IMPROVING VISUAL OBSERVATION SKILLS THROUGH THE ARTS TO AID RADIOGRAPHIC INTERPRETATION IN VETERINARY PRACTICE: A PILOT STUDY

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Running head: Improving visual observation

Abstract:

Radiographic interpretation is a perceptual and cognitive skill. Recently core veterinary radiology textbooks have focused on the cognitive (i.e. the clinical aspects of radiographic interpretation) rather than the features of visual observation that improve identification of abnormalities. As a result, the skill of visual observation is underemphasized and thus often underdeveloped by trainees. The study of the arts in medical education has been used to train and improve visual observation and empathy. The use of the arts to improve visual observation skills in Veterinary Science has not been previously described. Objectives of this pilot study were to adapt the existing Visual Arts in Health Education Program for medical and dental students at the University of Melbourne, Australia to third year Doctor of Veterinary Medicine (DVM) students and evaluate their perceptions regarding the program's effects on visual observation skills and confidence with respect to radiographic interpretation.

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This adaptation took the form of a single seminar given to third year DVM students.

Following the seminar, students reported an improved approach to radiographic interpretation and felt they had gained skills which would assist them throughout their career. In the year following the seminar, written reports of the students who attended the seminar were compared with reports from a matched cohort of students who did not attend the seminar. This demonstrated increased identification of abnormalities and greater description of the abnormalities identified. Findings indicated that explicit training in visual observation may be a valuable adjunct to the radiology training of DVM students.

Introduction:

Visual observation is a core requirement of radiology and other visual clinical disciplines such as pathology and dermatology, however there is a concern that “the learned observational skill of physicians has declined from disuse”.¹ In the field of Veterinary Science education, there is a lack of awareness amongst students and clinicians of some of the principles of visual perception and radiographic interpretation. Perception is an important part of radiographic interpretation. What appears as an obvious finding to beginning radiologists may be incorrect because of a perception error². Many clinicians tend to see what they want to see on a radiograph whether it is there or not³. The causes of errors in visual observation in veterinary radiology have been explored⁴ however there is a lack of description of explicit training in visual observation in veterinary radiology.

The use of the arts to increase visual observation skills in medical and health training has been extensively described⁵⁻¹¹. In addition there are other programs in areas such as crime investigation and other professional fields in which acute observation skills are necessary, which utilise works of art as part of their training^{12 13}. To date there has been no description

on the use of the arts in Veterinary Science to aid visual awareness and to train visual observation skills.

Aims of the current study were to adapt an existing observation skills program using visual arts, the Visual Arts in Health Education Program (VAHE) utilised across the Faculty of Medicine, Dentistry and Health Sciences at the University of Melbourne^{10, 11} for use in veterinary students and to evaluate impacts of this program in a sample of third year Doctor of Veterinary Medicine (DVM3) students. Our projected outcome was to improve the Veterinary Science students' ability to effectively describe and interpret radiographic findings.

Method

The study was a prospective, pilot design. The study was approved by the University of Melbourne Human Ethics Advisory Group. The DVM3 students were selected for inclusion in the pilot program as they had received a major part of the radiology curriculum and it was felt that this training fitted best pedagogically with this year level. A small group collaborative session with one of the Radiologists from the University of Melbourne Veterinary Hospital (CB) and the Curator of the Academic Programs (Research) at the Ian Potter Museum of Art (HG) was held with the veterinary students over a single 3-hour period. The seminar was held at the Werribee campus of the Veterinary School, to suit the timetable and physical location of the students. As other iterations of the Visual Arts in Health Education Program occur within the art museum environment on the Parkville campus at UoM, the program was adapted to incorporate digital and physical reproductions of artworks, rather than originals. All students in DVM3 were invited to participate in the pilot program via an email request, and 24 students out of the cohort of 108 responded. The session was

capped at 14 students, in order to maximise each student's experience and attention from the facilitators. The first 14 responders to the Expression of Interest were selected to attend.

Following an introduction to the pilot program, students were led through a group exercise in visual observation and objective description, using a digital reproduction of a complex narrative painting, *Bushrangers, Victoria, Australia, 1852*, by William Strutt, University of Melbourne collection (Figure 1). In a group discussion context, students were asked to first fully describe, and then interpret, the visual content of the image. Students were alerted to the difference between objective and interpretative modes of description of the visual data, and their task was to logically and progressively work from the former to the latter mode. As an example of this difference, students might observe that "the man in the centre of the image looks mean". An objective description is that "the man in the centre of the picture is wearing a red shirt and holding a gun" and later use this information to build the interpretation that "the man in the centre of the picture is a bushranger" (an Australian outlaw). This part of the session ran for approximately 15 mins and demonstrated the process of objective visual observation and interpretation to the students.

To facilitate detailed discussion and transfer to the radiological context the students were then split into groups of 2. Each pair was given a life-size reproduction of an Old Master print from the University of Melbourne's Baillieu Library Print Collection. These fine art prints, including works by artists such as Renaissance artists Albrecht Durer and Crispin de Passe the younger (Figure 2), were chosen especially for their similarity to radiographs in the use of shades of grey to display visual information, as well as the closeness to the experience of working with the original artworks that could be achieved through reproductive means. To help make the connection between these teaching tools and the students' disciplinary understanding each print included some visual imagery related to animals. Students were

asked to look closely and carefully at their artworks, in order to facilitate a full objective description of the scene depicted in the print, and to build an interpretation of the content. Students were given a simple worksheet, divided vertically into 'Objective' and 'Interpretive' columns, to guide their note taking and reinforce the key concepts. Students worked in their pairs for approximately 12 mins on this exercise then each pair in turn presented their shared findings to the whole group, utilising a digitally projected image of their artwork. A group discussion of the findings of each pair, focussing on the objective and interpretive descriptions was undertaken. The group discussion was led by the students and facilitated by both instructors.

To make the disciplinary relevance of the observation exercise utilising artworks explicit, and to promote transfer of skills, the radiologist then projected two selected thoracic radiographs, two abdominal radiographs and one musculoskeletal radiograph to the group. The instructors encouraged the students to use the descriptive skills learnt during the visual art analysis in making a radiographic description and interpretation. This group discussion of the radiographs allowed the students to practice the objective descriptions of the radiographs prior to the interpretation of the radiographic findings.

The students were surveyed one week after the pilot session via Survey Monkey (<https://www.surveymonkey.com/>) on their perceptions of the Visual Arts in Health Education Program. The survey included fixed questions and opportunity for free text feedback. The participants of the study were again followed-up in their 4th year. During the DVM4 Diagnostic Imaging Rotation all students were required to submit three written radiology reports for assessment. All students had received the standard DVM Curriculum in radiology with the only difference being that those in the pilot study had received additional training with the visual arts. The participants of the study were paired randomly with a

student within their Diagnostic Imaging Rotation Group in DVM4, who had not received the visual arts training, and therefore acted as a control. The reports were anonymised and randomised and marked for the identification of abnormalities and the quality of the radiographic description. The quality of identification was assessed on a 3-point scale and descriptions were evaluated on a 5-point scale developed by the authors for the study (Table 1). All scores were recorded by one of the authors of this report (CB) who was blinded to the participant status of students for the purpose of this evaluation. Outcomes were compared by the same author (CB), in consultation with a statistician. The Mann Whitney U test performed using commercially available software (Stata version 14, StataCorp, College Station, Texas). A p-value of 0.05 was considered statistically significant.

Results

Fourteen students participated in the pilot programme and responded to the survey based on a 5 point Likert Scale. Thirteen of fourteen students found the seminar either 'extremely engaging' or 'quite engaging' and thought the instructors made the contents and links between the disciplines either 'extremely well' or 'very well' (See Appendix).

The participating students were found to score more highly on both the quality of description and the identification of the abnormalities. Using the Mann-Whitney test, the difference was statistically significant for Identification ($p=.0056$), but not for description ($p=.0615$; see Table 2 for full results). The median score for the identification of abnormalities was 3 for the participating students and 2 for the control group, and for quality of the description the median was 4 for both groups.

Discussion

Explicit training in visual observation has a role in the training of radiographic identification and description for veterinary students. In this study, the quality of radiology reports produced by the control and test group in DVM4 was statistically significantly different for identification whereas for description it was not. Identification is more closely linked to the process of visual observation, which was the objective of the study. The scoring of reports for identification is potentially more straight-forward and quantitative, whereas description involves an expressive element and involves a more qualitative judgement by the assessor. The descriptive process, the scale used and assessor training would all be elements to identify as an area where further research would be desirable.

The interpretation of medical images and the development of expertise require both perceptual and cognitive skills. Visual search is a fundamental perceptual skill, whereas diagnostic reasoning and decision making are cognitive skills acquired over time through education and experience.¹⁴ In the pursuit of clinical knowledge some of the theory of visual interpretation, and how this influences what is seen on a radiograph, and radiographic perception, has been lost in the veterinary literature. A textbook chapter in the 3rd and 4th editions of *Textbook of Diagnostic Radiology*⁴ on “Visual Perception and Radiographic Interpretation” has been removed from subsequent editions, although it is available on line. The topic of visual perception and radiographic interpretation was discussed in a paper published in 1998¹⁵ however there have been no subsequent articles on visual perception in the veterinary literature with the exception of this topic being briefly touched on in an article regarding the inspection of CT and MR images.¹⁶ The use of works of art allows the instructors to make explicit the skills of visual interpretation and the difference between the descriptive and interpretive modes of description.

Students enrolled in this study are at the Stage 1 novice level in the Dreyfus model of skill acquisition¹⁷ with respect to radiology. At this stage the instructor needs to decompose the task of image interpretation into context-free features that the beginner can recognise.¹⁷ Students need to be given the skills to move to Stages 2 (advanced beginner) and 3 (competence) of skill acquisition. Part of the transition to competence, then proficiency, is that the mental function of recognition starts to become more holistic rather than decomposed.¹⁸ Students often feel anxiety when asked to interpret a radiograph feeling that they should instantly “know” the answer without understanding the processes involved in reaching the radiographic interpretation. By deconstructing the task of description for the interpretation of works of art, the students are given the skills to begin moving through the phases of skill acquisition.

Artworks were used in this pilot program, as key sources of visual data, for a number of reasons. In terms of alleviating student anxiety, the artworks provided a stimulating, novel and aesthetically pleasing visual context that had no ramifications around the need for a ‘correct interpretation’ or a ‘right answer’. Students were told at the start of the session that viewing artworks was an open ended and creative endeavour and that they were deliberately being introduced to this material to encourage them to think in lateral and creative ways. Having seen this process working effectively across other examples of the visual arts program at the University of Melbourne in Medicine, Dentistry and Health Sciences, the authors were confident that working with the visual art images would be effective in encouraging a ‘safe’ environment for students to explore new visual skills. Prints that depicted animals were specifically chosen to increase the interest and relevance for the students. The artworks were also chosen for their intellectual and historical relevance, as they documented a period in history in Renaissance Europe, in which there was a close alignment

with artistic practice, particularly in the field of printmaking, and scientific endeavour related to early anatomical study. Students were encouraged to consider the historical development of the skill of observation and scientific visual representation. This was made very clear to students in a number of examples in the artworks, where the representation of animals such as the Rhinoceros in the print by Albrecht Durer (1515), or horses in a print by Crispin de Passe the younger, *Maneige Royal* (c.1623-66)(Figure 2), differ from reality. This inspired high engagement from the students and enriched the group discussion. For example, the *Maneige Royal* print depicts the horses with their eyes positioned at the front of their heads rather than to the side: the time students took to become aware of this anomaly was a point of discussion, as well as the curious nature of the representation itself.

In addition, the use of artworks to train visual observation capitalises on the students' lack of familiarity with the content. The viewers search for and select all of the details in the paintings because they do not have a bias as to which visual attribute is more important than another¹⁰, the use of an unfamiliar object about which the student has no biases and no significant prior knowledge resulted in the object, an artwork, being very carefully inspected and every feature reported.¹⁹ The use of art to train visual observation has been associated with a significant improvement in subsequent test scores,¹⁰ and it has been found that formal art training can improve medical students' visual diagnostic skills.⁷ The use of visual art images with guided questions can further train medical students in visual observation skills.¹¹

Whilst other programs using visual arts to hone observation skills typically utilise a wide range of paintings as subject matter,^{10, 19} the instructors in our program specifically chose highly complex black and white art prints (engravings or etchings), by skilled artists from the 16th and 17th centuries. These prints were chosen for two key reasons: firstly, the fine detail

inherent in the medium of printmaking that provides complex visual data for students to examine; and secondly, the limited colour palette of the print, shades of grey, which replicates the experience that students will have with radiographs. Radiographs are images created when x-radiation is absorbed heterogeneously by the body, depending on the makeup of the tissue. The ability of a radiograph to display subtle differences in x-ray absorption is limited leading to poor contrast resolution. In addition patient thickness will affect relative radiopacities because as thickness increases radiopacity increases.² Another limitation of radiographs is the two dimensional display of a three dimensional patient. These features of radiographic imaging may lead to confusion, or frustration, when learning radiology. This pilot program aims to give students strategies to reduce this confusion and frustration.

A source of potential bias within the study is the selection of the participants. The DVM3 students were invited to attend via an email invitation. The first 14 responders were selected to attend the session. This gives rise to a potential bias with only motivated students responding who may also be the higher achieving students, and thus skewing the results. In addition, only those students with access to emails at the time the invitation was sent had an opportunity to be within the first 14 responders thus other students who were interested did not have an opportunity to be part of the study.

By bringing an experiential learning session to veterinary students through the use of the novel medium of fine art to learn the importance of visual observation skills, the objective and interpretive descriptions in radiographic contexts are made explicit. In addition, students have an opportunity to practice these skills in a relatively simplified and non-stressful environment, contributing to alleviation of anxiety. Our anticipated objectives and outcomes for the pilot session were confirmed through positive student feedback in online evaluations, with one student noting that “This seminar really demonstrated how important (and less

stressful) it is to simply look at the image and describe it FIRST, than to try to interpret it”.

The positive impact of training in visual observation was also demonstrated through assessment of student written radiology reports twelve months later. Further exploration of the utility of the visual arts to improve short and long term observational skills with respect to veterinary radiology is planned at the University of Melbourne.

Author contributions:

Category 1

(a) Conception and Design: Cathy Beck, Heather Gaunt, Neville Chiavaroli

(b) Acquisition of Data: Cathy Beck, Heather Gaunt

(c) Analysis and Interpretation of Data: Cathy Beck, Heather Gaunt, Neville Chiavaroli

Category 2

(a) Drafting the Article: Cathy Beck

(b) Revising Article for Intellectual Content: Heather Gaunt, Neville Chiavaroli

Category 3

(a) Final Approval of the Completed Article: Cathy Beck, Heather Gaunt, Neville Chiavaroli

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Figure 1 William Strutt, *Bushrangers*, Victoria, Australia 1852, 1887, oil on canvas, 73 x 154 cm. The University of Melbourne Art Collection. Gift of the Russell and Mab Grimwade Bequest 1973. This art work was used for the initial part of the seminar. Students were led through the objective description of this work, then interpretation.

Figure 2 Crispijn de Passe the younger (Dutch c.1597-c.1670), illustration from *Maneige Royal*, (1623-66), engraving, image (sheet trimmed to image): 19.5 x 29.9cm, Baillieu Library Print Collection, reg. no. 1959.3536, the University of Melbourne. Gift of Dr J. Orde Poynton, 1959. One of the prints used for the second part of the seminar. Students worked through the description and interpretation of images such as this and presented their findings to the group.

APPENDIX

1. SURVEY and RESPONSES

ITEM						N
Q1 How engaging was this seminar?	<i>Extremely engaging</i>	<i>Quite engaging</i>	<i>Somewhat engaging</i>	<i>Unsure</i>	<i>Not at all engaging</i>	
	7	6	1	0	0	14
Q2 How worthwhile are cross disciplinary learning activities of this nature, particularly in the acquisition of complex skills?	<i>Extremely worthwhile</i>	<i>Quite worthwhile</i>	<i>Moderately worthwhile</i>	<i>Slightly worthwhile</i>	<i>Not at all worthwhile</i>	
	6	6	2	0	0	14
Q3 How worthwhile was the seminar material?	<i>Extremely worthwhile</i>	<i>Quite worthwhile</i>	<i>Moderately worthwhile</i>	<i>Slightly worthwhile</i>	<i>Not at all worthwhile</i>	
	6	6	2	0	0	14
Q4 How well did the instructors make links between content and learning across the different disciplines?	<i>Extremely well</i>	<i>Very well</i>	<i>Moderately well</i>	<i>Slightly well</i>	<i>Not at all well</i>	
	8	5	1	0	0	14

Q5 Did this seminar increase your confidence in interpreting visual data?	<i>1 (Not at all)</i>	2	3	4	5	6	7	<i>8 (Very much)</i>	Average rating	N
	0	0	0	0	3	5	4	2	6.36	14
Q6 Do you think this seminar will aid your radiographic film interpretation?	<i>1 (Not at all)</i>	2	3	4	5	6	7	<i>8 (Very much)</i>	Average rating	
	0	0	0	0	3	3	3	4	6.62	13

Q7 (Free response) Describe in a couple of sentences a key outcome of the seminar for you.

1. Affirmed that taking the time to look at the whole 'image' (whether diagnostic or artistic) before trying to interpret is a worthwhile way of analysing the information. It also demonstrated that history and extra information about the case (or the title of a piece) can change my interpretation of an image so it is important to formulate some ideas then read the information and reconsider how it fits into my thinking.

2. I now feel more confident in how I can approach interpreting a radiograph. I know i can take my time and describe the whole scene instead of just trying to find the abnormality.
3. It's good to make observations before interpretations!
4. It helped me to some degree to take a global view of a film and break it down to describe it. I think it will help me to gain confidence in describing lesions to myself as a trigger to build the story and aid my diagnostic skills
5. It really helped me to step back and try to just describe what I see rather than automatically trying to determine what processes might be going on to produce the image on the radiograph. I think it will definitely impact on the way I look at diagnosing imaging throughout my career and to remember to go back to first principles.
6. I learned that it's important to be able to objectively describe findings on a radiograph, especially when communicating with colleagues. Analyze the whole picture carefully, rather than jumping to a quick diagnosis.
7. I have learnt to be objective, detailed and precise in my descriptions. I understand the value of not jumping to conclusions and looking at images in context.
8. The idea of stepping back and taking in all the details without the bias of interpretation was driven home. Also, the fact that different people pick up on different details was very interesting.
9. Although it's been told to us in lectures to just look at a radiograph and describe it before taking into account disease processes or possible differentials, we hadn't been given a chance to really apply this. This seminar really demonstrated how important (and less stressful) it is to simply look at the image and describe it FIRST, then to try to interpret it. It really showed how prejudiced one can be, and how things could be easily missed (especially for new vets).
10. Learned to look at the whole picture, not just jump to the first thing I saw. It was nice to see a different perspective (art) vs science. Thank you for the clear and wonderful seminar. Both great teachers.
11. I found the seminar provided me with a very important reminder of why we need to take a step back and make an objective assessment of radiographs, before jumping to conclusions of what the animal may be suffering from. If this is not done it is very easy to make misinterpretations based on your assumptions and not what it is actually present in the radiograph.
12. Very valuable for developing skills in objective assessment and subjective interpretation during a visual assessment of art, and the application of these skills to veterinary radiography. Also developing skills in communication these outcomes to others.
13. Fantastic experience and a fun way to broaden the mind in terms of radiographic interpretation. Really good to have a cross-discipline approach and would highly recommend it to future students if it is done

Q8 Do you have any further comments?

1. Thank you for the opportunity! I think it is really worthwhile and would almost be better for me if it was offered in first year. The reason I think this is that the earlier we are introduced

to the skills the more practice we get at analysis of images 'the right way' during lectures, case studies and pracs.

2. I think this will be a very useful learning tool. I particularly enjoyed it because I am a visual learner and enjoy being creative. I also like looking at art works and hearing about people's different interpretations. I liked that there was no need to feel like you were interpreting or seeing things incorrectly. It makes it much more relaxing and easier to participate. Thank you for such a wonderful opportunity.
3. I feel like taking 3 hrs is maybe a bit much for this exercise. I agree it was worth while, but maybe if we set aside 15 minutes in lecture or during a prac to do these exercises in smaller groups would be a more efficient way.
4. I still got anxious looking at the xrays. I would have liked more time on the xrays and less time on the art or else do them as separate sessions
5. Thanks for organizing and running this seminar! 9/15/2014 12:19 AM
6. It was a very useful workshop which I recommend for all DVM students. The presenters were very engaging and knowledgeable. Timing - would have been better to have had this at the beginning of third year so that we can practice the skills learnt throughout the RAD pracs during the year. Variety of art pieces - I understand the limitations in time but would have liked to have seen a larger variety of 'types of art' (most of what we looked at were quite similar). I am no art expert but I think different types may have had something different to teach. Language of description - I think spending a little time at the beginning focusing on our use of terms of description would be valuable. Overall, it was a great experience, I definitely learnt a useful skill and I am glad I participated. Thank you very much for organising this for us :)
7. Thank you for the workshop, I think it was very useful :) 9/12/2014 11:09 AM
8. I really hope this becomes available to everyone in DVM! I found it quite helpful to have this in the penultimate year as we are somewhat comfortable with radiography (at least with opacities, understanding how they are made, etc). Perhaps earlier in the year so that we could apply this to the radiography practicals?
9. Keep the small group numbers. Taking the titles of the art was good as the titles when read could already be leading your mind on a different thought path.
10. Great class size, and really interesting opportunity to appreciate artwork!
11. BRILLIANT workshop! Very worthwhile & obviously well prepared for. Has boosted my confidence in looking at Radiographic images & given me more direction should I ever feel stumped.
12. Would be ideal to do much earlier in DVM3 but can't foresee any benefits in doing this DVM1/2. Perhaps even made part of the curriculum? It really does change how you look at radiography, and certainly I've gained more patience for appreciating basic geometric descriptions and communication skills for radiology today. (And a crash course in Baroque art.) Well done for a really engaging approach. Thanks Cathy for organising this!

Table 1

Score

- 1- No abnormalities identified
- 2- Some but not all abnormalities identified
- 3- All abnormalities identified

Description (objective and interpretive)

- 1. Poor or incorrect description
- 2. Minimal description
- 3. Adequate description
- 4. Good description
- 5. Excellent description

Table 2: Scores of participants and non-participants on Identification and Description

	Identification (3-point scale)		Description (5-point scale)	
	<i>Participants</i>	<i>Controls</i>	<i>Participants</i>	<i>Controls</i>
Mean	2.81	2.38	3.90	3.52
Median	3	2	4	4
U-value	572		672	
Z-score	2.77		1.87	
p-value	.0056		.0615

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