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RESEARCH ARTICLE

More Than Meets the Eye: Inattentional Blindness

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Abstract

Background: The phenomenon of inattentional blindness has been discussed for years, in relation to everyday life and clinical practice. Inattentional blindness refers to the common failure to notice plainly visible items when attention is otherwise preoccupied. The purpose of this study was to assess any potential difference in inattentional blindness between chiropractic students on assessing plain film radiograph, and any difference compared to expert radiologist.

Method: The subjects were invited to join if above 18 years of age, enrolled on the MChiro course (USW) and familiar with Pelvic plain film radiographs. Ethical approval was obtained by Research module ethics review panel and written consent was obtained on entering the assessment room. The subjects were shown 20 plain film radiographs and asked to state all findings. A gorilla figure was placed in three of the images, with 50, 75, and 100% density. Cross-tabulation was used to compare the groups.

Results: 51 subjects participated, age range 19-36 (mean = 23, 53, SD = 3.79), 29 females and 22 males. Group 1 consisted of 25 2nd year students, and group 2 was 26 4th (final) year student. Of the final year students 35% saw the gorilla at 75- and 100% density, whereas only 4% of the second-year student noted the figure. There seemed to be no significant correlation between those already familiar with the Drew, et al. study.

Conclusion: It was clear that level of education had little effect on level of inattentional blindness, though a slight difference was noted. Further research is needed to explore ways of minimizing the occurrence of inattentional blindness.

Keywords

Inattentional blindness, Chiropractic, Plain film, Radiography, X-ray

Background

The phenomenon of inattentional blindness (IB) involves the relationship between attention and visual perception, were looking without seeing often occur in moments of intense concentration or when attention is otherwise preoccupied [1,2].

Studies have assessed IB in clinical settings in relation to image modalities and found that if an object appeared on the screen in a more similar luminance to the attended object, with a lack of similarity, the more likely the observers were to notice it [3]. This finding seems reassuring as similar luminance often occurs in medical images [4]. However, some radiological findings may look similar and can equally be missed, even though the luminance or density might be more optimal.

There have been suggested three different categories where objects are easily overlooked [4]. Firstly, search error can occur when a lesion is overlooked within the useful visual field and thereby not reported. Secondly, recognition error can occur when a lesion is noted, but vision is not held long enough to recognize the ambiguity. Thirdly, decision error can occur when a lesion has been noted but actively dismissed or not consciously recognised. The incidence of overlooked findings is found across different image modalities and settings; thus, the importance goes across all professions that utilizes imaging [4].

A recent study invited 24 radiologists to perform a familiar lung nodule detection task, where a gorilla, 48 times larger than the average nodule, was inserted in the last CT case [5]. The results showed that 83% of the expert radiologist failed to report the inserted gorilla. They stated that the reason for the difference might be that the attentional capacity in the radiologists was less occupied by the primary task [5]. A replication of the first experiment compared naïve observers with no medical

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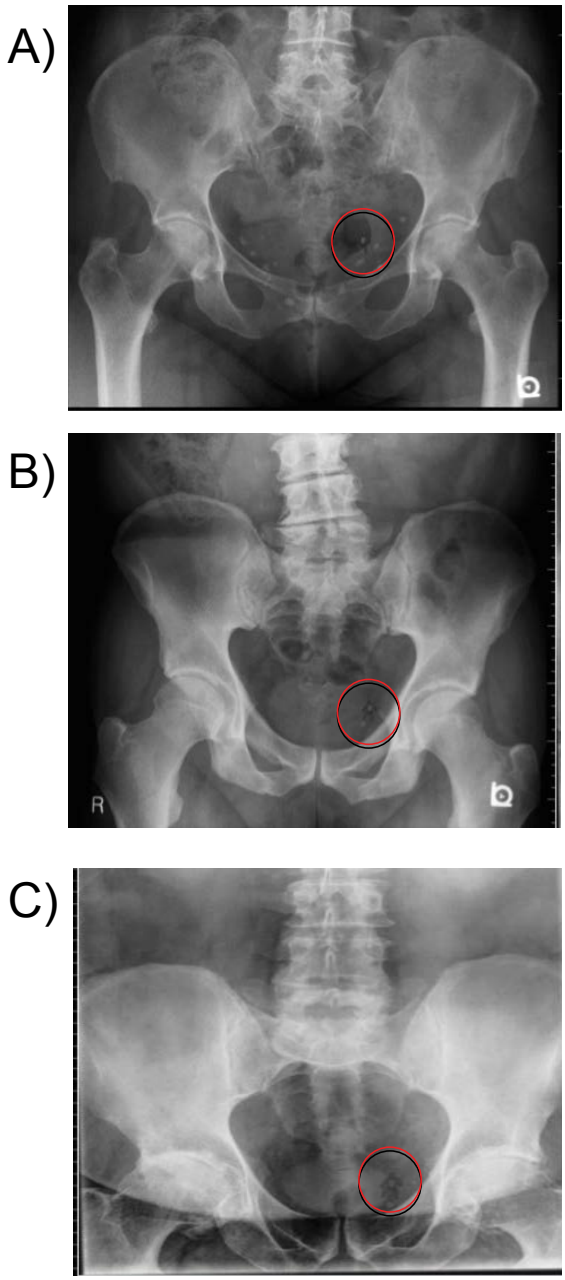

Figure 1: Gorilla location is marked within the red circle with density of 50% (a), 75% (b) and 100% (c).

training and expert radiologist, but a gap remained between the two groups. As expected, radiologists were much better at detecting the lung nodules [5].

A group that could natural fill this gap would be students with radiology as a significant part of their curriculum. A parallel could therefore be drawn between chiropractic students and their skills in assessing plain film x-ray to the expert radiologist and their skills assessing lung CT scans in the original study [5]. Such a test would naturally be altered, but the concept with the gorilla remains.

Although it is common to experience IB, questions remain to whether we truly can blame not noting obvious objects, whether we simply are being incapable, or if bad habits and stress are to blame? One thing is for certain; the phenomenon is highly complex and poorly understood.

The 1st objective of this study was to assess the presence and potential difference in IB between 2nd and 4th year chiropractic students on reading plain AP pelvic radiographs films replicating the methodology using the inserted gorilla study by Drew, et al. [5].

The 2nd objective was to evaluate the results as compared to the expert radiologist assessed by Drew, et al. [5].

Method

Students were initially invited through a collective Facebook message containing a short summary of the study, but due to poor response, a decision was made to recruit them in an in-class setting. 164 subjects were informed and invited to participate, i.e., 90 students from 2nd year and 74 students from 4th year. Chiropractic students were considered if ≥ 18 years of age and enrolled at the 2nd or 4th year of the MChiro course at University of South Wales. The students were encouraged to bring along necessary equipment such as glasses to ensure optimal visual performance. No other visual acuity testing was performed. Students whom were not familiar with AP pelvic x-ray films were not invited to participate. Students whom were found talking to other participants during the assessment were excluded. Due to difficult time schedules the other years were excluded.

The study contained 20 AP Pelvic radiographs randomly retrieved from the Welsh Institute of Chiropractic (WIOC) database, whereof three of them contained a gorilla figure at 50-, 75- and 100% density, Figure 1a, Figure 1b, Figure 1c [6].

The gorilla was placed close to a phlebolith in the pelvic basin in all three images [7] and measured 29 × 50 mm. The students were divided into their respective years and had 30 seconds at disposal per image. Each student was given a questionnaire containing 20 sections, i.e., one section per image. In each of the 20 sections the students were asked to report whether or not there were any findings, and if yes, please state all findings, but not the anatomical location. Question 21 stated if they were familiar with the study by Drew, et al. [5] "The invisible Gorilla Strikes Again", and if so, to elaborate.

All students were randomly placed on every other pre-numbered seat perpendicular to the screen to minimize any visual distortion [8] and allowed 15 minutes eye dark adaptation in the dimmed-light environment. The randomization included sealed letters, i.e., a-z, corresponding to a specific seat, i.e., 1-26. The students were all tested simultaneously as the randomised seating was confound to the mid area of the room, which was not found to impact the outcome.

The projector used was a Casio Signature Series XJ-M155-UJ, DLP Texas Instruments, with a height of 242.5 cm and 236 cm width. The distance between the projector and the screen measured 505 cm, while the distance

Table 1: Correct answer at the different density gorillas.

Gorilla density	Year	No	Yes	P-value
50% density	2 (total number of students: 25)	23 (92%)	2 (8%)	0.671
	4 (total number of students: 26)	23 (88%)	3 (12%)	
75% density	2 (total number of students: 25)	24 (96%)	1 (4%)	0.006
	4 (total number of students: 26)	17 (65%)	9 (34%)	
100% density	2 (total number of students: 25)	24 (96%)	1 (4%)	0.006
	4 (total number of students: 26)	17 (65%)	9 (34%)	

P-values are based on Chi-Square test. P-values < 0.05 denotes significant finding.

Table 2: Correlation between correct answer and familiarity with the previous study.

Question	Year	No	Yes	P-value
Have you heard of the Invisible Gorilla strikes Again?	2 (total number of students: 25)	23 (92%)	2 (8%)	0.139
	4 (total number of students: 26)	20 (77%)	6 (23%)	

P-values are based on Chi-Square test Asymptotic Significance (2-sided). P-values < 0.05 denotes significant finding.

between the screen and the first and last row was 173 cm and 725 cm, respectively. The images were played via a computer, i.e., a Viglen omnino that ran on Windows 7 system, 2009, which was placed in the bottom right corner not to disturb the student's visual field.

Statistical Analysis

All statistical analysis was conducted by a blinded statistician in SPSS v22. As the sample size was less than 60, a Chi-Square was done to assess the data, while crosstabulation was used to compare the data. P-value below 0.05 was considered statistically significant.

Results

A total of 51 students participated in the study (29 females and 22 males), the mean age was 23, range 19-36 years, SD 3.79. The two groups were equal (25 in 2nd year and 26 in 4th year).

A statistically significant difference was found between the years at 75% and at 100% density, but not for 50% density, Table 1. Students whom discovered the gorilla at 75% did equally discovered the gorilla at 100% density.

No statistically significant correlation was found between those who had heard of the invisible Gorilla strikes again study, Table 2.

After excluding students who were familiar with the past study, no statistical significance difference was seen between the groups, Table 3.

No statistically significant difference was seen between the genders (p = 0.625). All students completed all questions and no missing data was found.

Discussion

This is to our knowledge, the first study to evaluate IB among 2nd and 4th year chiropractic students who have radiology as a significant part of their curriculum. The study is a replication of the study by Drew, et al. [5], which assessed IB among expert radiologists. Our results show that 65% of the 4th year students failed to report the inserted gorilla, a statistically significant difference from the 96% in the 2nd year student group, and slightly better than the 83% of the expert radiologist who failed to report the gorilla. After excluding the students who knew about the previous study, 82% of the 4th year students failed to report the gorilla. It is plausible that the reason for the 4th years doing better in this experiment is that with experience and education comes routine and better quality of examining the x-rays [9].

The conscious experience we have of the visual world is a product of two pathways, i.e., the non-selective and selective [10]. The non-selective gives us an overview and first impression of what we are looking at, but it does not provide much detail. The more detailed the picture the more selective pathway is required in order to identify the object [10]. This selective way of observing includes the knowledge of the probability of an object in a particular setting, i.e., semantic guidance, and is highly apparent when subjects have pre-set ideas of what they are looking for. There is also the aspect of recognition and search pattern on assessing x-rays.

Table 3: Correct answer at the different gorillas' densities after excluding those who had previously heard of the invisible Gorilla strikes again.

Gorilla density	Year	No	Yes	P-value
50% density	2 (total number of students: 23)	21 (92%)	2 (8%)	0.883
	4 (total number of students: 20)	18 (90%)	2 (10%)	
75% density	2 (total number of students: 23)	22 (96%)	1 (4%)	0.110
	4 (total number of students: 20)	16 (80%)	4 (20%)	
100% density	2 (total number of students: 23)	22 (96%)	1 (4%)	0.110
	4 (total number of students: 20)	16 (80%)	4 (20%)	

P-values are based on Chi-Square test Asymptotic Significance (2-sided). P-values < 0.05 denotes significant finding.

Once one has noticed something in one place, one often looks at that same area again, i.e., episodic guidance [11].

IB tends to disappear when the target is expected [12]. As for the study by Drew, et al. [5], our students did not expect to find a gorilla in the image and might therefore not have been looking for other abnormalities than those previously encountered during radiology classes or clinical practice. However, it has been hypothesized that location is unimportant for IB and that the key factor is attention control which reduces the susceptibility for IB [12-14].

Past studies have concluded that experts, in any field, are thought to be able to encode more information in less time than those with less experience [15-17]. This stands in contrast to our study, were 4th year students had similar results to expert radiologist in terms of noticing the gorilla [5]. It has also been suggested that subjects tend to stop searching for other findings once they have found what they perceive to be the main finding [18]. This translates well to our study as most of the students only stated one finding, although there were several findings to report on some of the images.

It has been stated that an important consequence of training is to teach radiologists that some areas are more likely to contain lesions than others [5]. This improves the chances of detecting findings in a specific area but might similarly predispose for neglect of thoroughly searching other areas. Thus, the result of omitting important information due to IB or simply attention deficit can naturally have a serious consequence for the patient causing delays or misdiagnosis.

One might therefore find it alarming that a study has estimated that up to 35% of x-rays are misinterpreted for different types of trauma [19]. Another study found that 75% of cervical ribs were not reported on CT imaging, which might be of clinical importance [20].

Conspicity, mental workload, expectation and capacity have all been suggested to be involved in IB [21]. However, when a study estimates up to a 30% miss rate and an equally high false positive rate [4], radiologist and similar professions should have IB in mind and stay highly focused when analysing different image modalities.

Our study has a few limitations including small sample size. Thus, the results are not necessarily representative for the chiropractic students across the world. The size of the images on the projector screen might have influenced the level of difficulty as image distortion might occur on larger screen size. Any potential influencing factors such as stress of the subjects should be prevented to the extent possible to reduce potential impact on the outcome. Future studies should therefore be done with larger sample groups and within different professions to provide more reliable results. But more importantly, studies need to investigate ways of minimizing IB, which would improve the quality and safety in assessing radiographic images.

Conclusion

It is clear that level of education and even years of experience, does not make us immune to IB as the majority of students failed to report the gorilla. Neither bad habits nor stress has been tested fully in relation to this, so it cannot be excluded as a potential co-factor. It would be clinically important to reduce IB to increase safety and accuracy in image assessment. A window of opportunity for this improvement might be in the educational setting, though a precise aid in this is not clear.

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