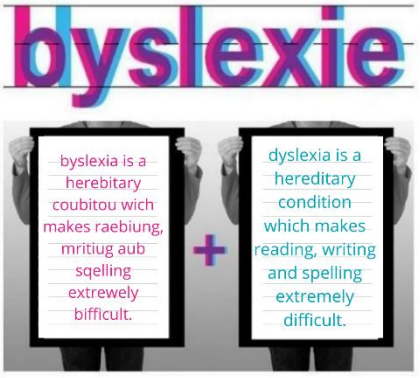
2021-2022 Professional degree in optics
Amélie Chassaing
Astrid Rancon

Dyslexia and vision



Summary

A) Definition of dyslexia

Dyslexia, is a pathology that is still little known to the general public. To help these people, two scientists from Rennes have carried out a study on the subject. Thanks to their work, one of the causes of dyslexia has been identified.

The definition of dyslexia according to the WHO (World Health Organisation) (1) is as follows: "Dyslexia is a specific reading disorder. It is also a persistent disorder of written language acquisition showing great difficulty in acquiring and automating the mechanisms necessary for mastery of the written word (reading, writing, spelling, etc.). It is a specific and long-lasting disorder because despite rehabilitation it will never disappear. The aim is for the patient to be able to compensate for it (as in speech therapy). It is neurological and hereditary. It is not related to intellectual efficiency, although there may be comorbidities.

There is a prevalence of about 10% of the population, 1 girl for every 3 boys. There are factors of variation with socio-economic background, mother tongue, gender. Dyslexia is synonymous with dysorthographia because one is the reversibility of the other.

There are several types of dyslexia: phonological dyslexia, surface, lexical or addressing dyslexia, and mixed dyslexia.

Dyslexia is a neurocognitive disorder whose pathophysiology is not known. It is a disorder that disrupts reading, comprehension, and the rhythm of reading, which often makes one think of children who are failing.

B) Study of the physicists of Rennes

A study by two physicists from Rennes has highlighted the relationship between the eyes and dyslexia. They built their study on the left-right asymmetry of the centroids of the points of the Maxwell task in adults with and without dyslexia. With the help of a foveascope they found that for 30 adults without pathology, the two blue coneless areas in the centre of the fovea are asymmetric, unlike dyslexics. Their tests are carried out on these people who have previously had an optometric assessment to rule out any binocular vision problems. The way their study works, an observer looks at a bright white screen through a blue filter, the coneless area in the centre of the fovea is seen as a dark area against a blue background. They have them set a frequency between 0.1 and 1 Hz (most often 0.2Hz). Then the observer will draw for each eye the contours of the blue zone without cones. In the case of an unaffected person there is an asymmetry and in the other case a symmetry. As shown in figures 1 and 2.

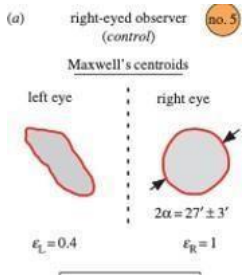


Figure 1 : Maxwell spot for a non dys

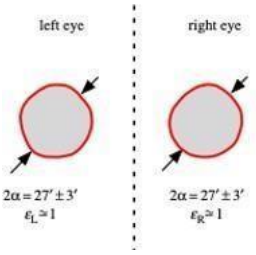


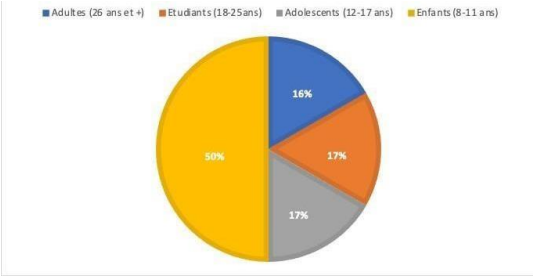
Figure 2 : Maxwell spot for a dys

C) Our study

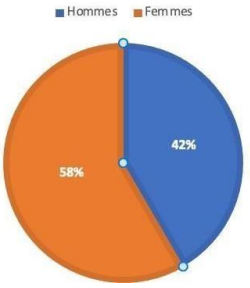
1.Our sample

The sample consisted of 12 dyslexic people, male/female, of all ages. We have a fairly young sample because the effects of dyslexia are more significant in children. They are in the early stages of treatment by the speech therapist, and have not yet developed many compensations. Here is the breakdown by age and gender:

Graphique 1 : Age sample



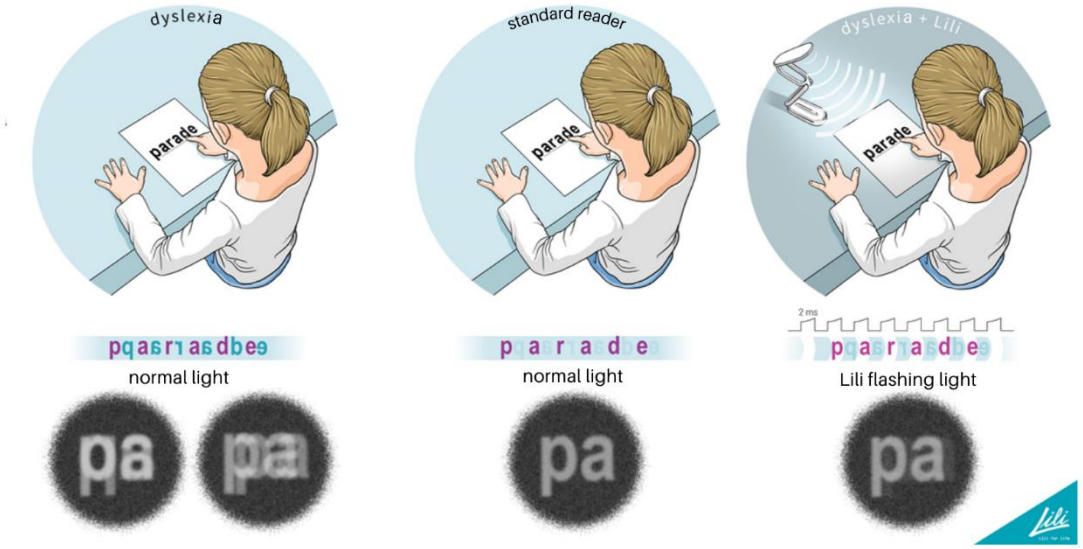
Graphique 2 : Gender sample

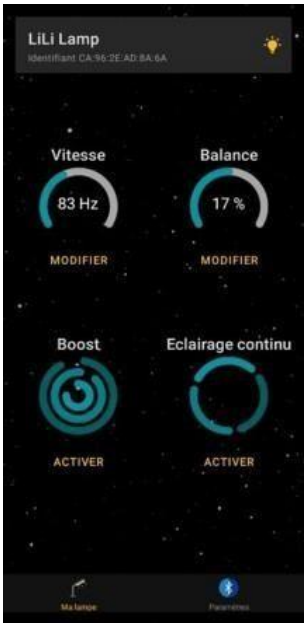


2) <u>Lili lamp</u>

The Lili lamp is a lamp to help people with dyslexia. It works on the basis of research by physicists. It emits flashes of light that remove mirror images or overlapping letters that interfere with reading. By removing these images, reading can be much more fluid, comprehensive and less tiring for the dyslexic person.
It will be released in May 2021 and is still quite expensive: it costs 349€. For the moment, it is not reimbursed by the social security or by mutual insurance companies. Lili for Life is fighting to be recognised by a scientific study, which would allow it to be labelled as a medical device, and thus make it possible for these authorities to reimburse it.

Neutral, the lamp aims to be very discreet, similar to a desk lamp. It is easy to carry and the user can use it anywhere.
It removes images that interfere with good reading. It creates a magnifying effect by increasing the space between words and the space between paragraphs. It also makes reading more fluid and understandable.
The effects may or may not be felt - this is up to each individual. To test it, the brand offers a 45-day trial, 100% satisfied or refunded. This allows the effects to be seen over a longer period of time and in different conditions, whether at home or at school.
A beta test conducted by Lili for Life was carried out on children and adults over a period of 4 months.
The result: an improvement in reading fluency and/or speed, and also fewer reading errors. As the mirror image is eliminated, the reader is less disturbed when reading.





The settings are specific to each user. You have to download the application on your smartphone and activate the Bluetooth then you connect the lamp. Once the settings are done, people can use it, the settings are saved. We start by adjusting the speed (HZ) by concentrating on the light flashes. Then the balance by trying several positions until you find the most optimal. It intervenes on the luminosity and thus the contrasts in percentage. And the lamp is set.

3) Methods

In an isolated room, in order to avoid distraction by noise, we first explained how the lamp works and what it does.
Then, the lamp is adjusted as needed. To do this, we connect the lamp via Bluetooth with the mobile application. We ask the person to look at a word in the book and concentrate on it. Then we turn on the lamp and adjust it. He will feel flashes of light and he must warn us when he no longer perceives them. We adjust the hertz in this way. To continue, we adjust the balance which is in percent. We compare several positions and keep the most comfortable one. Once the adjustments have been made, the person will read extracts from the book with and without the lamp. First of all they read with the lamp, and then we discuss their feelings.

If there is a difference in the size of the words. How are the spaces between the words or between the paragraphs. Then we have her read without the lamp and we keep an eye on the reading errors and the fluidity of the reading. After a while, the lamp is turned on without interrupting the reading. We exchange again on our feelings about the reading, its comfort. We take note of their reading with and without the lamp.

A short note from the parents present during the tests. It was noted that today it is very difficult to find a speech therapist. Often there is no help at school, which does not make it easier to support the child. They are delighted that research is progressing on the subject and that they can find other aids for their children to complement the work done by the speech therapist. However, the financial cost of these visual aids remains high and is a negative point. It was noted that most of the children who tested the lamp were from rural areas where there was a lack of speech and language therapists. There are 4 speech and language therapists with a one-year waiting time for a first appointment in the test location. Appointments at 6 months are available within an hour's drive in the larger towns. These journeys will add further fatigue to children already struggling with this. Moreover, parents do not always have the logistical possibility of honouring these appointments. Some of them are distraught, which is what we felt during the tests. All of these elements contribute to a loss of self-confidence and a feeling of being different in the eyes of others. In the end, it takes good professional support to overcome these difficulties. The path is not without pitfalls, but we must encourage them to persevere.

4) Results for Lili

For the different cases, we have grouped our results into graphs:
The lamp settings shown in graphs 5 and 6:

Figure 5: Setting the speed

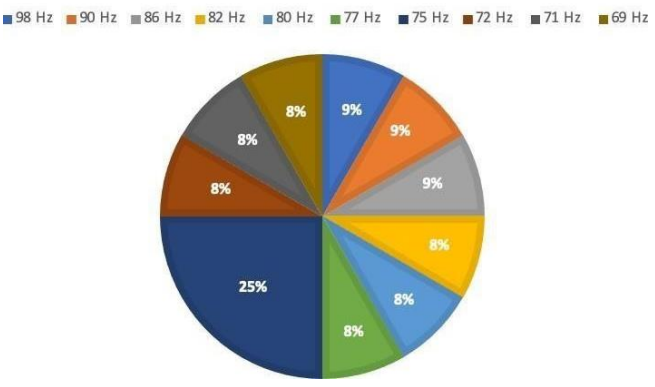


Figure 6 : Setting balance

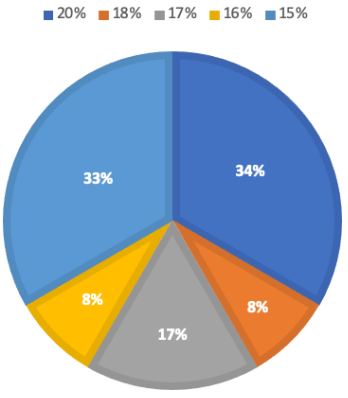
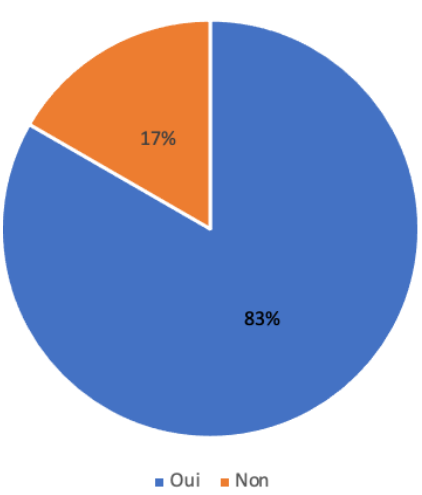
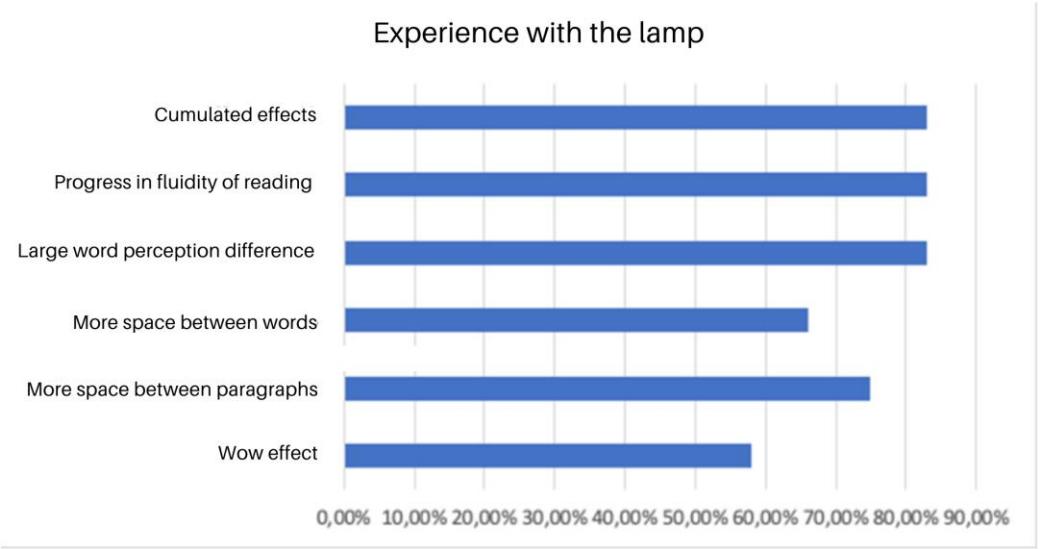


Figure 7 : Recommandation of the lamp



The effects that people felt during the tests on their reading, the space between words and paragraphs, the size of the words.

Figure 8 : The effects experienced with the lamp according to our study



There were 2 cases that did not feel any real effect, one child and one adult. They would have to leave the lamp on for a longer period to see if there is a real effect on reading or the magnification of words or spaces. This is why the brand offers a 45 day trial on their website which is 100% satisfied or refunded. Other people who have experienced an effect recommend the lamp, but are reluctant to invest money.
The feelings of our testers with the lamp are shown in graph 7.

4) <u>Situation de l'utilisation :</u>

For our testers, it was complicated to leave the lamp on for a long time. They did 15 minutes of testing. It is therefore difficult to conclude on this. Nevertheless, following our various exchanges with the children and parents, the use would have been primarily at home. They would have used it to **do homework and thus reduce the time spent on work**. Indeed, **dyslexic children are slower and have less concentration time**. In addition, they have to use more energy for all these tasks and are therefore more tired. The use of the device at home also avoids the stigmatisation of the child in relation to his peers at school. This aid could **give the child a taste for reading**.
The testers recommend the lamp because of a real difference and a contribution to reading.

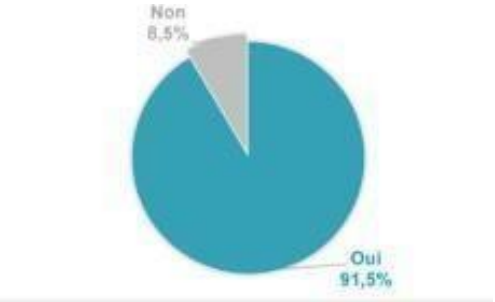


Figure 8 : Lamp recommandation for the testers of Lili

5) Conclusion

In the beta test carried out by Lili for Life, more than **75% of users felt a real difference in perception, we found 83%.** Lili lamp's result is slightly lower but the number of people tested in their study is higher. The wow effect is an immediate difference in perception. The Lili for Life beta test indicates that **30% of users have a wow effect. In comparison, 58% of our testers felt an immediate difference in perception with the lamp.** We almost doubled our percentage compared to the Lili's beta test, out of 12 people we had more people who were sensitive to this difference.
The **perception of the words is the most felt difference at 83% while the difference in space between paragraphs is 75% and the spaces between words 66%.** The magnification of words is therefore more perceptible to testers than the spaces, which are more difficult to perceive. Depending on the person, the feeling is variable, more than 60% felt these 3 effects.
65% of testers in the Lili for Life beta test and 83% in our study felt that reading was improved. This is the effect most felt in both studies. The Lili lamp therefore has a real benefit on reading. It **makes reading less "choppy" and improves comprehension** of the text. The **light flashes eliminate the mirror images that allow for greater fluidity.** The brain only perceives one image thanks to the flashes. It has been observed that there are fewer errors, for example the b/d are no longer reversed. **Fatigue is reduced** because the brain no longer needs to sort out the right and wrong images. The children tested felt more confident with the lamp, some of them enjoyed reading again. One child liked to read, but he was quickly tired. With the lamp, he didn't want to stop because he was more comfortable and less tired.
Fluency in reading and greater perception of a word were the effects most felt by our testers.

To conclude on our beta-test and that of Lili lamp, we can say that the **effects most felt are the fluidity of reading and the reduction of fatigue**. Thanks to the light flashes, the **mirror image is eliminated for dyslexic people, thus providing better comfort.** It can be said that the Lili lamp is a help for dyslexic people in general.