

**Titel:** Tablets as a vision aid for elderly with age-related macular degeneration

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with age-related macular degeneration**

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## **2. Abstract**

In this study we have examined whether tablets can be used as a vision aid for elderly with age-related macular degeneration. During a 30 days period, the subjects used a tablet equipped with mobile internet and a subscription for a newspaper. To evaluate if tablets are good vision aids, the subjects underwent a reading speed test on a paper without any aids before the start of the study and at the end of the test period the subjects underwent a similar reading speed test on a tablet with magnification and were allowed to set the magnification as they wanted. The subjects also answered some questions about their experience. The study was hampered by a high drop out. However, it seemed that if the subject could read the text fairly well without aids they read the text more slowly on a tablet. However, subjects who read the text on paper with difficulties, or could not read it at all, improved a lot. According to the survey most found it helpful to read from tablets but the technology was a bit difficult to learn. Special attention should be paid to the design of tablets for elderly and to the teaching of tablets to elderly.

## **3. Populärvetenskaplig sammanfattning på svenska**

I den här studien har jag undersökt om läsplattor kan vara ett hjälpmedel för äldre som har åldersrelaterad makuladegeneration. Studien genomfördes genom att försökspersonerna fick använda en läsplatta under 30 dagar. Läsplattan var utrustad med Svenska Dagbladets elektroniska version. Inför studien genomgick försökspersonerna ett läshastighetsprov på vanligt papper utan hjälpmedel. Detta upprepades sedan efter testperioden men på läsplatta. Försökspersonerna fick då förstora texten så mycket de ville. Försökspersonerna fick även svara på några enkätfrågor om hur de har upplevt läsning med läsplatta. Det blev bara sex personer som genomförda studien vilket försvårar utvärderingen av utfallet. Dock tydde resultaten på att de som kunde läsa första läshastighetsprovet utan större problem fick sämre lästid på läsplattan. De som däremot tog väldigt lång tid på sig eller inte kunde läsa texten alls hade en klar förbättring. Från enkäten kunde man dra slutsatsen att de flesta tyckte att det var ett bra sätt att läsa på, men att tekniken var krånglig att lära sig.

## 4. Background

### 4.1 The function of the human visual system

The visual system allows the human body to perceive information stored in scattered electromagnetic energy in the waveband 400-700 nm, light. Light from the sun or an artificial light source in the surrounding of the human body is modulated by absorption and scattering. A fraction of the scattered light incident on the eye is transferred to the retina by the optics of the eye. The optics of the eye collects light scattered from each point of an object within a solid angle and converges the light to a point on the retina. The collection of all points on the retina forms an inverted image of the object on the retina. The photoreceptors in the retina transduce the light energy incident on the retina to bioelectricity, phototransduction.

Each photoreceptor cell is able to discriminate the number of photons per area unit per time unit (irradiance  $\text{W m}^{-2}$ ), perceived as intensity, and under high luminance conditions, photon energy (J or after transformation with Planck's law Hz or nm), perceived as colour. Both intensity and photon energy is angularly resolved. Photon energy discrimination depends on the presence of three types of photoreceptor cells, each cell type containing one of three pigments, each pigment type with a specific spectral absorption. These photoreceptor cells, the cones, are densely packed in the centre of the retina, the macula. The photoreceptor cells in the retina peripheral to the macula contain a fourth pigment with a unique spectral absorption. These cells are used for transduction of low light intensities and, since they all contain the same pigment, they can only discriminate irradiance.

The limit of angular resolution in the visual system is absolutely limited by the diameter of the pupil of the optics of the eye and the spatial density of the photoreceptors. In a normal eye the maximum density of photoreceptors is matched to the pupil diameter with regard to resolution.

Two points angularly separated in space can only be perceived as two objects if the pupil of the eye is sufficiently large, and if the image of the two points, respectively, is separated by at least one not illuminated photoreceptor in the retina. Further, the contrast between the irradiance on the photoreceptors responding to the illuminated points and the irradiance on the photoreceptor between the illuminated photoreceptors is above the threshold for discrimination of irradiance difference. The threshold for discrimination of irradiance difference in the photoreceptor is set by the noise in the phototransduction.

The resolution limit of the human visual system is measured with visual acuity charts with standard optotypes. The optotypes are presented at optically approximately infinite distance (6 m). According to the definition of angular resolution, a standard letter is resolved when it can correctly be identified. The standard letter has 5 units height, 5 units width and the optotype leg is one unit. The angle of the optotype is the width of the leg. The angular subtense of the smallest letter resolved is the minimum angular resolution. The range of optotype leg widths on the visual acuity chart is typically distributed on a logarithmic scale between 1 minute of arc and 10 min. of arc. Visually acuity therefore is expressed in log minimum angle of resolution (logMAR).

#### **4.2 The macula**

The macula is located in the centre of the retina and constitutes less than 4 % of the area of the retina (1). The macula contains the highest density of cones and is responsible for high acuity vision. Within the macula there is an area called the fovea, which is about two millimetres in diameter where most of the cones are gathered. The macula is the functional centre of photoreception for the visual field of the eye. The development of the retina occurs in a centro-peripheral sequence. As a consequence, the maturation of central regions of the retina is more advanced than that in the peripheral retina. But, the finalization of the maturation of the fovea is also protracted and the later stages' do not occur until around the age of four. The retinal cells have a fixed birth sequence. In late stages of development, rods are excluded from the fovea and microglial cells migrate out of the fovea, thus creating a high density of cones.

The blood supply to the central retina develops later. At 22 weeks of gestation, around 50 % of the retina is covered with a plexus of blood vessels. There is however an avascular zone several millimetres around the becoming fovea. During the next four weeks of gestation, a ring of blood vessels is formed around an avascular area centred on the becoming fovea.

The macula can geographically be divided into three regions; the perifovea, the parafovea and the fovea based on the rod/cone ratio and the anatomy of the blood circulation.

The perifovea is a transition zone between the periphery and the centre of the retina. The perifovea has a high rod/cone ratio and a high density of blood vessels. The parafovea has a lower rod density and a lower density of blood vessels than the perifovea and the periphery. The rod/cone ratio in the parafovea is about 4:1 compared to 33-130:1 in the perifovea. The fovea is divided into the foveal slope and the foveola. In the foveal slope region of the retina

there is a transition from domination of rods to domination of cones, and from vascularised to avascularised tissue. In the foveola there are only cones, a few parasol ganglion cells, and no blood vessels. This enables high acuity vision.

### **4.3 Age Related Macular Disease**

Age-related macular disease (AMD) was first described in 1929 and is clinically divided into two types, wet AMD and dry AMD. The most common is the dry form of AMD, which is a slow and progressive change in the retinal pigment epithelium with concomitant death of photoreceptors cells in the macula. Usually choroidal neovascularisation precedes AMD. Leakage from new blood vessels may cause progressive or sudden loss of vision, wet AMD. Sudden haemorrhage originating from the new blood vessels may cause sudden loss of vision. Often leakage and haemorrhage is associated with detachment of the retinal pigment epithelium. (2)

The origin of AMD is still not known, but patients with sight threatening AMD often present with well-defined yellow spots, drusen, in the fundus of the eye before visual problems occur. Drusen are subretinal deposits of lipoprotein in the membrane between the pigment epithelium and the capillaries in the choroid, Bruchs membrane. It is unclear whether drusen cause AMD or if drusen are just associated with AMD. (2)

Oxygen stress is believed to be one important etiological mechanism in AMD (1). The macula has the highest oxygen tension in the human body and lipids in the photoreceptor outer segment membranes are constantly bombarded with photon energy. It is believed that the photon energy excites oxygen-to-oxygen free radical species that attack the lipids in the membranes of the photoreceptors. Further, AMD has been associated with an increase of inflammatory proteins in the macula, but it is unknown if the inflammatory proteins are the cause of AMD or just a reactive response.

Dry AMD leads to loss of photoreceptors in patches, which results in loss of phototransduction in patches and thus decrease of angular resolution in the visual system. In the early phase, the loss of photoreceptors is to some extent compensated by time integration of the image moving on the retina due to breathing and the arterial pressure wave. The patient can still read small fonts but the reading speed decreases. Later, only large fonts can be read and finally reading and other high acuity activities are not possible anymore. In the intermediate stage, magnifying optical solutions can extend reading of small fonts by making the image on the retina larger.

The strongest risk factor for AMD is age. In 2010 it was estimated that there are 23.5 million cases of AMD around the world. In developed countries, AMD is the leading cause of vision loss in people aged 50 or more. Since the population gets older, the prevalence of AMD increases. It was calculated that in 2050 up to 80.4 million subjects will suffer from AMD. In addition to age, smoking and genetic predisposal are important risk factors for AMD.

Over the age of 40, the prevalence of AMD is about 9 %. In the US and in Europe, late stage AMD, defined as occurrence of drusen and geographic atrophy in the center of the macula, affects 7.5 % of people 75 years and older. A study from the US showed that there are differences between ethnical groups. In that study, it was found that AMD affects 4.2 % of the Hispanics, 2.4 % of Afro-Americans, 4.6 % Chinese-descendants and 5.4 % of whites. (2)

The World Health Organization criterium for low vision is defined as best-corrected visual acuity worse than logMAR 0.5. Studies have shown that reading is one of the main goals for people with visual impairment. Without a good magnifying aid AMD patients often stop reading and other tasks that includes detailed vision.

#### **4.4 Magnifying aids**

The magnifying aids can roughly be divided into three groups; telescopes, loupes, and electronic devises that increase the visual angle between object points, electronic magnifying aids. (3,4) Telescopes are used for distant viewing while loupes and electronical aids are used for reading at close distance.

Loupes come in different forms, they can be hand held, bar-shaped, used as spectacles or be positive lenses fixed on stands. (3) Disadvantages of loupes are that the magnification is fixed, the loupe requires a fixed distance between the loupe and the object, and even if the focus is small, imaging in the periphery of the visual field is poor due to aberrations.

There are several electronic magnifying aids. The closed-circuit television (CCTV) is today one of the most common electronic magnifying aids. The CCTV consists of an electronic image processor that receives image information from an electronic camera, process the image and presents the image on a display, either colour or black & white. The electronic image processor allows the operator to vary contrast and magnification. (5) A CCTV has a large dynamic range of magnification, 2 to 70 times and provides an option for contrast enhancement. The disadvantage of CCTVs is high cost. Further, CCTV is usually bulky not portable systems that require electrical power from a socket. (5) Tablets and e-book



are new potential electronic magnifying aids. The source text presented on the tablet or e-book can either be information downloaded from the internet or information available on a paper that is imaged with the built in camera of the device like in CCTVs (3). Tablets and e-books are both portable, less expensive than CCTVs, and run on battery with adequate battery run time. Tablets and e-books allow field magnification and contrast enhancement like the CCTVs. The range of magnification in most general applications is more limited than with CCTVs but there are custom applications with a dynamic field magnification range that make tablets and e-books comparable to CCTVs. The tablet can be connected to a screen and thus provide an area of presentation of the information comparable to that of CCTVs.

#### **4.5 The potential of tablets as a reading aid in AMD**

As indicated above, AMD is a fairly common disease leading to decreased angular resolution in the visual system and as a consequence difficulties to read without magnifying aid. The advantage of the tablet compared to CCTV, being portable and more cost effective has been pointed out. One of the mayor obstacles to widespread use of the tablet as a magnifying aid is associated with the technology aspect. Many elderly people are not aware of the existence of the technology or think it is too complicated. The primary aim of this study was to evaluate if elderly patients with AMD that started to loose reading ability can improve their reading speed with a tablet after an initial tutorial on how to use the tablet and subsequent daily reading of a newspaper on the tablet for a month. Further, the experience of using a tablet was going to be evaluated by a questionnaire.

## **5. Method**

### **5.1 Subjects**

The subjects were collected from the ophthalmology department at the Uppsala university hospital. Patients with AMD and a visual acuity of logMAR [0.7;0.3] were asked to participate in the study. Ethical approval, from an IRB, was not required for this project according to Swedish law.

### **5.2 Procedure**

Patients that accepted were contacted on phone by the principal investigator and if still accepting were asked to come for eye examination and a tutorial on how to use the tablet.

The eye examination consisted of determination of best-corrected visual acuity and routine ophthalmological examination in the slit lamp microscopy including indirect ophthalmoscopy.

Subjects that met the inclusion criteria (Table 1) but not the exclusion criteria (Table 2) were included.

Table 1 Inclusion criteria

Variable	Criteria
Age	> 59 years
Near vision correction	Adequate near vision correction
Pathology in retina	Age-related macula degeneration according to hospital journal
Visual acuity	LogMar [0.7;0.3]
Mental capacity	Absence of dementia, assessed during ordinary visit at the ophthalmologist
Learning capacity	Capable of understanding instructions about tablets, assessed during ordinary visit at the ophthalmologist

Table 2 Exclusion criteria

Variable	Criteria
Lense disease	Cataract which clinically may effect reading ability.
Secondary cataract	Secondary cataract which clinically may effect reading ability
Corneal disease	Corneal diseases which clinically may effect reading ability
Macula	Abscense of age-related macula degeneration
Previous use of a tablet	Any previous use of a tablet

After the eye examination, baseline reading speed was determined. Further, the subjects was given a personal introduction to the tablet, where the basic functions and how to handle tablets were taught. They also received a simple manual with big letters and pictures, which they could use at home. In case they could not solve the problem themselves they could always call the test conductor.

The study was conducted during a 30 day period where the test subjects used a tablet in approximately A4 size equipped with mobile internet and a subscription for a newspaper, in this case Svenska Dagbladet. The 30 days period was considered to be a try out period where the subjects could learn to handle the tablet. After the end of the try out period, the principal investigator visited each subject and re-measured the reading speed and collected a questionnaire (Appendix 2).

### 5.3 Measurements

Reading speed was measured with two equivalent texts by August Strindberg of 71 words with Times New Roman font 10p. The texts were difficult enough that the subjects needed to make an effort to read every word, thereby testing their ability to resolve the text (Appendix 1). Reading speed was measured as time consumed to read the standardized text. Baseline reading speed was measured with the subject reading on paper without magnifying aid. End of study reading speed was measured with the subject reading on the tablet and the subject selected the magnification. Half of the group read version 1 first and version 2 on tablet, and vice versa.

### 5.4 Experimental design

Altogether 11 subjects were included, four men and seven women. The reading speed was measured once for each subject at baseline and at the end of the try out period, respectively.

### 5.5 Statistical parameters

The confidence coefficient was set to 0.95 considering the small sample size.

## 6. Result

Totally, six of the included subjects completed the study, two men and four women.

### 6.1 Reading time

The shortest baseline reading time was 48 seconds and one subject could not read at all (Figure 1, Table 3).

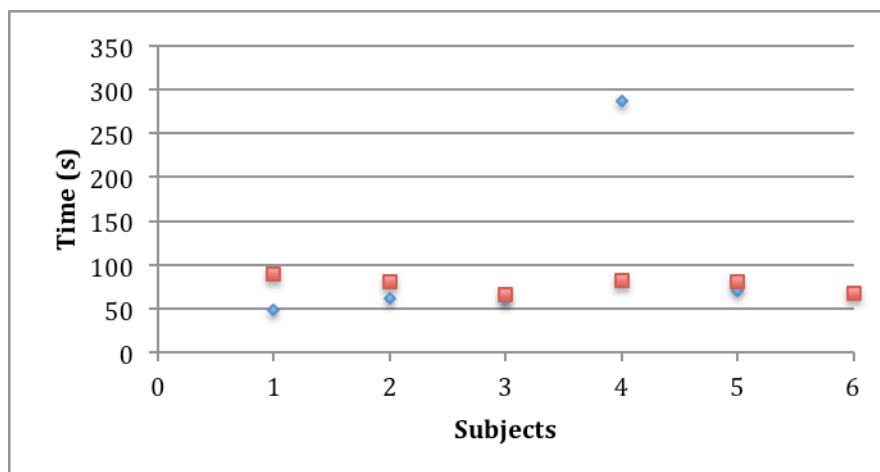


Figure 1 Distribution of reading time at baseline (blue diamonds) and at the end of the try out period (red squares).

Table 3 Measured reading time of standard text and tablet use time

Subjects	Reading time before (s)	Reading time after (s)	Total tablet use time (min)	Average tablet use time per day (min)
1	48	90	1045	35
2	61	80	785	26
3	60	66	651	22
4	287	82	935	31
5	70	81	1800	60
6	-	67	2760	92

At the end of the try out period, all subjects were able to read the text on the tablet. The reading time at the end of the try out period varied between 66 and 90 seconds. However, while all subjects were able to read the text, four subjects read the text slower on the tablet with magnification than at baseline on paper without magnifying aid.

The average tablet use time per day ranged from 21 to 92 minutes (Table 3). Most of the subjects used the tablet for reading Svenska Dagbladet. A few subjects also used the tablet for searching on the internet and other internet functions. The study indicated that there is no correlation between reading time of standard text and average tablet use time per day, 95 % confidence interval for inclination coefficient =  $0.92 \pm 12$  (Figure 2).

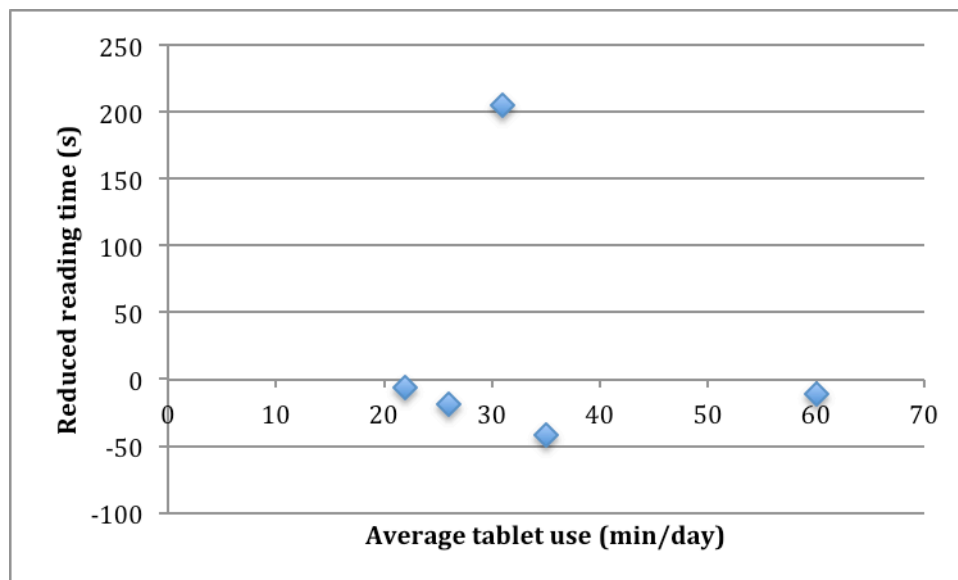


Figure 2 Correlation between reduction of reading time and average table use time.

## 6.2 Support required

The amount of support required varied a lot depending on how much computer skill the subject had prior to the study and if the subject had a partner or relatives that could help them. But, every subject needed at least two visits for assistance with various technical issues. Subjects with no previous computer skills needed a lot of support before they understood how to handle the tablet, some up to eight visits and a few phone calls. Most problems were related to problems that accidentally appeared without the subject knowing why and problems with orientation on the tablet. Even though the principal investigator had tried to make the screen as simple as possible and deleted unnecessary functionality, some subjects managed to access other programs or applications anyway and then had trouble knowing how to get back to the home screen. Another common problem was how to touch interface elements on the tablet screen. Tablets require accurate tap on icons for interaction. This caused problems for some subjects. Most of the subjects kept the finger on the icon for too long and then moved to another active surface thus accessing a different application. If the subject tried to tap faster the tap was often associated with a small movement and therefore the tablet did not react correctly. This took some time for most of subjects to learn.

## 6.3 Questionnaire

Altogether six subjects completed the questionnaire.

About two thirds of the subjects were aware of tablets before the study (Figure 3).

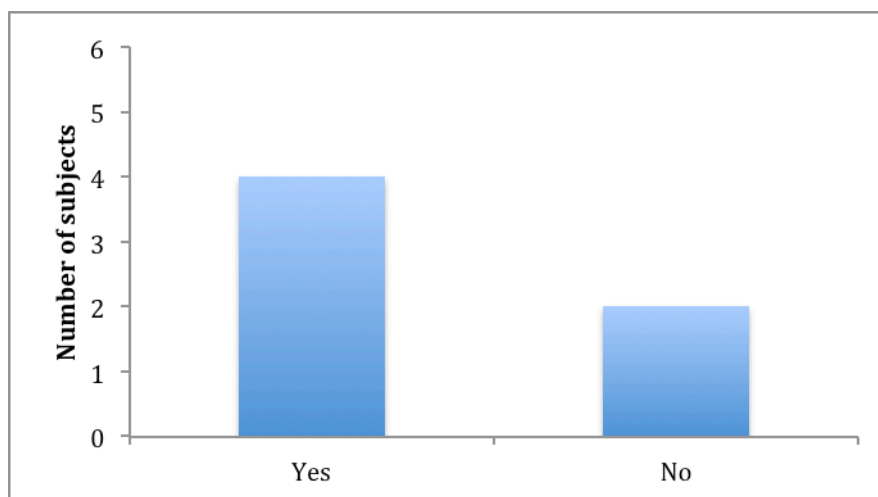


Figure 3: Were you aware of the possibility to read with tablets before the study?

A majority of the subjects felt that the tablet was usable (Figure 4).

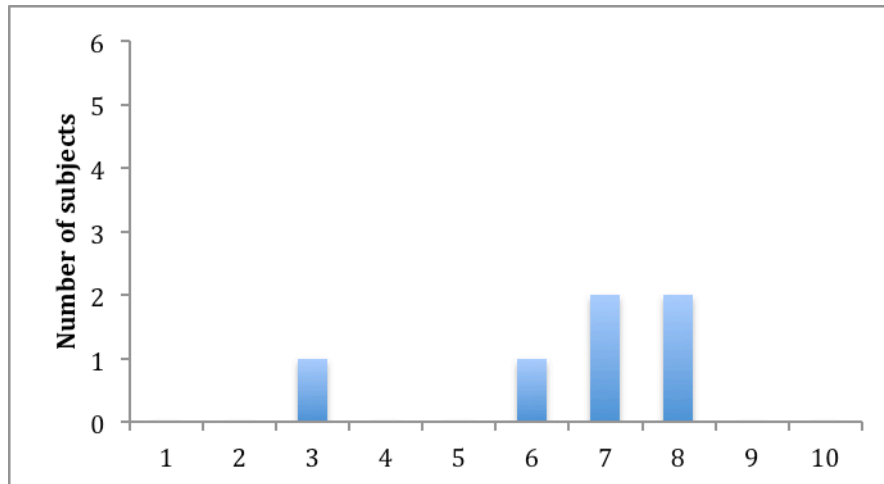


Figure 4: Do you feel that the tablet is usable? (1= very bad , 10= very good)

Examples of free comments were "I felt clumsy using it, like my fingers are too big and the tablet felt unpredictable." "It was difficult at first, more instructions would have helped a lot." "I could not handle it that well, it was difficult." "When magnifying to read, only a few letters were shown on the screen and I had to move around on the screen a lot. I found it irritating."

A majority of the subjects felt comfortable reading from a tablet (Figure 5).

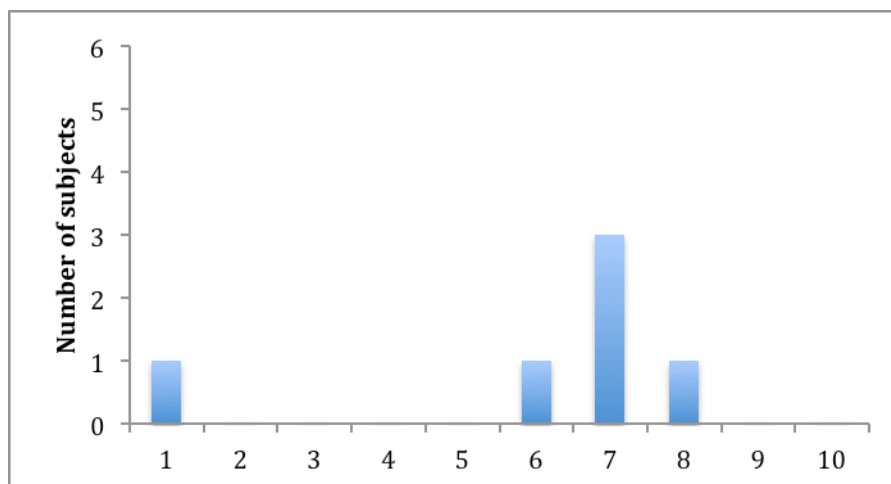


Figure 5: Did you feel comfortable reading from a tablet? (1 = no, not at all, 10 = yes, very much)

Examples of free comments were: "I could not find a good sitting position while reading." "I liked reading from it, especially during the evening when it was dark outside but it was still easy to read because of its own light."

There was no clear trend in opinion on if the awareness of events in society improved (Figure 6)

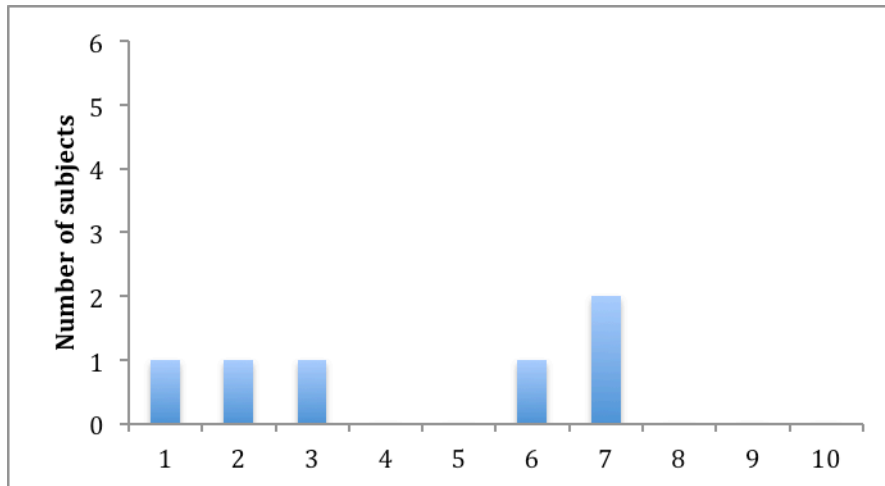


Figure 6: Have your awareness of events in society improved? (1 = no, not at all, 10 = yes, very much)

Examples of free comments were: "I always read newspapers anyway." "I have read the articles more profoundly." "I usually just read the headlines, but now I have also read the articles." "I usually read newspapers anyway."

There was no clear trend in opinion on if the tablet affected the quality of life (Figure 7)

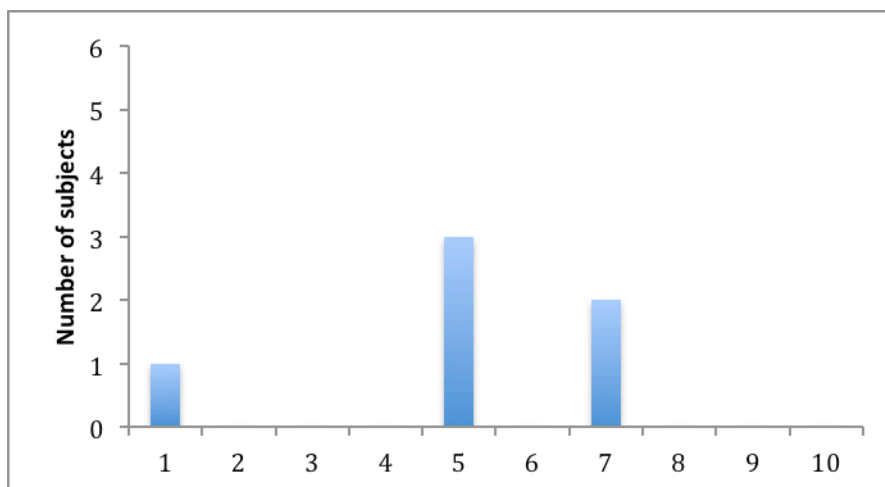


Diagram 7: Did the tablet affect your quality of life? (1 = no, not at all, 10 = yes, very much)

Examples of free comments were: "It may in the future, if my eye-sight gets worse." "I have realised that it may in the future." "Maybe a bit."

The study triggered some subject to attempt to continue using a tablet while others did not seem interested (Figure 8).

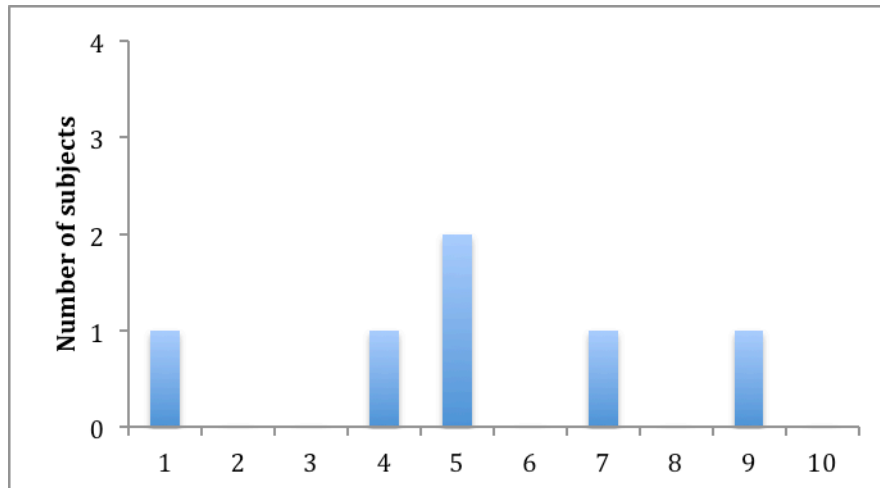


Figure 8: Do you want to continue using tablets? (1 = no, not at all, 10 = yes, very much)

Examples of free comments were: "I am considering it. Need to know more about conditions and such first." "As long as I see as well as I do now I prefer regular newspapers and books. But if my eyesight decline I probably will get one." "If there are tablets with bigger screens, this one is to small." "Maybe, but not an android. I will test iPad and see if it is better."

The majority of the subjects liked the Svenska Dagbladet application (Figure 9)

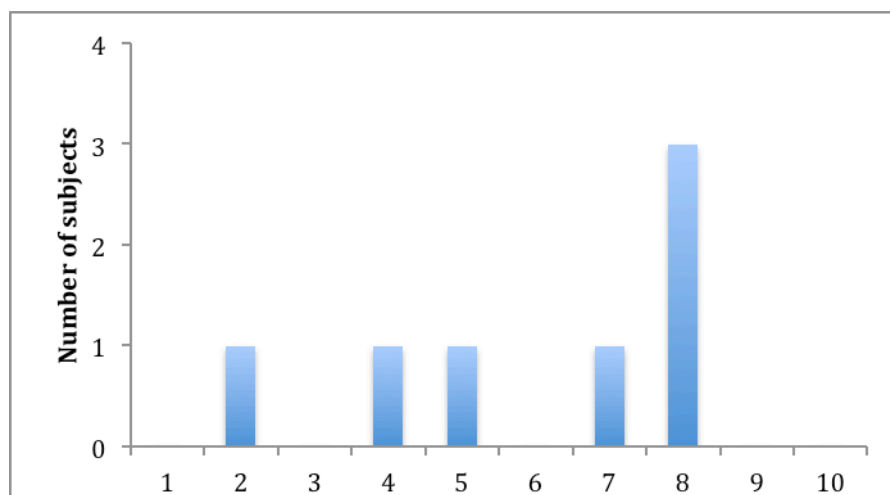


Figure 9: How well did you think the Svenska Dagbladet-application worked? (1 = very bad, 10 = very good.)

Examples of free comments were: "Very good, easy to read." "I did not like how it kept zooming out while changing side." "It kept zooming out and going back to the front page, otherwise it worked quite well"



## 7. Discussion

The current study intended to evaluate if elderly patients suffering from AMD can improve reading by using a tablet.

The visual acuity of the subjects was set to the interval logMAR [0.7;0.3]. The outcome that mainly subjects with long baseline reading time improved (Figure 1) in addition to the comments indicating that the reading difficulty was not expressed enough for use of the tablet, indicates that a future study should be focused on subjects with a low visual acuity level.

In this study everybody got a personal introduction to tablets. It was the principal investigator's impression that a group session with more time, perhaps a few hours, would have been better. Then subjects could have started trying the tablets and perhaps a few of the support visits would not have been needed.

The sample size was set to 10, based on existing information about the variability in measurements of reading time with the presently used method, setting the significant change of reading time to 4 s at a 5 % significance level and considering an 80 % power of the statistical inference. Considering the unexpected high drop out, a future study should be considerably oversized in order to provide statistically valid conclusions.

Of the 11, three women did not show up for the baseline visit as appointed claiming health problems. Two men dropped out. One man stated that he had trouble handling the tablet. He felt clumsy and could not get his hands to cooperate the way he needed to and therefore gave up. The other man felt the tablet was too complicated and he preferred to use his CCTV. It is unclear if he made a serious attempt to use the tablet.

The outcome of the reading time measurements (Figure 1, Table 3) indicated two subgroups of subjects. One that improved a lot while the other group had longer reading times with the tablet. In the group that improved a lot was one subject that could not read at all on paper and another subject that had considerable difficulties to read. In the group that had longer reading times, the subjects read relatively easy on paper at baseline and seemed to have technical difficulties that slowed down the reading on the tablet. Interestingly, all subjects tried to increase magnification. Technical problems were e.g. limited field of view requiring movement of the field while reading.

The fact that approximately one third of the subjects were not aware of the tablet (Figure 3) indicates that low vision health care should make an effort in informing about the tablet as a possible magnifying reading aid.

Despite the perceived technical difficulties in using the tablet it seemed that a majority of this present patient group are able to use the tablet (Figure 4) and feel comfortable with reading from the tablet (Figure 5).

Although the questionnaire did not detect an increase awareness of events in society after using the tablet (Figure 6) the free comments indicated that regular newspaper reading for some subjects was limited to headlines only while on the tablet full articles could be read.

The finding that the tablet use triggered an interest in some subjects but not in others (Figure 8) indicates that at least for a subgroup, the tablet is of value. The free comments indicated that if the reading capacity on paper deteriorates their interest would increase.

Although, a majority of the subjects liked the Svenska Dagbladet application (Figure 9) some of the subjects commented that small movement on the screen too easily led to another page or the first page of the newspaper. This caused a lot of distress and almost everybody commented that it therefore took quite a long time to read the newspaper. For some patients with good enough resolution this may have made the paper version of the newspaper more convenient at the current time.

During the study the principal investigator made the following observations about using tablets as a magnifying aid for low vision.

Unfortunately, some of the icons on the user interface of the tablet are too small for low patients suffering from low vision making it difficult to handle the tablet technically. This is particularly true for the keyboard, which makes it difficult to access internet. Also the charger is not easy to handle, the micro-usb male and female are too small and therefore difficult to couple.

The teaching of tablets to elderly people requires special attention. The principal investigator initially tried to teach the way young people use the tablet but for some issues such as e.g. zooming it may be more easy to use both hands rather than spreading the fingers. Using the thumb and index finger was troublesome for some subjects partly because of coordination problems but also because of stiff fingers due to age. Further, a touch-pen (specially made for tablets and smartphones) could have been better than trying with the fingers.

Since AMD is increasing due to an aging population more people will be in need of vision aids. Tablets do have advantages compared to CCTVs. Since they are cheaper, they are more affordable for a larger target group. Also the fact that a tablet is more portable facilitates the

use. Even though elderly people have more difficulties in learning how to handle the tablet, most of the subjects in present study did learn at least simple procedures. With longer time and perhaps more teaching with gradual increase in difficulty level the tablet some of the technical difficulties could probably be overcome.

It is concluded that a tablet is a potentially powerful magnifying aid for elderly people with decreased visual resolution. The tablet technology may have to be adapted to this particular target group and the teaching of the use must be aimed at the target group. Further studies are required to validate the advantage to the tablets as a magnifying aid.

## **8. Acknowledgements**

I would like to thank my supervisor Per G Söderberg and my co-supervisor Lars Malmqvist for all the help and encouragement.

I am very grateful to Telenor who sponsored the mobile internet and simcard for the tablets. I would also like to thank Svenska Dagbladet who sponsored free subscriptions of Svenska Dagbladet during the test period.

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## 10. Appendix 1

### Version 1

Fyrtioalet hade gått ut. Tredje ståndet, som genom 1792 års revolution tillkämpat sig en del af människans rättigheter, hade nu blifvit påmindt om att det fans ett fjerde och ett femte, som ville fram. Svenska bourgeoisien, som hjälpt Gustaf III att göra den kungliga revolten, hade längesedan recipierat i öfverklassen under förre jakobinen Bernadottes stormästarskap, och hjälpt till att motväga adels- och embetsmannaståndet, hvilka Karl Johan med sina underklassinstinkter hatade och vördade.

### Version 2

En stormig julnatt på Kattegatt 1869 har slutligen utkämpats av däckspassageraren, uppländingen, tjugoåringen, vilken aldrig sett annat än Stockholmstraktens gråstensberg, rullstensåsar och sandtäkter. I morgonens gryningen, när solen tändes, släckes Kullens fyr, och som en väldig vågbrytare mot gattets oceandyningar skjuter det trolska Kullaberget fram. Berget krossar böljorna och låter ångaren löpa in i sundets smula vatten. Till höger mellan jord och luft löper en grön böljegång, mjukt och vällustigt tjusigt.

## 11. Appendix 2

**1) Kände du till möjligheten att läsa med läsplatta fanns innan du var med i studien?**

<b>Ja</b>	<b>Nej</b>

## 2) Tycker du att läsplattan fungerar praktiskt att använda?

**Nej, inte alls**

**Ja, mycket bra**

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**Kommentar**

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**3) Känner du dig bekväm när du läser  
på plattan?**

**Nej, inte alls**

**Ja, mycket**

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**Kommentar**

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**4) Har plattläsningen förbättrat din medvetenhet om vad som händer i samhället?**

**Nej, inte alls**

**Ja, mycket**

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**Kommentar**

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## 5) Har läsplattan påverkat din livskvalité?

**Nej inte alls**

**Ja, mycket**

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**Kommentar**

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## 6) Vill du fortsätta att använda läsplatta?

**Nej inte alls**

**Ja, absolut**

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**Kommentar**

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## 7) Hur tycker du att Svenska Dagbladet-appen har fungerat?

**Väldigt dåligt**

**Mycket bra**

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**Kommentar**

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