Throwing Light on Migraine Triggers

Report on a Lamp Trials project conducted jointly by Megaman UK Limited and the charity Migraine Action, Spring 2012

Megaman, one of the world's leading manufacturers of compact fluorescent lamps (CFLs,) joined forces with UK charity Migraine Action to conduct a joint research project in the early part of 2012. The project, to monitor the effects of exposure to CFLs with different light characteristics on migraine sufferers with light sensitivity issues, was designed to identify which, if any, light sources were more or less likely to trigger migraines.

The trials, which were implemented using a small-scale group of just 25 volunteer subjects, indicate that lamps of certain colour temperatures could cause up to twice as many attacks as other lamps, while others were more benign.

The results also indicated that smaller 'point source' format lamps (such as spot lamps and small bulbs) were probably more likely to trigger migraines than larger sources (e.g. large diameter globes).

Background

Since the ready availability and widespread adoption of compact fluorescent Lamps (CFLs) within the last five years, a number of sufferers from Migraine (migraineurs) have reported that the energy saving light bulbs have triggered migraine attacks. The recent phasing out of traditional (incandescent) light bulbs by European governments has brought this challenge further into focus, since without the use of the universally accepted older style bulbs, only CFLs, 'Eco-Halogen' and LED based lighting products are now officially available for the domestic environment.

While there have been many anecdotal reports in both printed and online media of migraines triggered by CFLs, there have to date been no large scale clinical or scientific studies to determine exactly how widespread the phenomenon is, or what the root cause of such triggers could be. An authoritative report by the Association for the Conservation of Energy (ACE) in 2009 confirmed that robust research had at that time been inadequate globally, and that various anecdotally reported health problems had not been followed up scientifically.[1]

However, there is no doubt that migraine is a global phenomenon. Separate European and American studies for the World Health Organisation (WHO) have shown that 6-8% of men and 15-18% of women experience migraine each year and it is estimated that 14% of the adults in Europe are affected by the affliction [2]. In the UK the affliction currently affects around 9 million people (about 14% of the population). [3]

The ACE Report suggested that light spectrum is the technical property regarded in scientific circles as being connected to the greatest number and widest range of potential health issues associated to CFLs, but knowledge on the effects of incomplete spectrum of lighting (or non-full spectrum lighting) and on the effect of particular ranges of the light spectrum is sketchy. Particular ranges in the spectrum have been connected with both positive and negative effects on health, and blue light in particular has been connected broadly with negative effects.

As a result of these issues, Megaman UK agreed to conduct a small-scale trial of different CFLs with a panel of 25 volunteers provided by Migraine Action, with a view to identifying potential triggers and seeking the best lighting solution for severe migraine sufferers.

Structure of the Lamp Trials

The 25 volunteer participants were asked to record their reactions (if any) to CFL light bulbs of four different colour temperatures [4] – just discernible by the human eye as minor differences in brightness and colour. They were asked to use each colour temperature for a period of one week, recording their reactions on a single response form covering the entire four week trial.

The four week schedule for the trial was as follows:
Week 1: Colour Temperature 2300K [warmest]
Week 2: Colour Temperature 2700K
Week 3: Colour Temperature 4000K
Week 4: Colour Temperature 6500K [coolest]

Where the bulbs were used

The participants were asked to use the bulbs in exactly the same way that they would use a traditional incandescent bulb, in a frequently used area of the domestic dwelling like a living room. It was pointed out that it was not necessary to leave each bulb switched on for unusually long periods, or to leave it on if a migraine attack were triggered

Different caps and bulb shapes

Because of the wide variety of domestic lamp fittings here in the UK, participants were provided with a selection of four different styles of light bulb and cap for each colour temperature, that is, they each received sixteen bulbs in all, to cover most light fitting variations. The most common UK fitting (22 millimetre bayonet fitting or B22) made up at least two bulbs in each of the four colour temperature groups. Because some light fittings are restricted in the size or shape of light bulb used (e.g. halogen type spotlights) a further variety of bulb for each colour temperature group was provided.
The four Megaman lamps used were;
GSU420 (20 Watt 147mm diameter globe, bayonet cap)
GSL0111 (11 Watt standard GLS pattern, bayonet cap)
BR0711i (11 Watt reflector, GU10 two-pin base)
GSU215 (15 Watt small diameter globe, bayonet cap)

Recording Attacks

Participants were advised that should they suffer a migraine attack, they should switch off the offending bulb straight away and record their experiences, repeating the experiment every day for a week if possible. If very severe attacks were triggered they were advised to simply record this and stop using the bulb for the remainder of the week.

Analysing Results

In order to analyse the results sent in by participants, the hand written report form entries needed to be converted to a digital spreadsheet matrix to identify patterns, repetitions or trends occurring across all participants. This was done in two stages: The first stage was to take the data sent in by participants and enter this manually into a single spreadsheet for each colour temperature lamp, recording how many triggers occurred and at what severity. The second stage was to process the resulting collection of spreadsheets, giving each entry a "score" indicating how many attacks were triggered during the one week trials. This enabled patterns or trends to be identified.

For the purpose of recording and analysis, the way in which scoring was made was to mark each attack simply as a 'one', relative to the length of that particular lamp trial. For instance one attack over a seven day trial period would count as 1/7, (14% or simply '14') while two attacks over a six day trial period would count as 2/6 (i.e. 33% or simply '33'). Attacks triggered every day would register as 100% (or simply '100') whether the trial was over one day or several. No attacks recorded for any trial period would register as a '0'.

It should be noted that as the trials were small scale, informal, and unsupervised, they inevitably contained some anomalies, for instance:

a) While most report forms were completed or correctly filled in, a small number were incomplete or ambiguous

b) One respondent was such a severe sufferer that while not all trials were completed by her, those which were recorded registered 100% attacks throughout

c) Recording the severity of an attack is clearly subjective and so scores (1 to 10) needed to be taken in context as such.

The analysis stripped out both the zero returns (i.e. respondents who didn't record any results at all) and those who did record results, but didn't record which lamps they were using. By doing this, most obvious "doubtfuls" were removed, with a consequent reduction in sample size.

Summary of Results

Lamp Temp (K)	2300	2700	4000	6500
Attack scores %	18	14	28	17
100% attack scores	2	0	4	2

Lamp Type	GSU420	GSL111	GSU215	BR0711i
Attack scores %	16	16	32	15

These results clearly show that the 4000K lamps caused up to twice as many attacks as the other lamps (when extreme sufferer responses are ignored), while the 2700K lamps were the most benign. Interestingly, the coolest bulb colour temperature (6500K) caused fewer attacks than 4000K types.

- The GSU215 recorded about twice as many attacks as any of the others.
- The GSL111 (standard GLS light bulb shape) caused least problems.

However, some additional factors need to be taken into account:

1. While the one spotlight (BR0711i) did not appear at first glance to cause more problems than any of the other three types tested (in fact just less), very few tests were actually carried out using this lamp. Only two participants out of the twenty five used them, and one of these tried out no other type of bulb. Bearing this in mind, we suggest that the figures for the BR0711i should be discounted
2. There were many more tests carried out using the GSU420 than any other bulb

While the 20W (GSU420) globe bulb is a lot a bigger and more powerful than the 15W (GSU215) bulb trialled, it appeared to cause fewer problems. This could be because it has a different coating which gives off less glare, and also represents a larger (less intense) light source.

Anecdotal Notes

Separately to the detailed participant reports from which this analysis is drawn, a number of participants (10 in total) were kind enough to provide a separate narrative describing their personal experiences during the trial. These anecdotal notes sometimes included details of their particular migraine symptoms, relevant background information and their likes (or dislikes) of particular lamp colour temperatures.

What the notes reveal is that while migraine sufferers endure a wide range of 'triggers', these triggers vary enormously between sufferers and severity of attacks also vary considerably. Several mentioned that their attacks were mainly triggered through monthly changes in hormone levels, while others mentioned that shopping was difficult because of the fluorescent lighting in high street stores. Of the ten participants who provided these notes, four were at pains to point out that they did not believe the use of CFLs caused their migraine attacks at all.

Phrases like: "..I had a migraine before the lights were turned on.." and "..I don't know what triggers my migraines.." as well as "..These bulbs were much better than previous CFLs tried out – they caused no problems at all.." would indicate that a proportion of previous anecdotal reports may have been due to some of the characteristics of early CFLs (e.g. flicker, electromagnetic radiation, wide colour temperature variations, etc.) which have since been improved or corrected in newer models.

It was also notable that opinions on comfort levels also varied. While most participants in the trial felt most comfortable using the higher temperature bulbs (2300K and 2700K) there were complaints that these lamps were "too dim" for practical purposes like reading. However, (ironically) while the cooler lamps (4000K and 6500K) statistically resulted in fewer attacks, several anecdotal notes reported that some participants hated using what were described as "too bright" or "too blue" bulbs which caused conventional headaches.

One participant mentioned that while the 6500K bulbs were "unpleasant", they found the 4000K version the best, in complete contradiction to the overall results of the trial.

One conclusion we can draw from these notes is that there is an enormous variation in triggers, symptoms and comfort levels across migraine sufferers, and what might seem to be acceptable and comfortable for some cannot be tolerated by others. As a result it would clearly be unwise to select one type of bulb, or one type of colour temperature as providing a universal panacea for all sufferers, and that each individual seeking the best lighting solution should take the trouble to try out a selection of available bulbs.

It would seem however, that statistically one colour temperature (2700K) probably does cause fewer triggers than others and that if a special "Migraineur's CFL" were to be made available this would be the colour temperature chosen.

Summary Conclusions

The relatively small scale of these lamp trials, and the fact that they were not conducted under tightly controlled scientific conditions, mean that the results obtained cannot be viewed either as definitive or accurate. The group of participants were all acknowledged migraine sufferers, so any conclusions from these trials cannot be applied to the general public (of average health).

They do however provide us with some indicators which might form the basis for future, more rigorously structured investigations. This might hopefully lead to guidelines which could inform the choice of artificial lighting for migraineurs.

The records provided by this group of participants indicate that:

a) A standard 'GLS' traditionally shaped bulb of colour temperature 2700K resulted in fewer 'triggers' than other types tested.
b) Warmer and cooler colour temperatures than 2700K (e.g. 2400K and 4000K and 6500K) triggered more attacks.
c) 4000K bulb types caused most attacks.
d) A small diameter 'globe type (GSU215) triggered more attacks than a larger, more powerful type (GSU420) indicating that glare or intensity of the light source may also be a factor.
e) The range of colour temperatures tested would seem to represent the limits of practical application, as a number of participants viewed 2300K types as "too dim" and 6500K types as "too bright" or "too intense".

References

1 ACE Report: "Mapping knowledge on low energy lamps and health"
http://www.ukace.org/index.php?option=com_content&task=view&id=538&Itemid=45
2 WHO Factsheet: http://www.who.int/mediacentre/factsheets/fs277/en/
3 Migraine Action: http://www.migraine.org.uk/index.php?sectionid=11)
4 Colour Temperature: http://en.wikipedia.org/wiki/Color_temperature

Subject	2300K			2700K			4000K			6500K			Averages
	A	T	Score	A	T	Score	A	T	Score	A	T	Score	
1	1	7	14	2	7	29	3	7	43	2	7	29	29
2	7	7	100	0	7	0	0	7	0	0	7	0	25
3	0	6	0	0	7	0	3	7	43	1	3	33	17
5	2	7	29	2	6	33	4	7	57	1	7	14	33
6	7	7	100	5	7	71	1	7	14	0	7	0	46
7	0	7	0	0	5	0	3	3	100	0	7	0	14
8	1	7	14	0	7	0	0	4	0	0	7	0	4
9	0	7	0	0	7	0	0	7	0	0	7	0	0
10	3	6	50	1	7	14	2	6	33	0	7	0	23
11	0	7	0	0	6	0	0	0	0	0	7	0	0
12	0	7	0	0	7	0	0	7	0	0	0	0	0
13	0	7	0	0	7	0	0	7	0	0	6	0	0
14	0	7	0	1	7	14	1	7	14	2	7	29	14
15	0	7	0	0	5	0	0	5	0	1	7	14	4
16	0	7	0	0	7	0	0	7	0	0	6	0	0
17	0	7	0	1	7	14	3	7	43	1	7	14	18
18	4	7	57	2	3	67	1	7	14	5	5	100	55
19	0	7	0	0	7	0	0	7	0	0	7	0	0
20	1	7	14	0	7	0	1	7	14	2	7	29	14
21	0	6	0	0	6	0	0	5	0	0	5	0	0
22	3	7	43	3	7	43	5	5	100	3	7	43	54
23	0	5	0	0	1	0	3	3	100	0	0	0	33
24	0	7	0	0	7	0	0	7	0	0	7	0	0
25	0	7	0	3	5	60	2	2	100	3	3	100	47
Lamp scores %	29	163	18	20	149	13	32	138	23	21	140	15	
Lamp Average			**18**			**14**			**28**			**17**	
True Zeros			**15**			**15**			**11**			**14**	
100%			**2**			**0**			**4**			**2**	

Appendix 2: Tabulated results by Lamp Types

GSU420					GSL111					GSU215					BR0711i				
S	Temp	A	T	%	S	Temp	A	T	%	S	Temp	A	T	%	S	Temp	A	T	%
7	2300	0	7	0	2	2300	7	7	100	1	2300	1	7	14	15	2300	0	7	0
13	2300	0	7	0	3	2300	0	6	0	5	2300	2	7	29	15	2700	0	5	0
17	2300	0	7	0	9	2300	0	7	0	8	2300	1	7	14	25	2700	3	5	60
23	2300	0	5	0	12	2300	0	7	0	10	2300	3	6	50	15	4000	0	5	0
7	2700	0	5	0	14	2300	0	7	0	20	2300	1	7	14	15	6500	1	7	14
8	2700	0	7	0	16	2300	0	7	0	21	2300	0	6	0					
9	2700	0	7	0	18	2300	4	7	57	22	2300	3	7	43					
10	2700	1	7	14	19	2300	0	7	0	24	2300	0	7	0					
12	2700	0	7	0	5	4000	4	7	57	6	2700	5	7	71					
13	2700	0	7	0	6	4000	1	7	14	18	2700	2	3	67					
14	2700	1	7	14	8	4000	0	4	0	14	4000	1	7	14					
16	2700	0	7	0	9	4000	0	7	0	18	4000	1	7	14					
17	2700	1	7	14	10	4000	2	6	33	20	4000	1	7	14					
19	2700	0	7	0	12	4000	0	7	0	22	4000	5	5	100					
20	2700	0	7	0	16	4000	0	7	0										
21	2700	0	6	0	24	4000	0	7	0										
22	2700	3	7	43															
23	2700	0	1	0															
24	2700	0	7	0															
1	4000	3	7	43															
2	4000	0	7	0															
3	4000	3	7	43															
7	4000	3	3	100															
13	4000	0	7	0															
17	4000	3	7	43															
19	4000	0	7	0															
23	4000	3	3	100															
1	6500	2	7	29															
2	6500	0	7	0															
3	6500	1	3	33															
6	6500	0	7	0															
8	6500	0	7	0															
9	6500	0	7	0															
10	6500	0	7	0															
13	6500	0	6	0															
14	6500	2	7	29															
16	6500	0	6	0															
17	6500	1	7	14															
18	6500	5	5	100															
19	6500	0	7	0															
20	6500	2	7	29															
21	6500	0	5	0															
22	6500	3	7	43															
24	6500	0	7	0															
Averages:				**16**					**16**					**32**					**15**