

Response Inhibition and Visuospatial Ability among Manga Reading and Non Manga Reading Population

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ABSTRACT

The present study was a quantitative comparative research design. The aim of the present study was to examine the influence of manga reading on the level of response inhibition and visual spatial ability among manga readers by comparing the difference among manga reading population and non-manga reading population. Data was collected from Manga readers and Non-Manga readers living in India within the age group of 15 to 25 years. Judgment (purposive) sampling technique was used for the study. A sample of 30 Manga readers consisting of 15 males and 15 females and 30 non manga readers, consisting of 15 males and 15 females were taken for the study. The tools used for the study were the stroop task and mental rotation task on psytoolkit. After the data was collected it was analysed IBM SPSS. Descriptive statistics, Inferential statistics, Independent Samples T-Test was used to analyse the data. The results show that there is no significant difference between the visuospatial ability between the manga reading population and the non-manga reading population. The study reveals that there is a significant difference between the processing speed or response inhibition ability between the manga reading population and the non-manga reading population. When it comes to gender differences, it was observed in the study that there are no significant differences observed among the males and females of manga reading population and non-manga reading population for both, levels of response inhibition and visuospatial ability.

Keywords: Response inhibition, visuospatial ability, Manga reader

INTRODUCTION

Manga is a Japanese comic that has a multimodal medium of expression, giving you the cinematic expression through a multimodal perception. It not only consists of linguistic elements, (text) but the visual and spatial elements which is essential in the perception of movement in reading manga and the sound elements with the help of onomatopoeia (the formation of a word from a sound associated with what is named, e.g. sizzle, swoosh) are important factors influencing the manga reading experience. Another unique characteristic of Manga is that it is read from right to left. Even when translated to English, manga retain its original Japanese script's direction to give a more authentic experience.

Many people are aware of the popularity of graphic novels and manga in the Western world. This appreciation for alternative culture has spread to South Asia, particularly in India. Young Indians have been choosing to read both in recent years, exploring their varied genres and characters. While graphic novels and manga were once considered strange to read, India now embraces them. According to reports, 83% Indians prefer anime/manga over other animated content. It started with the entry of anime in Indian media. ("Manga Comics: The Latest Obsession of City's Youth," 2015). According to global statistics, India is second, after China, in the list of countries where anime is enjoyed the most. On an average, 73 per cent of Indians watched anime in 2021 (Research by Epic Dope, an anime-related website)

Social media expert Desmond Fernandez (2015) told Times of India: "Manga illustrations are very different from usual comics. The characters are detailed, and there is a lot more drama. It gives you a cinematic experience. It's not like the usual superhero comics you read, and it has a distinct appeal." ("Manga Comics: The Latest Obsession of City's Youth," 2015)

There are many studies and evidence supporting the fact that one's dominant language, of which we have years of reading experience, creates a direction bias within us, left-to-right bias or a right-to-left bias. The debate on biologically determined directionality and culturally acquired directionality has been going on for quite some time.

In a research conducted on the influence of a left-to-right bias in the reading direction on inhibition of return, Spalek and Hammad (2005) found differences between Canadian and Egyptian students on the inhibition of return measure of attention. Inhibition of return suggests that when searching for a target, an attentional mechanism biased to novel locations causes slower (inhibited) visual searches to locations that have already been examined. Left-to-right reading Canadians had a larger left to right inhibition of return effect, while a larger inhibition of return effect for right to left movement was observed among the Egyptian group. The findings replicated the left-to-right bias with an English sample, but showed the opposite bias in an Arabic sample, who read text from right to left. Thus, the regularity of shifting attention in a particular way during text reading seems to be the cause of the bias observed.

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In a research by Jordan et al., (2013) In English and other alphabetic languages read from left to right, useful information acquired during each fixational pause is generally reported to extend much further to the right than to the left of each fixation. However, empirical research has paid little attention to the asymmetry of the perceptual span for alphabetic languages read in the opposite direction (i.e., from right to left). As a result, this study used a gaze-contingent window paradigm to investigate the perceptual span for Arabic, which is one of the world's most widely read languages and is read from right to left. Skilled Arabic readers who were bilingual in Arabic and English read Arabic and English sentences while a window of normal text extended symmetrically 0.5o to the left and right of fixation or asymmetrically by increasing this window to 1.5o or 2.5o to the left or right of fixation. When reading in English, performance across window conditions was superior when windows extended to the right. When Arabic was read, however, performance was superior when windows were extended leftward, which was essentially the opposite of what was observed for English. The findings showed for the first time that a leftward asymmetry in the central perceptual span occurs when Arabic is read and provided a new indication that the perceptual span for alphabetic languages is modified by the direction of reading.

These findings imply that the asymmetry is caused by a bias that arises from the direction of text reading rather than an innate bias resulting from some form of hemisphere specialization in the attentional system. These studies establish that our reading experience produces a direction bias that influences our processing of information.

Therefore, as individuals who have an established left-to-right bias after years of reading in that direction, when they engage in reading manga, which is read from right-to-left, their initial tendency to read in the opposite direction needs to be inhibited.

Response inhibition refers to the suppression of actions that are inappropriate in a given context and that interfere with goal-driven behavior. It occurs when an individual cancels a prepared motor response due to a change in goals. Hence, we see response inhibition happening in an individual reading manga, as they suppress the action of reading from left to right to achieve a new goal i.e., reading manga and engage in an opposing goal driven behaviour, which is reading from right to left.

Visuospatial ability is a person's capacity to identify visual and spatial relationships among objects. The multimodality of Japanese manga, engages the reader's visuospatial ability for comprehension of the text for the perception of space, movement/motion etc.,

repetitive reading of manga would be involving the neurocognitive functions for visuospatial ability repeatedly which in turn might increase or strengthen those neurocognitive capacities, improving one's visuospatial ability.

According to research (Mayer et al., 1996; Moreno & Mayer, 1999), the spatial contiguity effect, which occurs when text and image are combined, can improve understanding. When the text is positioned close to the area of the image being described rather than below the image, the spatial contiguity effect is stronger. (e.g., Moreno & Mayer, 1999).

Text and images are combined in comic books in a number of different ways. Text is a useful represent comments from the narrator. Although it resembles a caption, narration is frequently included in the comic image itself rather than beneath it. A character's words and unsaid thoughts are expressed in text that appears in word and thought bubbles. Spatial contiguity in comics helps in better integration of information simultaneously with text and images which help in better spatial cognition in order to perceive the movement in relation to space of the context in the story.

METHOD

The aim of the study was to examine the influence of manga reading on the level of response inhibition and visual spatial ability among manga readers by comparing the difference among the manga reading population and the non-manga reading population and also see if there are any gender differences in the level of response inhibition and visuospatial ability among these two groups. Data was collected from Manga readers (who have been reading manga for at least 2 years) and non-Manga readers (who do not engage in reading in a language that follows a script that has a right to left direction (e.g., Arabic, Sindhi, Kashmiri etc.)) living in India within the age group of 15 to 25 years. Judgment (purposive) sampling technique was used for the study. A sample of 30 Manga readers consisting of 15 males and 15 females and 30 non manga readers, consisting of 15 makes and 15 females were taken for the study. The hypotheses of the study were:

Ho1: There is no significant difference between the processing speed or response

Inhibition ability between the manga reading population and the non-manga reading population.

Ho2: There is no significant difference between the visuospatial ability between the manga reading population and the non-manga reading population.

Ho3: There is no significant difference between the response inhibition ability or processing speed in males

and females among individuals who have been reading manga for at least 2 years.

Ho4: There is no significant difference between the response inhibition ability or processing speed in males and females among individuals who do not read manga.

Ho5: There is no significant difference between the visuospatial ability in males and females among individuals who have been reading manga for at least 2 years.

Ho6: There is no significant difference between the visuospatial ability in males and females among individuals who do not read manga.

The tools used for the study were the stroop task and mental rotation task on psytoolkit. The Stroop test is a neuropsychological test extensively used to assess the ability to inhibit cognitive interference that occurs when the processing of a specific stimulus feature impedes the simultaneous processing of a second stimulus attribute, well-known as the Stroop Effect. Stroop effect in Psytoolkit (measures the participant’s processing speed, response inhibition, selective attention capacity and skills) There were least 40 trials, 20 in which the font colours and word names are different, and 20 in which the font colours and colour names match (e.g., the word "RED" in red font colour. Basu (2022) examined the validity and reliability and there was a positive correlation between the interference scores of manual and computerized versions of the Stroop Test ($r(11) = .65, = .014$). The computerized Stroop Test was also highly reliable (90 items; $\alpha = 0.74$) Mental Rotation in Psytoolkit (measures the visuospatial ability, the ability to mentally manipulate images). There are a minimum of 15 trials. One will need to find out which two object match each other. You can only do that if you mentally rotate the objects and see which ones match. In this version of the task, the stimuli are 2 dimensional, or 2D.) Once a response is selected, they will receive feedback on whether their response is correct or if they missed the trial due to exceeding the time limit. The first 5 trials are for training.

After the data was collected it was coded MS Excel and then analysed IBM SPSS. Descriptive statistics, Inferential statistics, Independent Samples T-Test was used to analyse the data.

RESULTS

The data obtained from the sample of 60 individuals out of which 30 were manga readers, consisting of 15 males and 15 females of the age group 15 to 25 years was analysed quantitatively using mean and standard deviation.

Table 1. Mean and standard deviation for Visuospatial Ability

Visuospatial ability	Manga reader	N	Mean	Std. Deviation
Mental rotation	Manga reader	30	3852.1236	2088.3704
average reaction time	Non Manga reader	30	4321.1636	2563.1816

Table 01 depicts the Visuospatial Ability of individuals by examining the average reaction time taken on mental rotation task on the basis of whether the participant is a manga reader or non-manga reader, the data was collected from a sample of 60 consisting of 30 Manga readers and 30 non manga readers. The mean value for Visuospatial Ability for manga readers was 3852.1236 and the standard deviation was 2088.3704 and for non-manga readers the mean value was 4321.1636 and standard deviation, 2563.1816, this shows that there was no much difference in the Visuospatial Ability among manga readers and non-manga readers however, it was seen that non manga readers had better average reaction time in contrast to that of manga readers showing that they might have better Visuospatial Ability in comparison.

Table 02 depicts the Response Inhibition ability of individuals by examining the average reaction time taken on the stroop effect task on the basis of whether the participant is a manga reader or non-manga reader, the data was collected from a sample of 60 consisting of 30 Manga readers and 30 non manga readers. The mean value for Response Inhibition for manga readers was 971.7022 and the standard deviation was 290.0899 and for non-manga readers the mean value was 1333.0606 and standard deviation, 280.6269, it was observed that manga readers had better average reaction time in contrast to that of non-manga readers in the stroop task, showing that reading Manga has made them better at response inhibition.

Table 2: Mean and standard deviation for Response Inhibition

Response Inhibition	Manga reader	N	Mean	Std. Deviation
Stroop average reaction time	Manga reader	30	971.7022	290.0899
	Non Manga reader	30	1333.0606	280.6269

Independent sample t-test was used to analyse if there is significant difference in the visuospatial ability and response inhibition among manga readers and non-manga readers and whether the differences are observed among males and females in these two groups. Table 03 shows that an independent sample t test was conducted to compare the response inhibition in manga reading population and non-manga reading population by analysing their performance on the Stroop task.

The null hypothesis, Ho1, stating that there is no significant difference between the processing speed or response inhibition ability between the manga reading population and the non-manga reading population, was rejected as there is a significant difference in the response inhibition of manga reading population (Stroop average reaction time, M= 971.7023, SD =

290.0899) and non-manga reading population (M = 1333.061, SD = 280.6269) ; t(58) = - 4.904 and p = 0.001 (p<0.05).

Table 03 also shows that an independent sample t test was conducted to compare the visuospatial ability in manga reading population and non-manga reading population by analysing their performance on the mental rotation task.

Table 3: t, df and p value on scores of mental rotation task and Stroop task for manga readers and non-manga readers

Logical Parameter	Manga Reader		Non-Manga reader		T(58)	P
	M	SD	M	SD		
Stroop average reaction time	971.7023	290.0899	1333.061	280.6269	-4.904	.001
Mental Rotation average reaction time	3852.124	2088.370	4321.164	2563.182	-.777	.440
Stroop number of correct	38.63	1.810	36.47	2.897	3.474	.001
Stroop number of wrong	1.00	1.486	1.70	1.579	-1.769	.082
Mental rotation number of correct	7.43	1.612	7.20	1.584	.565	.574
Mental Rotation number of wrong	2.53	1.634	2.67	1.668	-.313	.756

The null hypothesis, Ho2, stating that there is no significant difference between the visuospatial ability between the manga reading population and the non-manga reading population, was accepted as there is no significant difference between the visuospatial ability of manga reading population (stroop average reaction time, M= 3852.124, SD = 2088.370) and non-manga reading population (M = 4321.164, SD = 2563.182) ; t(58) = - .777 and p =.440 (p<0.05).

Table 04 shows that an independent sample t test was conducted to compare the gender differences in the response inhibition and visuospatial ability among the males and females in manga reading population by analysing their performance on the stroop task and mental rotation task.

For response inhibition, the null hypothesis H03, stating that "there is no significant difference between the response inhibition ability in males and females among individuals who have been reading manga for at least 2 years", was accepted as there is no significant difference in the level of response inhibition among the males (stroop task average reaction time, M= 1046.895, SD = 356.1187) and females of manga reading population (M = 896.5100, SD = 188.0937); t(28) = - 1.446 and p = 0.159. (p>0.05)

Table 4: t, df and p value on scores of mental rotation task and stroop task for males and females among manga readers

Logical Parameter	Male		Female		T(28)
	M	SD	M	SD	
Stroop average reaction time	1046.895	356.1187	896.5100	188.0937	1.446
Mental Rotation average reaction time	3463.873	1743.125	4240.375	2381.724	-1.019
Stroop number of correct	38.67	2.024	38.60	1.639	.099
Stroop number of wrong	.87	1.356	1.13	1.642	-.485
Mental rotation number of correct	7.53	1.885	7.33	1.345	.335
Mental Rotation number of wrong	2.47	1.885	2.60	1.404	-.220

For visuospatial ability, the null hypothesis H05, stating that "There is no significant difference between the visuospatial ability in males and females among individuals who have been reading manga for at least 2 years", was accepted as there is no significant difference in the level of visuospatial ability among the males (mental rotation task average reaction time, M= 3463.873, SD = 1743.125) and females of manga reading population (M = 4240.375, SD = 2381.724); t(28) = -1.019 and p = 0.317 (p>0.05)

Table 5: t, df and p value on scores of mental rotation task and stroop task for males and females among non-manga readers

Logical Parameter	Male		Female		t
	M	SD	M	SD	
Stroop average reaction time	1345.617	285.8375	1320.505	284.7581	.241
Mental Rotation average reaction time	4038.182	1819.349	4604.145	3182.366	-.598
Stroop number of correct	35.73	3.390	37.20	2.178	-1.410
Stroop number of wrong	1.87	1.642	1.53	1.552	.571
Mental rotation number of correct	7.00	1.732	7.40	1.454	-.685
Mental Rotation number of wrong	3.00	1.732	2.33	1.589	1.099

Table 05 shows that an independent sample t test was conducted to compare the gender differences in the response inhibition and visuospatial ability among the males and females in non-manga reading population by analysing their performance on the stroop task and mental rotation task.

For response inhibition, the null hypothesis H04, stating that "There is no significant difference between the response inhibition ability in males and females among individuals who do not read manga.", was accepted as there is no significant difference in the level of response inhibition among the males (stroop task average reaction time, M= 1345.617, SD = 285.8375) and females of non-manga reading population (M = 1320.505, SD = 284.7581); t(28) = .241 and p = .811. (p>0.05)

For visuospatial ability, the null hypothesis H06, stating that "There is no significant difference between the visuospatial ability in males and females among individuals who do not read manga", was accepted as there is no significant difference in the level of visuospatial ability among the males (mental rotation task average reaction time, $M = 3463.873$, $SD = 1743.125$) and females of manga reading population ($M = 4038.182$, $SD = 1819.349$); $t(28) = -.598$ and $p = 0.555$ ($p > 0.05$)

DISCUSSION

It has been established through various pieces of evidence from different studies, throughout this paper, that every individual has an established direction bias which influences our asymmetry in central perceptual scan, scanning behaviour, drawing tendencies, and most importantly reading behaviour. Harsel and Wales (1987) found that when the stimuli were organized in a way that was compatible with the direction that people in the culture read printed text, people performed better on an inductive reasoning test. Thus, there is growing evidence that when attention begins on the side of the display where text would originate and progresses in a direction congruent with text reading and writing, performance is observed to be improved across a range of tasks. These findings imply that the asymmetry is caused by a bias that arises from the direction of text reading rather than an innate bias resulting from some form of hemisphere specialization in the attentional system.

Several such studies establish that our reading experience produces a direction bias that influences our processing of information. Therefore, as individuals who have an established left-to-right bias after years of reading in that direction, when they engage in reading a text in a new direction like manga, which is read from right-to-left, their initial tendency to read in the opposite direction needs to be inhibited, thus comes the role of the individual's capacity for response inhibition.

The current study tried to see if the continuous practice of reading manga, for a minimum period of 2 years, has an effect on their overall response inhibition ability. In accordance to the prediction of the study, people who engaged in reading manga would perform better in the response inhibition task (i.e., have better average reaction time in the stroop task). And the results showed a significant difference between people who read manga and those who don't in their levels of response inhibition.

Manga, a visual medium that frequently features rapid action and intricate narratives, may have a comparable impact on response inhibition. Additionally, reading manga demands a lot of concentration and focus in order to follow the plot and understand the illustrations,

which may also help to boost cognitive function along with cognitive demands of engaging in an inhibitory reading direction.

Response inhibition is an integral component in reading comprehension, individuals require their executive functions to be focused, pay attention, and self-regulate their behaviour while they read since reading is not instinctive, at least during the early stages of its learning. Therefore, inhibition may play a role in the reading process, among other executive processes (Christopher et al., 2012), specifically to prevent guessing mistakes (i.e., substituting a word with its orthographic neighbour).

The current study also examined the effects of reading a multimedia text like manga on the visuospatial ability of its readers, the assumption was that individual who read manga that required more visuospatial perception in the comprehension of the myriad narratives would result in a better visuospatial ability. However, the results showed no significant difference between individuals who engaged in regular reading of manga and those who don't read manga.

The ability to cognitively manipulate and comprehend spatial connections and visual information is known as visual-spatial ability. While it is often held that engaging in activities like reading manga or other graphic novels may help one's visuospatial abilities, this might not necessarily be the case for everyone which could be a contributing factor to the results. First off, the substance and visual intricacy of manga may differ greatly. Some manga could be quite plain, with few subtle visual features or spatial relationships. In these scenarios, the amount of mental effort and spatial processing necessary to comprehend the narrative might not be sufficient to improve visuospatial ability. Second, while reading manga may include some spatial processing, it may not be the same kind of spatial processing needed for tasks like figuring out riddles or traversing a three-dimensional space. Thus, rather than reading manga, engaging in these other activities may be more beneficial at enhancing visuospatial ability.

Finally, it's crucial to bear in mind that a variety of other factors, including genetics, age, and past experience with spatial activities, can also have an impact on visuospatial ability. As a result, even if a person engages in activities that are known to improve visuospatial ability, like reading manga, they might not necessarily notice a large improvement if these other circumstances are not in their favour. In conclusion, reading manga could require some visuospatial processing, but it's not a certain strategy to sharpen that skill. This skill may be improved further by undertaking tasks that require more intricate spatial connections, such as puzzle-solving or 3D environment navigation.

CONCLUSION

The aim of the current study was to study the influence of manga reading on the level of response inhibition and visual spatial ability among manga readers by comparing the difference among the manga reading population and the non-manga reading population.

The findings of the current study observe that there is a significant difference in the response inhibition of manga reading population and non-manga reading population, rejecting the null hypothesis and indicating that reading manga along with other contributing factors, does have an influence on the level of response inhibition of an individual. With regard to visuospatial ability, the finding showed that there is no significant difference between the visuospatial ability between the manga reading population and the non-manga reading population, and the null hypothesis was accepted. There are almost no prior studies examining the effect of manga reading in an individual's response inhibition and visuospatial ability, and further, more comprehensive studies are required for more conclusive evidence regarding the same.

Effective inhibitory mechanisms have been shown to be related to reading comprehension along with a number of other factors, including the knowledge one has of the material read, the capacity to monitor one's understanding of text and adjust reading strategies (Cornoldi & Oakhill, 1996), and working memory (Cain, 2006; Carretti et al., 2009; Cornoldi, De Beni, & Pazzaglia, 1996). These studies provide a significant implication on the importance of response inhibition in better reading comprehension. And a positive implication for the possibility of improving response inhibition by the use of reading manga as a form of fun intervention which is also on par with the increasing trend and prevalence of manga as a leisure activity among teens in India. Manga reading being a rising trend among the youth today and a less explored research area, more studies are required for further understanding regarding the different aspects and effects of manga reading. The possibility indicative of the findings from the current study can be a window for future studies to learn more about the same.

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