flanker Effects

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ABBREVIATED ABSTRACT

- The classic Flanker effect is highly replicable but relatively small and fragile (i.e., very sensitive to stimulus characteristics).
- **We hypothesized** that the reason for that is because subjects can settle into concentrating on the central location.

  We therefore predicted that if a switching component were added, requiring subjects to sometimes focus on the flankers and sometimes on the central stimulus, that **the flanker effect would be far larger and far more robust** (less sensitive to stimulus size or distance between stimuli).
- **Our prediction was resoundingly confirmed.** The Flanker effect was dramatically larger in the mixed-condition than in single-task blocks (in both cases comparing non-switch incongruent and congruent trials). It was also much less sensitive to variations in stimulus characteristics.

METHODS

All subjects received 3 kinds of trial blocks:

Inside-Only	Outside-Only	Both Trial Types Intermixed
10 practice trials before each		16 practice trials
70 trials per block		180 trials

Half the subjects received Inside-Only first.
Half the subjects received Outside-Only first.

Study 1 included one block of each type, the single-task blocks before the Mixed block.

Study 2 included single-task blocks of only Inside and only Outside trials both before and after the Mixed block (counterbalancing the order of the 2 single-task blocks).

In Study 1, the stimuli were larger & farther apart than in Study 2:

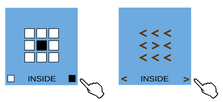
These are the stimulus parameters used in most Flanker experiments.

Half the subjects were tested with Iconic Stimuli: < > or ⬅ ➡
Rule: Press where the stimulus is pointing

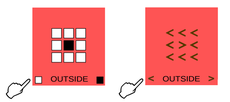
Half were tested with Symbolic Stimuli: e.g., △ ▲ or □ ■
Rules: For White, press Left. For Black, press Right.

All subjects in Study 2 and half the subjects in Study 1 were tested with a Separated Cue (the Background Color):

Rules: **If blue background,** focus on the **INSIDE** stimulus

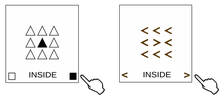


Rules: **If pink background,** focus on the **OUTSIDE** stimulus

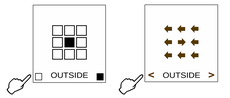


The other 50% of subjects in Study 1 were tested with an Integrated Cue (the Stimulus Shape):

Rules: **If images are,** △ **or** > focus on the **INSIDE** stimulus



Rules: **If images are,** ■ **or** ⇨ focus on the **OUTSIDE** stimulus

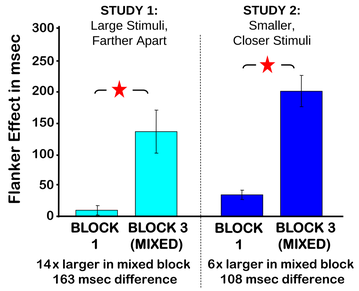


Study 1: 96 young adults Study 2: 32 young adults
Both studies: 50% female; mean age 22 years
50% Chinese Canadians; 50% European Canadians

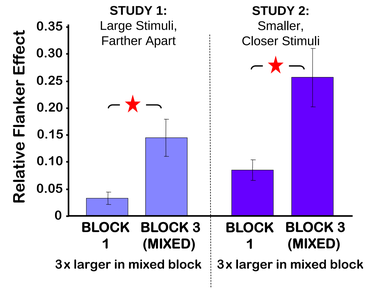
Main Result, 1:
FAR LARGER FLANKER EFFECT IN MIXED BLOCK

Block 1 (Standard Flanker) vs. Block 3 (Mixed Block) Inside Non-Switch Trials Only

RT Difference: Incongruent minus Congruent



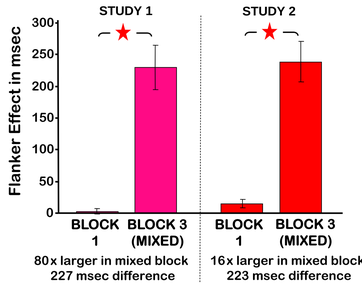
Relative RT difference: (I – C) / C



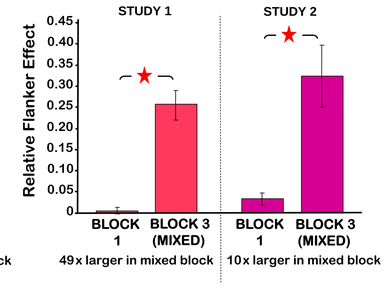
Both studies show a large increase in the Flanker effect between the standard Flanker condition (Block 1; focus on the Inside figure) and the Mixed-Task block (Block 3; on some trials focus on the Inside and on some trials focus on the Outside).
RT was longer on all trials in the Mixed Block, but as the right-hand figure shows, the Flanker effect is still much amplified in the Mixed Block when the effect is scaled to the baseline (Congruent) RT.

Block 1 vs. Block 3 (Mixed Block) Outside Non-Switch Trials Only

RT Difference: Incongruent minus Congruent

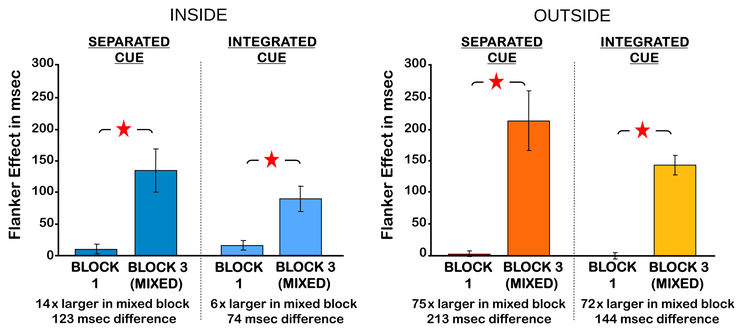


Relative RT difference: (I – C) / C



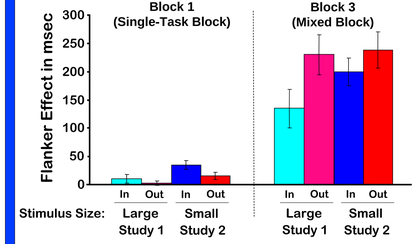
"Outside" Trials (ignore the center stimulus) also show a dramatic increase in the "Flanker" effect between the Single-Task block (focus only on the Outside stimuli) and the Mixed-Task block (on some trials focus on the Inside, on some trials focus on the Outside).This was true for both studies and for both the absolute "Flanker" effect and correcting for longer RTs in the Mixed Block (right-hand figure).

Flanker Effect in Block 1 vs. Block 3 (Mixed Block) Non-Switch Trials



Regardless of whether the cue indicating which rule to follow (focus on central figure or flankers) was part of the stimuli (their shape – the Integrated Cue condition) or external to the stimuli (the background color – the Separated Cue condition), the Flanker effect was much larger in the Mixed Block than in the Single Task Block. This was true for the standard flanker condition and for focus-on-the-flanker trials.

Summary for Main Result, 1: Block 1 vs. Block 3 Non-Switch Trials

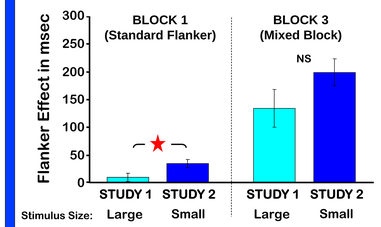


IN SUMMARY, regardless of
- **stimulus size or the distance between stimuli (Study 1 vs. Study 2),**
- **whether subjects had to focus on the Inside or the Outside on a given trial,**
- **whether the cue was Integrated with the stimuli or the color of the background, or**
- **whether the Flanker effect was calculated as Incongruent minus Congruent RT or the ratio of that to baseline (Congruent) RT,**

the Flanker effect was dramatically larger when subjects could not stay focused on just the inside or just the outside, but had to periodically switch the focus of their attention across trials.

Main Result, 2:
MORE ROBUST FLANKER EFFECT IN MIXED BLOCK
(Less sensitive to changes in stimulus size or dispersion)

Larger, Farther Apart Stimuli (Study 1) vs. Smaller, Closer Stimuli (Study 2) for Standard Flanker Blocks and Mixed Blocks (Inside Non-Switch Trials)

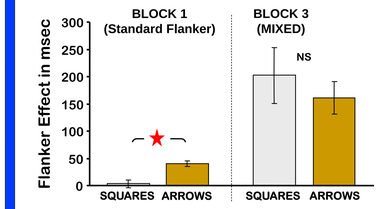


Consistent with past studies, we found a larger Flanker effect in the Standard Flanker task block (Block 1) when the stimuli were smaller and closer (Study 2) than when they were larger and farther apart (Study 1). The Flanker effect was far smaller with the larger stimuli.

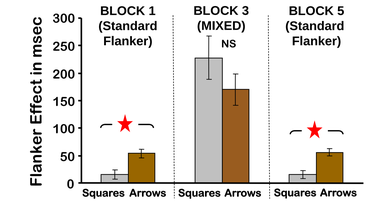
However, in the Mixed-task block, the Flanker effect was much less sensitive to the size or dispersion of the stimuli. There was no significant difference in the size of the Flanker effect in the Mixed block in Studies 1 or 2.

Squares vs. Arrows for Standard and Mixed Blocks Inside Non-Switch Trials

Studies 1 and 2 Combined



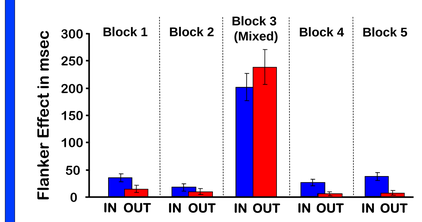
Smaller, Closer Stimuli (Study 2) Only



In the standard flanker condition, the type of stimulus used significantly affected the size of the Flanker effect. The Flanker effect was much larger for Iconic Stimuli (Arrows) than for Symbolic Stimuli (Squares). However, in the Mixed-task block, the Flanker effect was insensitive to stimulus type. There was no significant difference in the size of the Flanker effect in the Mixed block whether arrows or squares served as the stimuli.

NOT DUE TO PRACTICE EFFECTS

Flanker Effect by Block for Study 2 Non-Switch Trials Only

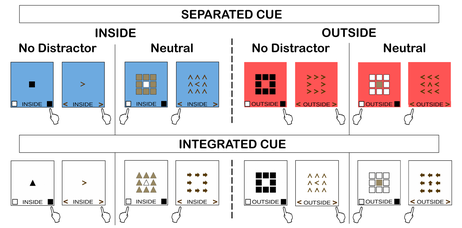


Early or late in the session, before or after the Mixed Block, the Flanker effect was far smaller when subjects did not have to change the focus of their attention, whether they were focusing on the center or on the outside.

The size of the flanker effect for inside-only or outside-only trials was similar in Blocks 1, 2, 4, and 5. This also indicates that the size of the Flanker effect was not affected by the preceding block of trials.

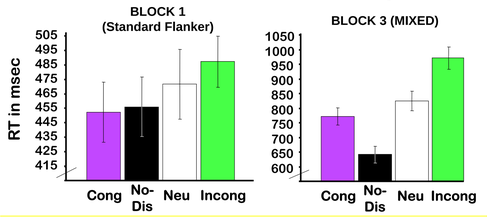
The much larger Flanker effect in the Mixed block cannot be explained by practice effects.

Besides congruent and incongruent trial types, there were also No-Distractor and Neutral trials:



Order of trial types was counterbalanced within blocks.
Percentage of each trial type was: 43% Incongruent, 29% Congruent, 14% Neutral, and 14% No-Distractor trials.

Mean RT for each Trial Type for Inside, Non-Switch Trials in Study 2



Congruent and No-Distractor trials were equally easy in the standard Flanker task, but No-Distractor trials were far easier in the Mixed condition.

CONCLUSIONS

MAIN FINDINGS:

- When observers were allowed to consistently focus on a specific area (either Inside-only or Outside-only), the Flanker effect was much smaller than when subjects did not know in advance whether the target would be in the center or the outside.
- The Flanker effect for Inside-only and Outside-only blocks was very susceptible to disruption by increasing the size and dispersion of the stimuli or by using stimuli less directly, automatically tied to the response.
- When observers had to randomly switch mindsets and the focus of their attention across trials (Mixed block), the Flanker effect increased *dramatically* in size and became significantly more robust and resistant to disruption due to changes in the physical
- The much larger Flanker effect in the Mixed block was true regardless of stimulus type (iconic or symbolic), stimulus size or spacing (large, farther apart or small, closer together), cue-type (an integrated aspect of the stimuli themselves or the color of the background), block order (whether preceded by a block where all trials had the other rule, intermixed rules, or no preceding block), whether early or late in a session, which rule was in effect (press where the central stimulus tells you, or press where the outer stimuli tell you), or how flanker effect was calculated (diffference in absolute RT or that difference as a fraction of baseline RT).
- The dramatically larger Flanker effect in the Mixed block cannot be attributed to practice effects or longer to RTs on all trials in the Mixed block.

OTHER FINDINGS:

- Gender and age had no significant effect on RT or the Flanker effect.
- Participants whose first language was Chinese showed larger Flanker effects than non-Chinese participants for trials in which the outer stimuli were the target.

This research was supported by an R01 grant from NIDA (#DA19685-16A2).