can only conclude that similar instruments are measuring different properties. This presents a quandary, employers would probably like to identify the top 40%, as indicated by a good degree in 1980, but cannot insist on a 1st, as there are not enough available. They are left relying on personal academic references to distinguish between 2.1 students, obviously far less reliable than the externally validated degree awarding process. This is also a major problem for graduates, since their achievements are undermined. It also militates against students with good degrees from less prestigious universities, often working class, as employers no longer take a student with a good degree form lesser universities, since such a high proportion form more prestigious universities have good degrees.

The satisfaction scores, in spite of their shortcomings, have a dramatic message about what universities are doing well, and what they are doing less well. Features that depend on a high staff student ratio, particularly assessment that is detailed, timely and contributes to student understanding got disappointingly low ratings. Features that can be delivered almost equally well to 300 or 30 students, particularly teaching explanations were highly rated. IT was also highly related, presumably the drop in PC prices has offset the increase in student numbers.

The discipline differences are also striking. In this supposedly materialistic age, the strong preference for more academic disciplines was perhaps unexpected. The superior performance and satisfaction in these disciplines may be due to students studying their preferred subject, as well as to their superior incoming achievement. Science, particularly physical science maintains a higher proportion of excellent degrees with a relatively lower proportion of good degrees, as compared with humanities and to a lesser extent social sciences.

The Thurstonian analyses of performance show interesting similarities across time and disciplines. If criteria had stayed constant, the observed shifts would be equivalent to an increase in IQ of 7 to 12 points. Since this is unlikely, it is probable that criteria have shifted. Interpreting such results and devising insightful evaluations remains a key research problem.

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READING HABITS FOR BOTH WORDS AND NUMBERS CONTRIBUTE TO THE SNARC EFFECT

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Abstract

This study compared the spatial representation of numbers in three groups of adults: Canadians who read both English words and Arabic numbers from left to right; Palestinians who read Arabic words and Arabic-Indic numbers from right to left; and Israelis who read Hebrew words from right to left but Arabic numbers from left to right. Canadians associated small numbers with left and large numbers with right space (the SNARC effect), Palestinians showed the reverse association, and Israelis had no reliable spatial association for numbers. These results suggest that reading habits for both words and numbers contribute to the spatial representation of numbers.

The spontaneous association between numbers and space has drawn much attention since its discovery (Dehaene et al., 1993). Around 200 published experiments have now shown that small magnitude values are associated with the left side and larger values with the right side of space (for a recent meta-analysis, see Wood et al., 2008). The association is typically found by comparing the speed of right and left hand responses in a parity classification task. This so-called “spatial-numerical association of response codes” (SNARC) effect has been interpreted as reflecting a “spill-over” of directional reading or writing habits. Just as readers in Western cultures progress through each line of text from left to right, they also seem to place small numbers further on the left side of a “mental number line” than larger numbers when they enumerate objects or think about magnitudes. Supporting this explanation of the SNARC effect as a generalized habitual association, the spatial association for numbers was weaker in Iranians who habitually read Arabic script from right to left but were only recently immersed into a left-to-right reading culture (Dehaene et al., 1993, Experiment 7). However, that study reported no data from Iranians in their native reading context, and thus no demonstration of the expected reversed association between numbers and space in right-to-left reading people.

A field study by Zebian (2005) tried to address this point. She reported that monoliterate Arabic readers were faster to name the side of the larger number in a pair when it was on the left compared to the right side of a display, suggesting a reversed association between numbers and space that would be consistent with their right-to-left reading habits. However, the verbal naming task is not sensitive to the SNARC effect (Keus & Schwarz, 2005) and this was evidenced by the absence of a normal effect in Zebian’s English control group. Together, these results cast doubt over whether a reversed SNARC effect was indeed present in Zebian’s (2005) study, or whether some other aspect of the task led to a spatial bias in these monoliterate Arabic readers.

Ito and Hatta (2004) reported a vertical SNARC effect (small numbers were associated with lower keys and larger numbers with upper keys) in Japanese readers. This association conflicts with the habitual top-to-bottom reading direction in Japanese and suggests that reading habit and SNARC effect might be independent. Recently, Hung et al. (2007) showed a horizontal mapping for Arabic number symbols, which their Chinese participants typically encountered in horizontally printed English text, and a vertical mapping for Chinese number symbols, which most often appeared in vertically printed Chinese text. Such flexibility in the association of numbers with space, in the same group of readers, and as a result of both the number format and the associated reading context, suggests that number concepts might not possess spatial associations in their own right. Instead it seems possible that separate spatial associations become activated from the number itself, and also from the associated reading context.

To test this possibility, we measured the SNARC effect with a parity task in three groups of participants with different combinations of spatial directional habits associated to the processing of words and numbers: Canadians who habitually read and write both English words and Arabic numbers from left to right; Israelis, who habitually read and write Hebrew words from right to left but Arabic numbers from left to right; and Palestinians who read and write both Arabic text and Arabic-Indic numbers (also called Eastern Arabic numerals) from right to left. We expected a normal left-to-right SNARC effect in Canadians, a reversed right-to-left SNARC effect in Palestinians, and a diluted SNARC effect in Israelis due to their inconsistent spatial associations for words and numbers.

Method

Participants. Twelve Canadians (7 female, 5 male, age 18-24 years, one left-handed), 16 Israelis (12 female, 4 male, age 19-23, three left-handed) and 11 Palestinians (2 female, 9 male, age 19-25 years, two left-handed), with normal or corrected vision, participated in a single 30-minute session. The Palestinian participants read Arabic only and use Arabic-Indic numerals (where both words and numbers are written from right to left) and reported minimal exposure to any left-to-right written language.

Stimuli and Design. Either Arabic digits 1, 2, 3, 4, 6, 7, 8, and 9 (for Canadians and Israelis) or the corresponding Arabic-Indic digits١ , ٢, ٣, ٤, ٦, ٧, ٨, and ٩ (for Palestinians) appeared in black Times New Roman font (size 30) at the center of the screen on a white background of a 17-in. (43 cm, 800 X 600 pixel resolution) monitor. Responses were made on a standard keyboard, with all keys covered except A (for left hand responses) and L (for right hand responses).

Procedure. Participants were tested individually in a dimly lit room, seated approximately 50 cm from the center of the screen. They were instructed that on each trial a number would appear and they would have to indicate with a fast key response whether it was odd or even. Each trial ended with the participant's response, and the next trial started after 1000ms. All 8 digits appeared randomly and equally often in each of two blocks with opposite response assignments (even-left key or even-right key), resulting in 160 trials in the Palestinian group and 128 trials in the Canadian and Israeli groups. Block order was counterbalanced across participants and there was a short practice phase before data collection.

Analysis. Correct reaction times (RTs) within 200 and 1500 ms (amounting to 97% of data) were averaged for each digit and each hand. Then the RT difference right minus left hand was calculated for each digit and regressed on digit magnitude to determine the strength and direction of the SNARC effect for each participant (cf. Fias & Fischer, 2005; see also Lorch & Myers, 1990). Negative slope coefficients reflect the typical Western association between numbers and space.

Results

The findings are reported in two main sections. The first section presents analyses based on regression analyses of individual participants, as indicated above. The second section is based on the overall data combined over participants.

Individual participant analyses

For Canadians, the average slope coefficient was -10.81 ms/unit (SD = 12.12, range = -27.03 to 0.05), indicating a significant SNARC effect, $t(11) = 3.09$, $p < .01$, with small numbers associated to left responses and large numbers to right responses. For Israelis, data from two participants were excluded because of an error rate > 30%. The average slope coefficient for the remaining 14 Israelis was 1.25 ms/unit (SD = 9.10, range = -8.22 to 14.08), reflecting the absence of a systematic association of numbers with space in this group, $t(13) = 0.66$, $p > .52$. Finally, for Palestinians, the average slope coefficient was 12.56 ms/unit (SD = 8.19, range = 4.43 to 31.9), showing a significant *reverse* SNARC effect, $t(10) = 5.09$, $p < .001$, with small numbers associated to right responses and large numbers to left responses. The slope difference of 12 ms/digit between Canadians and Israelis was significant, $t(24) = 3.15$, $p < .01$, as was the 11 ms difference between Israelis and Palestinians, $t(23) = 3.69$, $p < .01$.

Overall group analyses

As is evident from the plots in Figure 1, the slopes based on group means are -11.36, 1.29, and 12.56 for the Canadian, Israeli, and Palestinian participants respectively, and these converge nicely with those obtained from the means of individual participant regression analyses. A between-group analysis of variance (ANOVA) on the slope coefficients was highly significant, $F(2, 34) = 18.14$, $p < .001$, and Bonferroni-corrected post-hoc tests found all pairwise between-group contrasts to be reliable, $p < 02$. These results show that the SNARC effects changed with reading experience for words and numbers. This conclusion is well supported from the results of the more detailed ANOVAs for the experimental factors provided below.

A multiple regression analysis was performed to assess the contribution of number parity to performance, with magnitude coded as 1/small and 2/large, and parity coded as -.5/even and +.5/odd (cf. Andres et al., 2004). The contribution of parity was not significant in Canadians and Israelis, both $t < 1$, and only marginally reliable in Palestinians, $t(10) = 2.099$, $p = .062$.

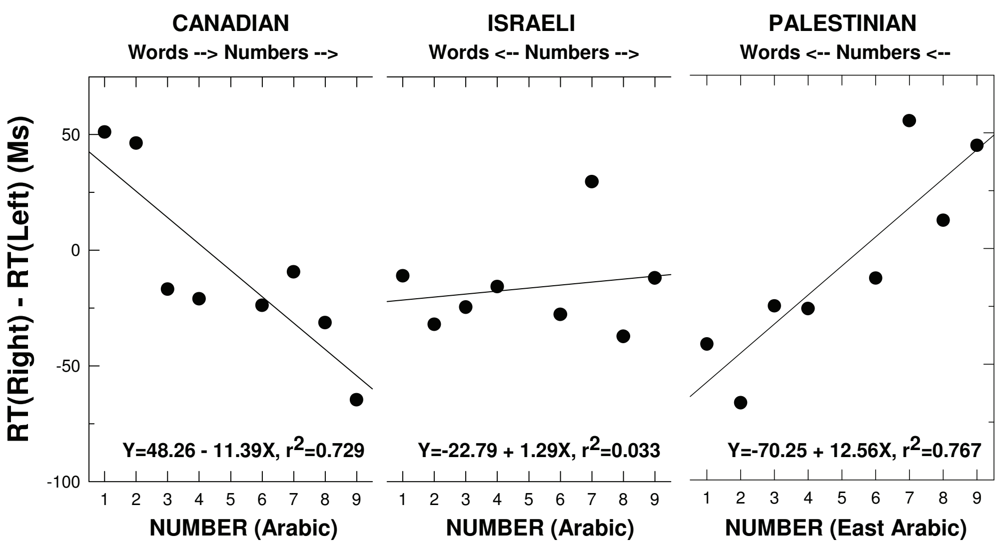

Figure 1. Mean SNARC effect (RT(Right) – RT(Left) in ms) as a function of digit presented in the parity task with Canadian, Israeli, and Palestinian participants. Direction of reading words and numbers for each group indicated by arrows.

Mixed-factors (ANOVA) evaluated effects of group (Canadian, Israeli, Palestinian), number magnitude (small: 1, 2, 3, 4; large: 6, 7, 8, 9), number parity (odd, even), and response key (left, right) on correct RTs and error percentages. Average RT was 610 ms (SE = 19 ms) with no between-group differences, $F(2, 34) = 0.95$, $p > .39$. Group means were 574 ms (SE = 32 ms), 629 ms (SE = 30 ms), and 626 ms (SE = 33 ms), for Canadians, Israelis and Palestinians, respectively. There was a main effect of parity, $F(1, 34) = 20.77$, $p < .001$, indicating an "odd effect" (see Hines, 1990; Nuerk, Iversen, & Willmes, 2004) with slower responses for odd than for even numbers (624 ms and 596 ms, respectively). The only other reliable effect was the predicted triple interaction between number magnitude, response key, and group, $F(2, 34) = 16.74$, $p < .001$. It reflected the fact that, under the SNARC-compatible mapping of numbers to keys (small – left, large – right) there was a reliable 24 ms RT benefit in Canadians, $t(11) = 2.79$, $p < .02$), a non-reliable 7 ms RT penalty in Israelis, $t(13) = 1.57$, $p > .14$, and a highly reliable 33 ms RT penalty in Palestinians, $t(10) = 6.41$, $p < .001$.

Average error rate was 5.3% (SE = 0.9%), with no between-group differences, $F < 1$. Error rates replicated the odd effect, with 6.5% errors for odd and 4.0% errors for even numbers, $F(1, 34) = 9.04$, $p < .01$. The triple interaction between digit magnitude, response key, and group was marginal in error rates, $F(2, 34) = 3.24$, $p = .051$, but consistent with the RT pattern: under the SNARC-compatible mapping of numbers to keys (small – left, large – right) there was a 1.2% benefit in Canadians, a 0.9% benefit in Israelis, and a 4% penalty in Palestinians, when compared to the reverse mapping.

Discussion

This study has two important results. First, by testing Palestinians in the standard parity task with Arabic-Indic digits, we demonstrated for the first time a clear association between small numbers and right space and between large numbers and left space. This observation constitutes a reversed SNARC effect when compared to the well-documented association pattern in Western cultures.

Secondly, we compared three groups of participants with different combinations of spatial directional habits associated to the processing of words and numbers. This revealed that the directional habits associated with *both* text and numbers contribute to the overall SNARC effect. Specifically, we showed that the SNARC effect is present when the reading directions for numbers and words are consistent (both from left to right: Canadian group; or both from right to left: Palestinian group) but it is absent when the two directions are inconsistent (words are read from right to left and numbers from left to right in the Israeli group). Of course, there are several other cultural differences between our groups, and among them might be some that affect the mapping of numbers onto space, such as finger counting preferences (e.g., Fischer, 2008), or general spatial heuristics that may be present before reading acquisition (e.g., Opfer & Thompson, 2006; Tversky et al., 1991).Our results support the hypothesis of a link between reading direction and SNARC effect, as was first inferred by Dehaene et al.(1993), but also suggest that, in addition, reading habits for numbers are an equally important factor. From this perspective, our use of the Arabic-Indic number stimuli was important in bringing about the reversed SNARC effect in Palestinians because this surface format probably activated the habitual right-to-left processing strategy associated with such numbers (see also Hung et al., 2007). This spatial-numerical association was consistent with the other long-term spatial association of these participants, resulting from their directional reading habits. We think that this consistency enables the association between numbers and space to become significant.

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REPRESENTATIONAL MOMENTUM AS A NEW GESTALT PRINCIPLE

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Abstract

Gestalt principles of perceptual grouping have been considered to reflect dynamic aspects of mental representation. Another phenomenon considered to reflect dynamic aspects of mental representation is representational momentum (when memory for a target is shifted in the direction of target motion), and similarities of consequences of Gestalt principles of perceptual grouping and consequences of representational momentum are discussed. These similarities involve (a) displacement in remembered location, (b) reflection of environmental regularities, (c) decreases in the amount of information to be processed, (d) bases in isomorphism, (e) contributions to aesthetics and artistic expression, (f) effects of context, (g) production of laboratory-based illusions, and (h) automaticity of application. It is concluded that representational momentum represents a new class of Gestalt principle.

Gestalt psychologists proposed several grouping principles that govern which elements in a sensory field would be grouped together. Although examples of these principles found in textbooks usually involve static figures (see Figure 1), these principles actually reflect dynamic processes. More recently, another phenomenon suggested to reflect dynamic processes, representational momentum, has been documented (for review, Hubbard, 2005). Representational momentum is a displacement in the direction of motion of the remembered location of a target (see Figure 2). Given that Gestalt grouping principles and representational momentum both result from dynamic processes, it is possible these phenomena are more similar than previously realized. It will be suggested here that consequences of Gestalt principles of perceptual grouping and consequences of representational momentum are highly similar, and that representational momentum reflects a new class of Gestalt principle.

Similarities of Representational Momentum and Gestalt Principles

Displacement in Remembered Location

Both representational momentum and Gestalt principles of perceptual grouping result in displacement in remembered location. Coren and Girgus (1980) examined "Gestalt Illusions," and an example is shown in Figure 3. The principle of proximity results in the vertical lines in the top row being grouped as four pairs and the vertical lines in the bottom row being grouped as three pairs. Two lines in each row are indicated by the arrows, and the two lines in the top row are the same distance apart as the two lines in the bottom row. However, the indicated lines in the top row are parts of different pairs, and the indicated lines in the bottom row are parts of the same pair. When participants reproduced the distance between the lines, the reproduced distance for the lines in the top row was larger than the reproduced distance for the lines in the bottom row. Remembered location was biased so that the distance for lines grouped together was decreased relative to the distance for lines in different groups. Coren and Girgus also provided examples of similar illusions based on closure, good continuation,