
A SURVEY OF EDUCATORS REGARDING STUDENTS WITH PHOTOSENSITIVITY AND DIGITAL MEDIA

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Abstract

Photosensitivity is a medically recognized and documented spectrum disorder, but little known by Australian educators. Australian educators use digital media as part of contemporary classroom practice, but for students who are visually photosensitive, this learning experience can adversely affect their cognitive ability, behaviour and even stimulate physical responses such as nausea and migraine.

From an online survey of 61 Australian educators, 43 completed the sections on digital media use, knowledge level and confidence. Of these 43, 21 (49%) professed no knowledge of visual photosensitivity and 17 (40%) had little or no confidence in teaching students with visual photosensitivity. The survey showed educator's preferred mode of information distribution regarding inclusive education amendments was by professional development by medical personnel. However, a small group were asked by interview and all replied with reliance on 'Google'.

For 17 of the 43 educators (40%) digital media is utilized for 3 or more hours every day at school. However, information regarding pedagogies for safer classroom use of digital media for students with photosensitivity is not easily accessible to the classroom educator.

Background

Photosensitivity can be defined as having an abnormal sensitivity to visual light stimuli. For some students, visual photosensitivity can be linked with migraine, epilepsy or autism spectrum disorder. (Dermatological photosensitivity is linked with lupus, antibiotic use and skin conditions such as phototoxicity, and is not discussed in this paper.) Visual photosensitivity is not a new disorder, but only recently has the classroom become an environment where these individuals are potentially at risk. Visual photosensitivity has been medically recognized for over 50 years, is a spectrum disorder, can be found in students of any ability level and manifests in many different ways. This paper uses the term photosensitivity as inclusive only of the diagnoses of visual photosensitivity, which comprise visual sensitivity, light sensitivity, chromatic sensitivity and photophobia. Although educators are not trained to diagnose this trait, their knowledge of student behavior and continuing classroom observations provide invaluable data for diagnosticians.

Australian education environments continue to increase their use of digital based learning experiences. This investigation examines whether educators are confident in working with students with photosensitivity, thus providing equitable access to these learning experiences. It also highlights the possibility of certain students being caused discomfort through use of specific colours or digital media environments. The increase of online assessments highlights the need for educator understanding of the neurological and optical effect of digital media. Reasonable adjustments would assist online assessments for students with photosensitivity to target their academic abilities, rather than academic plus possible perceptual bias.

Photosensitivity can be physiologically generated in two ways. The first (Group One) is hypersynchronous neuronal activity in response to visual light stimuli (an epileptic response, though student does not necessarily have epilepsy). This response can be quantitatively measured on an electroencephalograph (EEG). Some students whose photosensitivity is neurologically generated display no overt symptoms, and as such their reactions are termed 'subclinical'. Clinical episodes can manifest with symptoms such as pain or altered behavioural patterns, each with associated altered

cognitive state.

The second type (Group Two) of photosensitivity is optically generated, and these students do not show any hypersynchronous patterns during an EEG. The causes can include ultrasensitive retinal cells and optic nerve anomalies. These students may show no obvious problems during a regular eye examination, but there are a large number who are predisposed to headache or migraine. Clinical episodes for these students can manifest with symptoms ranging from blurred vision to migraine.

The population statistics for each group of students varies. Group One global population statistics for individuals aged from 5 – 15 years old range from 1.4% in Brazil (Kasteleijn Nolst-Trenité, Silva & Manreza, 2003) to 8.0% in Perth, Australia (Nagarajan et al., 2003). Within this range, a predominance of adolescent females was reported in all investigations, although ratios varied. There are approximately 2.7 million students in Australia aged between 5 and 14 (Australia. Australian Bureau of Statistics., 2011). From this, we can estimate there are between 38 000 and 210 000 students within this age range who are predisposed to exhibit symptoms of photosensitivity which could be verified by EEG recordings. Population statistics for Group One photosensitivity beyond this age range are affected by the occurrences of spontaneous remission. Spontaneous remission is the unexplained cessation of any visually inspired hyperexcitability of the cortex, which previously was prone to exhibit epileptiform responses when stimulated. This phenomenon occurs in between 14 and 37% of Group One individuals during their early twenties (Harding, Edson & Jeavons, 1997) and subsequently affects whole population statistics. The age of possible remission also coincides with the age at which growth rate of brain volume plateaus (Giedd et al., 1999). The highest rates of brain growth therefore correspond with the age group presenting with the higher proportion of photosensitivity, which corresponds with the age most students are going through high school.

Group Two photosensitive population statistics are also difficult to determine around this age range. For example, although not all students with migraine or headache have photosensitive triggers, most become photosensitive during the episode. Migraine statistics range from 0.5% (Kong, Cheng & Wong, 2001) to 27.1% (Split & Neuman, 1999), most with predisposition towards females. Headache population estimates are higher ranging from 20% (Shivpuri, Rajesh & Jain, 2003) to an incredible 91% of 2358 adolescents aged between 10 and 17 years experiencing headaches, 28% of high school females having them weekly (Bendell-Hockstra et al, 2001). Group Two population statistics also include about 25% of students with Autism Spectrum Disorder (American Epilepsy Society, 2011), as do a percentage of students with ADHD, dyslexia and dyspraxia. Group Two students display diverse symptoms, may also be Group One students and unlike Group One (only) students are not prone to spontaneous remission.

Irrespective of cause, individuals from both Group One and Group Two display decreased levels of cognition with episodes that include clinical symptoms e.g. migraine (Moutran et al, 2011; Aldenkamp, Arends, de la Parra & Migchelbrink, 2010). In addition, there are the times of Transitory Cognitive Impairment.

Throughout a normal day, momentary alterations of consciousness (with or without observable muscular movements) may not be noticed (Kasteleijn Nolst Trenité & Vemeiren, 2005). These alterations collectively termed Transitory Cognitive Impairment (TCI) and are associated mostly with Group One students. Often lasting less than one second, and usually causing no further disturbance, these are not symptoms that the general public would usually associate with the term 'seizure'. The complication occurs when the student is unaware of the incident and relies upon peers and educators to observe, recognize and respond appropriately. Real life implementation of testing for TCI is seen in the medical testing for air traffic controllers in Eurocontrol, Europe. After an incident involving subclinical seizures and corresponding TCI, an additional screening test was introduced. Although rigorous medical testing had been performed before the applicant was permitted entry to the school, EEG testing was not introduced before 1995. From 2001 to 2003, 1.7%, 2.1% and 3% of applicants were denied entry to the program due to epileptiform EEG discharges (Kasteleijn Nolst Trenité & Vermeiren, 2005). These tests revealed subclinical seizures, previously undiagnosed which cause enough disruption to cognition as to prevent individuals from competently managing their screen based work. Long periods of screen based study for students creates a comparable situation.

Group Two students are not currently able to have duration of subclinical incidents quantitatively measured. Some students report awareness of an 'aura' pre- or post-episode, the precise effect of this

aura on cognition is still under investigation. The presence or effect of TCI in Group Two students is an area for further study.

Medical research into photosensitivity as a visually stimulated, global issue for children began after the broadcast of a cartoon in Japan in 1997. After screening 'Pocket Monsters' at 7pm on December 16, 685 Japanese children were hospitalized for neurological problems that developed during or after the broadcast (Harding, 1998). The neurological problems included seizures, nausea, headaches and vomiting (Furusho et al., 1998 as cited in Furusho et al., 2002), although photosensitive seizures appeared to occur mostly in the older children (Furusho et al., 2002). Figure 1 below is a still shot taken from Pokemon Episode 38, *Denno Senshi Porygon*, which is now banned from television broadcast in countries included in the International Telecommunications Union (ITU).



Figure 1. Attributed stimulus material, a still shot from Pokemon Episode 38.
http://en.wikipedia.org/wiki/File:Pikachu_seizure-2.jpg#filelinks

Subsequent analyses of the program prompted generation of many stimulus theories regarding wavelength (Yamasaki, Goto, Kinukawa & Tobimatsu, 2008; Parra, Kalitzin & Lopes da Silva, 2005; Harding et al., 1997), screen refresh rate (Fylan and Harding, 1997; Stefano, Fesrico & Kasteleijn-Nolst Trenité, 1998), luminance (Yamasaki, Goto, Kinukawa & Tobimatsu, 2008; Parra et al., 2005), flashing images (Binnie, Emmett, Gardiner, Harding, Harrison & Wilkins, 2002), percentage retinal area (Bruhn, Kronisch, Waltz & Stephani, 2007) and concentration during program (Furusho et al., 2002). Repeated, replicated, quantitative studies using Group One subjects were carried out using different visual stimuli. The visual stimulus (variable) would trigger observable hyperexcitation in the cortex of the subjects during an EEG. A particular group of stimuli consistently triggered observable adverse reactions and formed the basis of Recommendation ITU – R BT.1702 (ITU, 2005). Recommendation ITU – R BT.1702 promoted prohibition in any ITU broadcasting station for airing a program inclusive of any of the following (taken from Harding and Fylan, 1999):

- 1) *Frequency*. Flashes with frequency >3 Hz are prohibited
- 2) *Opposing changes in luminance*. Flashes > or = 20cd/m² are prohibited
- 3) *Area of flashes*. Flashes greater in area than one fourth of the screen are prohibited.
- 4) *Color*. Flicker from saturated light is prohibited.

In February 2005, the ITU issued a circular (ITU, 2005) stating that 13 administrations responded in favour of approving a group of recommendations including ITU-R BT.1702. ITU-R BT.1702 was implemented from this date throughout ITU's global telecommunication unions, including Ofcom (responsible for United Kingdom).

Internet material however, which is broadcast globally, is not covered by these guidelines. This means

that material free to air on the World Wide Web may contain epileptogenic sequences without incurring penalties to individual owners or businesses. The possible consequences of guideline discrepancies between visual media were highlighted in 2007 with the official televised launch of the London 2012 Olympics. BBC television marked the event by broadcasting clips taken directly from the London 2012 website. These clips were broadcast during the evening news (Figure 2 shows a still shot of the material aired that was attributed to causing seizures (Epilepsy Action, 2007)).

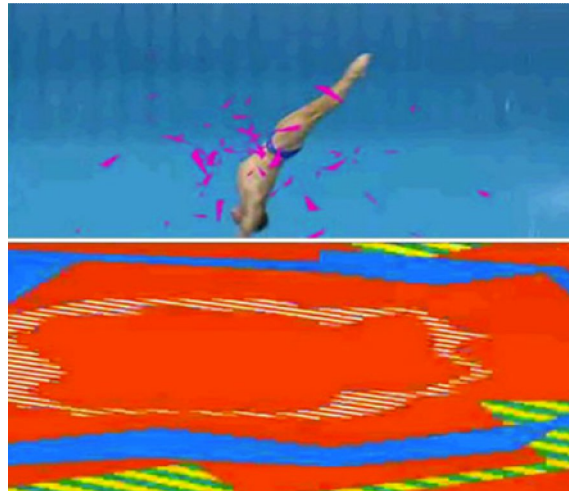


Figure 2. Attributed stimulus material, a still shot from BBC broadcast of *London 2012 Olympics* launch (2007)

After some people reporting having seizures triggered by watching the segment, Epilepsy Action UK released a press statement which cited ‘flashing and moving coloured images’ as precipitating the seizures (www.epilepsy.org.uk/pressreleases/national/statement-2012-olympics-brand). It continued with a warning that the images could affect 23 000 people in the UK who were known to have photosensitive epilepsy, ‘and may also affect others who do not yet know they are photosensitive’. It did not mention the people who could have been affected by migraine, nausea or other symptoms.

ITU-R BT.1702 had been instigated as Rule 2.13 of the Ofcom Broadcasting Code (2005). The saturated red colour contravenes Rule 2.13, together with the zig zag patterning which is stimulative for chromatically sensitive individuals, making this broadcast epileptogenic for many photosensitive individuals. (Note: photosensitive individuals controlled by pharmacological or non-pharmacological means may not be affected by these images.)

Seizures linked to television broadcasts are not restricted to individuals diagnosed with epilepsy. According to Fisher, Harding, Erba, Barkley and Wilkins (2005b) 76% of the children who had a ‘Pokemon’ seizure reported no previous history of epilepsy. Five years later, in follow up studies, Okumura, Watanabe and Ishikawa (2004) noted that 81% of the children originally reporting seizures had no recurrence of the phenomenon. I could find no reporting however of the recurrence of other neurological traits (eg migraine, blurred vision). Yamasaki et al. (2008, p. 1) stated ‘it is important to examine the neural basis of latent color-luminance sensitivity in healthy people to prevent epileptic seizures occurring when watching TV’. This colour-luminance sensitivity could be extended to any screen viewing by students, and the awareness of visual image effects extended to all educators.

Other examples of public access stimulus material include *Twilight Breaking Dawn: Part One* (<http://www.dailymail.co.uk/news/article-2066010/Twilight-birthing-scene-triggers-wave-seizures-cinemas-US.html>), 2012 Citroen car advertisement (<http://www.dailymail.co.uk/health/article-2087772/Citroen-advert-banned-TV-triggering-epileptic-seizures-viewers.html>) and some video games. Most video game manufacturers include a warning regarding seizures in their support package. One example reads, ‘[e]ven people who have no history of seizures or epilepsy may have an undiagnosed condition that can cause these “photosensitive epileptic seizures” while watching video games’ (<http://support.xbox.com/en-US/xbox-360/games/photosensitive-seizure-warning>). It goes on to include a list of symptoms including temporary loss of awareness.

Schools in Australia are not mandated to apply regulations similar to those governing broadcast television within the classroom. Currently familiarity, use and interpretation of digital media parameters, guidelines and manuals are at the discretion of individual educators.

Why investigate the current level of teacher knowledge and confidence regarding visual photosensitivity?

The increased use of digital media in schools combined with the possibility of students not being aware that they were photosensitive creates a potentially risky situation in the classroom. If educators are aware of safe digital media parameters and practices, then the risk to students with photosensitivity is greatly reduced. In 2005, the Disability Standards in Education promoted the use of reasonable adjustments in classroom strategies to allow equitable access to education for all students. In 2013, ACARA released a document entitled 'Student Diversity and the Australian Curriculum'. This document states that teachers are to 'take account of the range of their students' current levels of learning, strengths, goals and interests and personalise learning where necessary through adjustments to the teaching and learning program, according to individual learning need,' (ACARA, 2013, p 6). Also, that it 'support[s] teachers in meeting their obligations to ensure equity of access to the Australian Curriculum for all students'(ACARA, 2013, p 7). The assumption appears that teachers are able work with students who have barriers to full participation in learning activities (including photosensitivity) and adequately support them through reasonable classroom adjustments. Considering that photosensitivity is a relatively new phenomenon to encounter in the classroom and is not currently recognised in Western Australia as a disability, two questions were raised; how much do current teachers know about it, and do they have easy access to appropriate classroom pedagogies to support these students?

This investigation was designed to determine the current level of knowledge and confidence of teachers when working with students who are photosensitive. If the results displayed high levels of knowledge and confidence, then we can assume that equity of access for students with photosensitivity is being observed in classrooms utilising digital media. If the results displayed low levels of knowledge and confidence, then it is possible that equity of access for students with photosensitivity is not being observed in classrooms utilising digital media. The follow up question regarding teacher access to appropriate classroom pedagogies to support these students addresses the current opportunity for teachers to personally rectify any perceived discrepancy in equity during digital media use.

Survey

The survey was generated focusing on the current Australian educator's level of knowledge about photosensitivity and confidence (self-efficacy) in teaching students with this trait. Confidence items are used to determine situational self-efficacy. Bandura (1982, 2006) describes the operational process of self-efficacy, and that confidence must be present before an action is performed (Bandura, 1986). For the remainder of this paper, confidence and self-efficacy are used interchangeably. Some knowledge questions were adapted from Wodrich et al. (2011) including an item regarding possible side effects of anti epileptic medication. One confidence item was adapted from Bishop and Boag (2006), who surveyed teachers regarding their knowledge and confidence in teaching students with epilepsy. (Confidence Item 6 involves describing the student's response for medical personnel.) Other knowledge questions were generated specifically for this survey. (Item 28 asked the participant about seating arrangements, specifically regarding lighting requirements.)

Since length of use of digital media can act as a cumulative trigger for these students, additional sections regarding type and hours per day of digital media use were included as well as preferred source of information for educators. These were included for three reasons; firstly, to act as a digital media use benchmark for 2013 in Australian schools. Secondly, to indicate whether screen based visual stimuli was present for only short periods of the day, and thirdly to determine the best method of sending out information regarding changes in policy or disability status. It was premised that educators would follow the trend of preferences for information changing dramatically from books

and hard copy to online journals and Google (Bronstein, 2010; Kingsley et al., 2011). Calls for participation were circulated through teacher networks on social media. The point of contact was the webmanager, association secretary or president. 11 groups provided feedback supporting the call for participants. Participants of these groups were either emailed an Invitation Letter, or the Information Letter was included in the next newsletter. Completion of the anonymous online survey was taken as tacit consent for use of information provided. The survey allowed participants to withdraw at anytime. Through Survey Monkey, 61 surveys were returned, between November 2012 and February 2013. ‘Viable response’ was determined by completion of a survey section. Partially completed and empty survey sections were removed from the data set whilst completed survey sections were retained. Of these 61 surveys:

- 43 (70.5%) contained viable responses for digital media use
- 41 (67.2%) contained viable responses for confidence items
- 40 (65.6%) contained viable responses for information dissemination items
- 37 (60.7%) contained viable responses for knowledge items

The demographic results showed more females than males participated (60.5%, 26 out of 43), the majority of respondents being teachers (86.0%, 37 out of 43) other respondents were Education Assistants and one ‘other’. The majority of the respondents were from metropolitan schools with regional and remote respondents accounting for 8 and 5 surveys, respectively.

Digital Media Types

The types of Digital Media reported being used by educators (Table 1) ranged from ‘smart’ phones (32.6%, 14 out of 43) to personal computers (90.7%, 39 out of 43).

Table 1 Types of Digital Media (DM) used (n(responses)=43)

| | | |
|----------------------|------------------------------|----|
| Types DM used | Personal Computer | 39 |
| | IAW (Interactive Whiteboard) | 28 |
| | Television | 9 |
| | Tablets | 15 |
| | Phones | 14 |
| | Other | 4 |

Table 2 Amount of time spent with digital media during school hours (n(responses)=43)

| | IAW | Student personal computers | Television | Other digital media |
|---------------------------|-----|----------------------------|------------|---------------------|
| Don't have | 15 | 3 | 37 | 24 |
| < 1 hr per day | 2 | 24 | 0 | 0 |
| 1-3 hrs per day | 16 | 8 | 5 | 18 |
| > 3 hrs per day | 10 | 8 | 1 | 1 |

Table 2 displays the amount of time spent with digital media during school time. Some of these devices were used for less than one hour per day (60.4%, 26 out of 43) whereas others were used for more than 3 hours per day (46.5%, 20 out of 43). Some educators would utilise multiple device types

at different times throughout the school day. It is also possible that multiple device types are used concurrently, for example the IAW and personal computers.

Level of Knowledge of Photosensitivity

The remaining results are grouped into two categories: educators professing knowledge about photosensitivity (KP – Knowledge of Photosensitivity) and those professing no knowledge about photosensitivity (NKP – No Knowledge of Photosensitivity). Table 3 shows the self reported level of knowledge regarding photosensitivity of the respondents. Item 22 (...Please rate your current knowledge regarding photosensitivity) was used to divide the respondents to allow analysis of confidence between groups.

Educators rating their current knowledge of photosensitivity as ‘none’ were labelled as NKPs (n=21) for the confidence data analysis. The NKPs were not invited to answer the question asking the source of their knowledge of photosensitivity, however they were invited to answer a question regarding future sources of information regarding photosensitivity. The NKPs did not progress in the survey to answer individual knowledge questions. All NKP respondents had ‘Don’t Know’ entered as answers to the items relating to photosensitivity knowledge to reflect their self reported no knowledge of photosensitivity.

Table 3 Level of knowledge regarding photosensitivity

| | |
|-----------|----|
| None | 21 |
| Small | 18 |
| Med | 1 |
| Large | 1 |
| Extensive | 0 |

Educators rating their current knowledge of photosensitivity as ‘small amount’, ‘medium amount’, ‘large amount’ or ‘extensive’ were labelled as KPs (n=20) for the confidence data analysis. Only two respondents self reported a knowledge level of medium or above. KPs completed an additional question regarding the actual source of their knowledge regarding photosensitivity as well as the question answered by the NKPs regarding preferred future sources of information regarding photosensitivity. KPs were invited to answer individual knowledge items regarding photosensitivity.

Confidence

Confidence items were scored using a 6 point Likert-type scale. Response categories were ‘no confidence’ (0%), ‘little confidence’ (20%), ‘some confidence’ (40%), ‘moderate confidence’ (60%), ‘high confidence’ (80%) and ‘extreme confidence’ (100%). Each confidence item referred to a situation within a classroom, and asked the educator to self report the level of confidence they had in working with that situation. Internal reliability for the confidence items was tested using Cronbach’s alpha. Cronbach’s alpha was computed to be 0.937, which indicates good reliability.

Table 4 shows responses for each confidence item grouped into two categories: No/Little confidence and Some/Moderate/High/Extreme Confidence. Of the 43 viable responses, 17 (40%) showed No/Little confidence for every item.

Table 4 Summary of educator’s responses into two confidence categories

| Confidence Item | No/Little Confidence | Some/Moderate/High/ Extreme confidence |
|------------------------|-----------------------------|---|
|------------------------|-----------------------------|---|

| | (0%/20%) | (40%/60%/80%/100%) |
|---|------------|--------------------|
| 1. Ability to create classroom accomodations | 21 (51.2%) | 20 (48.8%) |
| 2. Ability to recognise side effects of medication and impacts | 21 (51.2%) | 20 (48.8%) |
| 3. Ability to determine barrier to classroom progress | 24 (58.5%) | 17 (41.5%) |
| 4. Ability to determine need for outside school resources/interventions | 24 (58.5%) | 17 (41.5%) |
| 5. Ability to judge adverse response to specific light combinations | 26 (63.4%) | 15 (36.6%) |
| 6. Ability to describe student's adverse response to medical personnel | 26 (63.4%) | 15 (36.6%) |

Initial analysis also suggested a possible difference in means between teachers self reporting knowledge about photosensitivity (KPs), and those reporting no knowledge about photosensitivity (NKPs). Using SPSS 20, Independent Samples t-test were run for each of the Confidence Items. Results were taken from the 'Equal Variance not Assumed'. This value was chosen because of the sample size and skewed distribution. Three confidence items showed no significant mean difference between NKPs and KPs ($p < 0.01$), these items are displayed by tally plot in Figure 3.



Figure 3. Confidence items 1,2 and 4, no significant mean difference between NKPs and KPs ($p < 0.01$)

Confidence Item 1: KPs had higher levels of confidence in creating classroom accommodations for students with photosensitivity (M=3.05, SD=1.15) than NKPs (M=2.38, SD=1.60). The mean difference was not significant using the independent measures t-test [t(36.3)=1.55, $p = 0.130$].

Confidence Item 2: KPs had higher confidence in recognizing side effects of medication ($M=2.90$, $SD=1.29$) than NKP ($M=2.33$, $SD=1.24$), but again the difference was not significant [$t(38.7)=1.43$, $\rho=0.160$]. Confidence Item 4: Confidence in describing a student's adverse reaction to light stimuli for medical personnel continued the similar results for KPs ($M=3.10$, $SD=1.33$) while the NKPs were slightly lower ($M=2.24$, $SD=1.41$). This result showed no significant difference of means at $\alpha=0.01$ level in the t-test [$t(39.0)=2.01$, $\rho=0.051$].

Three confidence items showed significant mean difference between NKPs and KPs ($\rho<0.01$), these items are displayed by tally plot in Figure 4. Confidence Item 3: Confidence in recognizing the need for outside school resources or interventions remained high in the KPs ($M=3.10$, $SD=1.25$), but dropped in the NKPs ($M=2.05$, $SD=1.16$). These means were significantly different at $\alpha=0.01$ level [$t(38.4)=2.79$, $\rho=0.008$]. Confidence Item 5: KPs self reported similar levels of confidence to other items in their ability to determine whether a barrier to classroom progress is caused by photosensitivity ($M=3.05$, $SD=1.19$) whereas the NKPs showed their lowest item mean and tightest standard deviation ($M=1.76$, $SD=0.83$). This returned a t-test score of $t(33.8)=4.00$ ($\rho=0.000$), this suggesting a significant difference between the two group means. Confidence Item 6: The final confidence item responses were similar to Confidence Item 5. KPs remained around 'Some Confidence' with a fairly loose standard deviation ($M=2.95$, $SD=1.28$) in response to the item 'ability to judge if a student is responding adversely to specific light combinations'. The NKPs remained fairly low in confidence but expanded their standard deviation ($M=1.81$, $SD=1.03$). These means were significantly different with $t(36.5)=3.14$, ($\rho=0.003$).

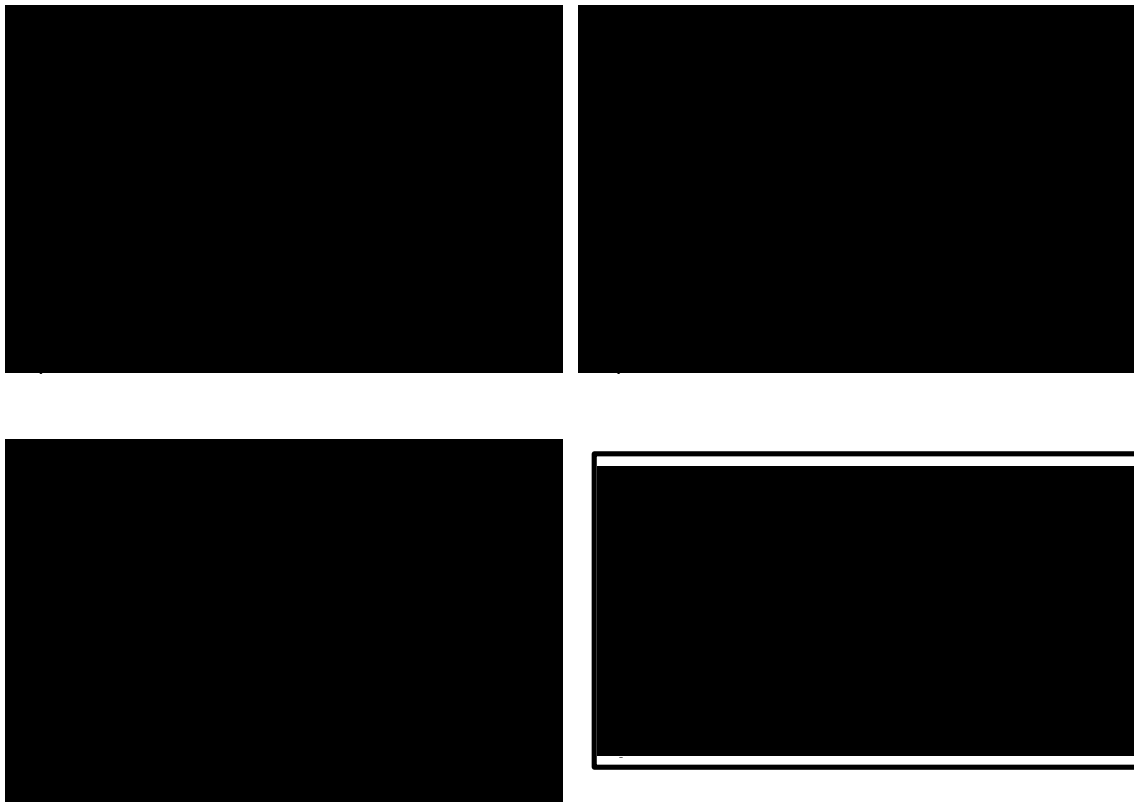


Figure 4. Confidence Items 3, 5 and 6 showing significant mean difference between NKPs and KPs ($\rho<0.01$).

Overall three of the six confidence items showed significant differences between group means of KPs and NKPs at $\alpha=0.01$ level. Although questions five and six both mention the term 'adverse response' there seems no further reason for the KPs' mean being significantly different from the NKPs' mean. It should be noted that all confidence item means showed the NKPs at the lower end of the confidence

range and the KPs at the higher end of the confidence range. This finding is important as it indicates a possible correlation between knowledge about a syndrome and confidence in teaching a student diagnosed with it. This finding would warrant further research with the objective to support both educators and students with a disability working in mainstream classrooms.

Knowledge

KPs (educators professing knowledge about photosensitivity, n=16) answered 9 items. The most widely known/correctly answered knowledge item was the categorization of photosensitivity as a neurological phenomenon, rather than contagious, permanent or a psychological phenomenon. Twelve of the sixteen KPs returned this response. One of the least widely known/correctly answered knowledge items was the identification of red as the most highly stimulative colour on screen, as opposed to violet, blue and yellow. Only one of the sixteen responded with the correct answer only, the remaining responses were either incorrect, added 'Don't Know' to their answer, or added incorrect options. The remaining seven items were ranged from the most widely known, to equal the least widely known.

Along with the twenty NKPs, the results from this section of the survey suggest that many of the typically responding educators do not possess the entire array of knowledge necessary to support a student with photosensitivity working with digital media.

Information Sources

From the survey, educators professing knowledge about photosensitivity (KPs) responded twice. For the source of KPs current knowledge they ranked people (parents, teachers and students) first, then websites. For source of future knowledge KPs ranked the student first, 'professional development by medical professionals' second and websites third. NKPs (educators professing no knowledge about photosensitivity) responded only once to the knowledge source question. They ranked 'professional development by medical professionals' first, then 'other teachers'. Websites ranked third. A summary of these results is shown in Table 5.

Table 5: Information source ranking by KPs and NKPs

| | Rank KPs Current Knowledge | Rank KPs Future Knowledge | Rank NKPs Future Knowledge |
|-----------------------------|----------------------------------|---------------------------------|----------------------------------|
| Parents | 1 | 4 | 6 |
| Other teachers | 2 | 6 | 2 |
| Student | 3 | 1 | 6 |
| Website | 4 | 3 | 3 |
| Journal | 5 | 7 | 6 |
| Professional development by | | | |
| medical personnel | 5 | 2 | 1 |
| University teacher training | 7 | 8 | 9 |
| Nurse | 8 | 5 | 3 |
| Pamphlets | 8 | 9 | 5 |

Although this table raises some interesting points, it must be remembered that they are from a non representative sample and therefore should not be taken as indicative of the whole population of educators in Australia. One obvious discrepancy lies between the source through which educators would prefer to access information (websites), and the ability for that to occur. An audit of easily accessible websites with information relevant to classroom pedagogy to support students with photosensitivity returned few hits. The most useful included a brochure produced by The Department of Education of the Northern Territory called Vision in the Classroom (http://www.education.nt.gov.au/__data/assets/pdf_file/0016/2293/VisionInClassroom.pdf). Although this straightforward brochure is aimed at supporting those students with ‘vision problems’, it is also applicable to students with photosensitivity, and very easy to read.

The Tasmanian Department of Education provided the document ‘Concepts and skills for Operating with ICT’. This document includes (p. 12)

Key focus areas - Suggested content focus

Occupational Health and Safety (OH&S)

- Demonstrating correct posture
- Being aware of ergonomic principles
- Identifying and following ICT safety procedures
- Identifying health and safety risks as a result of misusing ICT
- Awareness of what constitutes a safe and healthy ICT environment ‘

(<https://www.education.tas.gov.au/documentcentre/Documents/Tas-Curriculum-K-10-ICT-Syllabus-and-Support.pdf>). The suggested content focus may be at the discretion of the educator, but awareness of environmental pressures and influences is present.

Discussion

There are currently no enforced guidelines governing epileptogenic material on the Web (e.g. YouTube, Wikipedia). There is however a movement towards application of WCAG2.0 (Web Content Access Guidelines 2.0, www.w3.org/TR/WCAG20/). WCAG2.0 is an initiative by the World Wide Web Consortium (WWWC) led by web inventor Tim Berners Lee and CEO Jeffrey Jaffe. The WWWC recognizes that digital medium may be restrictive to groups of people and has recommended the gradual global implementation of WCAG2.0. WCAG2.0 includes the following in its abstract:

Web Content Accessibility Guidelines (WCAG) 2.0 covers a wide range of recommendations for making Web content more accessible. Following these guidelines will make content accessible to a wider range of people with disabilities, including blindness and low vision, deafness and hearing loss, learning disabilities, cognitive limitations, limited movement, speech disabilities, photosensitivity and combinations of these. Following these guidelines will also often make your Web content more usable to users in general.

The Australian State and Territory Government websites are currently compliant to a Level A rating of WCAG2.0 with the exception of South Australia (<http://www.mediaaccess.org.au/research-policy/australian-governments-access-policies/state-and-territory-adoption-of-wcag-20>). The Australian Government accessibility website states that national websites will gradually increase in rating to a Triple A (<http://australia.gov.au/accessibility>).

Knowledge of policy including WCAG2.0 is strongly related with technological pedagogical choices for our classes. In 2009, Koehler and Mishra created a model which depicts the interaction of Technological, Pedagogical and Content knowledge (TPACK) at work to determine classroom practice when integrating technology (Koehler and Mishra, 2009).

Technological Pedagogical Knowledge is defined as

[a]n understanding of how teaching and learning can change when particular technologies are used in particular ways. This includes knowing the pedagogical affordances and constraints of a range of technological tools as they relate to

disciplinarily and developmentally appropriate pedagogical designs and strategies (Koehler & Mishra, 2009).

These constraints would include the inherent safety practices and procedures associated with use of technology including digital media. In TPACK explained the definition of Technical Knowledge includes

being able to recognize when information can assist or impede the attainment of a goal (Koehler, n.d.).

The use of saturated red as a block colour for a large percentage of an IAW screen would be classed as such. Recognition of student impedimenta regarding neurological reactions to digital media falls to the educator. Definition and diagnosis of neurological impedimenta falls to the medical community. As shown in the survey, many Australian teachers are currently not confident in their ability to work with students with photosensitivity, or even describe the symptoms triggered to medical personnel. Digital dependent subjects such as Media studies and other areas in the Arts currently have no wavelength or pattern parameters set, nor are there standardized guidelines for safer classroom use of digital media. Educators using lights, patterns or any sort of digital media should be aware of the potential impact they have on this group of students, and what symptoms they should look for. Seizure is the worst-case scenario, and would happen rarely, headache, migraine and attention loss would be far more common as symptoms of photosensitivity.

Although education departments in Australia do not currently recognize photosensitivity as a disability, it does fit the category as stated in Western Australia's Disability Services *Count Us In: Teacher Information Book* (2010). The information book asks the question (p. 7) 'What is a disability?' The final three paragraphs of the answer are as follow:

A disability may be short or long term and some are episodic. Many people may have more than one disability.

A disability can affect a person's capacity to communicate, interact with others, learn or get about independently. Some disabilities, such as epilepsy, are hidden, while others, such as cerebral palsy, may be visible.

A disability can impact on a person's employment, education, recreation, accommodation and leisure opportunities.

All of these characteristics apply to students with photosensitivity. These students deal with an episodic, often comorbid, usually hidden trait which impacts their social and cognitive endeavours. These students would be well served by educator awareness, recognition and support for their syndrome. Support would include accessible, concise, medically sound information on which to base reasonable adjustments for students in the classroom.

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