Visual Perception is Affected by Motor Experience: Evidence from Letter Recognition

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Motor sequences associated with objects through learning are activated upon perception of the object (Grezes & Decety, 2002;Harman, 1999; James, 2000; Tse, 2000; Tucker & Ellis, 2001;)

Mental rotation (Wohlschlager, 1998, Wexler, 1998)
Letter Perception (Bartolomeo, 2002;)
are affected by concurrent motor behaviour.

**Motor and perceptual systems can interact in various ways: Do they interact in letter perception?

Research Question:
Does our motor experience with letters (writing) affect visual perception ?

Can we study the effects of prior motor learning by looking at effects of concurrent motor behaviour (in a dual-task paradigm)?

Dual-task Paradigm:
Subjects drew letters or shapes while verbally identifying letters presented in noise

500 ms
250 ms
"H"

See letter in noise while Continuously drawing and Say letter on screen aloud
(Letters presented at various contrasts all around threshold)

Measure amount of interference (decrement in perception performance) due to drawing letters vs shapes that can differ in terms of feature similarity with seen items

The nature of the interference in this task can tell us how the motor and perceptual systems interact

Possible results:

Feature Dimension
Curvy / Straight

S m o C e
H A K NL

Letters   Shapes
Category dimension

S m C e
K NL
H

Letters   Shapes
Category dimension

S m o C
H A K NL

S O
H

Letters   Shapes

'Low'-level interaction:
Interference determined by feature overlap among stimuli. Stimuli are clustered based on perceptual similarity: Interaction is prior to category segregation

'High'-level interaction:
Interference determined by category similarity. Interaction is after segregation into a 'stream' of processing

OR

MULTI-LEVEL interaction:
Interference determined by feature overlap and by category. Interaction occurs both at a low and high level of processing. (Could also be a single space that separates the dimensions)

Experiment 1:

See: "curvy" – G D U and "straight" – H N K Letters
Draw: "curvy" letters: SC or "straight" letters: WY or
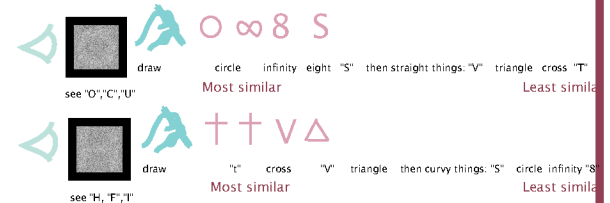
O O "curvy" shapes: ▢ ▮ or "straight" shapes:

Predictions:
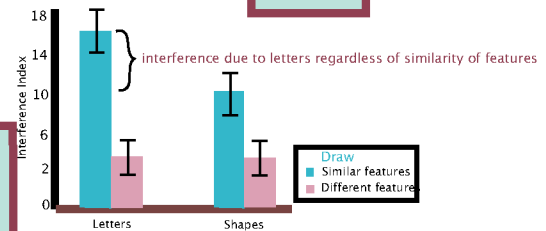–If low-level interaction, drawing anything straight should interfere with perception of straight letters more than curvy letters
–If high-level interaction drawing letters should interfere with letter perception more than drawing shapes.
–If multi-level interaction, letters interfere more than shapes AND items with similar features should interfere.

Results:

Interference Index
10
8
6
4
2

Draw
■ Similar features
■ Different features

Letters   Shapes
Draw

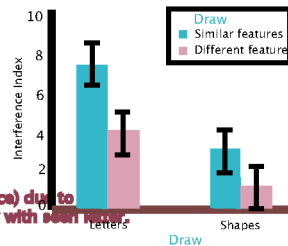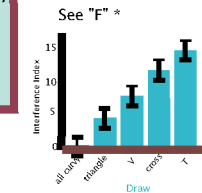Interference index=Naming accuracy without dual task(0)–accuracy during dual-task

Summary:
–Drawing letters worse than shapes overall
(high-level interference)
–Large effect of degree of similarity (low-level interference)

Similar category: interference
Similar features: interference

Interference at multiple levels of processing

Questions:
–Do letters interfere more because they are letters or because they share more features?

–need shapes that share features with letters.

Experiment 2:

See: "curvy" – C O U and "straight" – H F I Letters
Continuum of feature overlap among drawn and seen items:

draw   circle infinity eight "S" then straight things: "V" triangle cross "T"
see "O","C","U"   Most similar   Least similar

draw   "t" cross "V" triangle then curvy things: "S" circle infinity "8"
see "H","F","I"   Most similar   Least similar

Results

Interference Index
18
14
10
6
2
0

} interference due to letters regardless of similarity of features

Draw
■ Similar features
■ Different features

Letters   Shapes
Draw

See "F" *

Interference Index
15
10
5

all curvy triangle V cross T
Draw

–When same movement (cross & "t") more interference from letter
–not feature similarity alone
–more evidence for Multi-level interference

* results for other letters show a similar pattern of results

Results Summary:
–Drawing any stimulus that is similar in features (measured by amount of curvature) will interfere with perception.
–BUT drawing a similar letter will interfere the most!

Concurrent motor movement interferes with letter perception due to feature similarity, writing experience influences the degree of the interference

References:
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Grezes & Decety, (2002) Neuropsychologia, 40, 212–222
Harman et al, (1999) Current Biloogy, 9, 1315–1318
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