Vision Care Technology Platform For Amblyopia Treatment

Alice Chow
Manager
Bio-Medical Electronics Team

11 May 2012
Medical Background of Amblyopia
State-of-the-art “Technology” for Amblyopia Treatment & Other Vision Care
ASTRI’s v-Trainer® Technology
  - Medical Treatment Software
  - Portable Electronic System
  - Wearable Optomechanical Platform
Clinical Findings of ASTRI Amblyopia Treatment System
Future Development
KEY Notes …
Key Achievements

- Patents x 2
- Trademarks x 2
- Publications x ...

- **US 8,002,409 B2**, Vision Treatment Procedures And Devices

- **U.S. application No. 12/886,357**, Systems And Methods For Binocular Vision Diagnosis And Treatment

- **v-Trainer**: Hong Kong Trademark Office, Certificate no 301450809; China Trademark Office, Certificate no 7778258

- **b-Trainer**: China Trademark Office, Certificate no 7778260

- Dual-channel Portable Amblyopia Treatment System With Perceptual Template Model, The 4th *International Conference on BioMedical Engineering and Informatics* 2011
香港政府加大买家支持创新科技

港府加大买家支持创新科技

亿元诱稽谷中小企设分支

施政报告前夜

《施政报告》

前言

香港政府于2021年11月28日公布《施政报告》，旨在进一步推动科技创新和经济发展。《施政报告》提出了一系列政策措施，旨在吸引全球人才和企业来港发展，推动香港成为国际创新科技中心。报告强调，政府将加大对企业创新的支持力度，尤其是中小型企业。

东方日报（2009-09-10）
Newspaper Clippings (2)

Apple Daily (2011-09-09)

Ming Pao (2011-09-22)
Why Portable Medical Device?

A child amblyopia patient using our 1st version program in Beijing Tongren Hospital

What he needs?

A light-shielded **goggle** for fixing the optical settings & making patients more concentrated during the treatment (Vs using desktop LCD monitor)

A **stand-alone** device for flexibility in use (Vs traveling to hospital & sticking to computer)

An easy-to-use response input device for young children (Vs using the mouse)

User-Driven Technology

v-Trainer® Your Vision Trainer
Multi-Technology Integration

- MAKE IT INTO A PROMISING PORTABLE MEDICAL TREATMENT DEVICE!

I. Software

II. Electronics

III. Optomechanical

IV. Clinical evaluation
Images consisting of line patterns with different contrast sensitivity and spatial frequency are presented to patient’s weak eye.

- An equal visibility contour line is obtained.
- The training procedure is based on measurement of cut-off spatial frequency of the contrast sensitivity function of each individual.
- Training is focused at detecting gratings at the cut-off spatial frequency (based on PTM analysis, training at cutoff frequency is most effective).
Multiple Function Brain Training Device (BTD) for Amblyopia treatment and binocular vision training

ITF full project **completed** on 31 Dec 2011

- User friendly Amblyopia treatment software with enhanced training algorithm and analysis
- Portable, stand-alone brain-vision training head-mount device with patient specific backlight control
- Nearly 100 patients at two Beijing hospitals evaluated and HK patient study has been initiated at two local sites. Data supported effectiveness of improvement beyond 10 years of age

**Funding source:** Hong Kong Innovation and Technology Commission  
(Project reference code: ART/092 CP)
Outlines

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  ➢ Wearable Optomechanical Platform
◆ Clinical Findings of ASTRI Amblyopia Treatment System
◆ Future Development
Amblyopia is a developmental disorder of spatial vision in the absence of any detectable structural or pathologic abnormalities that cannot be corrected by refractive means.

- It is a problem in the neuro-pathway in visual cortex of our brain
- It is a brain deficit (**LAZY BRAIN**), not an eye deficit

Eye/Vison training ➔ **Brain Training**
More than half of amblyopia patients and also strabismus patients have **Binocular Vision Disorder**. That means they cannot **fuse the two images** from the two eyes into one coherent image (binocular combination) to get 3-dimensional view with depth perception (stereoacuity).

Binocular vision disorder leads to many problems in daily lives.

**Daily-life activities**

- Depth perception => Stepping on the moving escalator
- Motion perception & Eye-hand coordination => Sports like hiking, ball-games
- Entertainment like dancing, playing computer games, watching 3D-movies
### Worldwide statistics

<table>
<thead>
<tr>
<th>Vision Problem</th>
<th>Overall occurrence rate</th>
<th>Country</th>
<th>Data source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amblyopia</td>
<td>3% - 5%</td>
<td>China and worldwide</td>
<td>《眼科学杂志》2008; Weber JL &amp; Wood Joanne (2005)</td>
</tr>
<tr>
<td>Strabismus</td>
<td>1%</td>
<td>China</td>
<td>《眼科学杂志》2008</td>
</tr>
<tr>
<td>Myopia</td>
<td>33%</td>
<td>China and worldwide</td>
<td>WORLDWIDE DISTRIBUTION OF VISUAL REFRACTIVE ERRORS AND WHAT TO EXPECT AT A PARTICULAR LOCATION: August 31, 2006</td>
</tr>
<tr>
<td>Presbyopia</td>
<td>9%</td>
<td>China and worldwide</td>
<td>US Census Bureau, International Data Base, 2004</td>
</tr>
</tbody>
</table>

### Vision Problem statistics in CHINA and Hong Kong

<table>
<thead>
<tr>
<th>Vision Problem</th>
<th>Affected population in CHINA</th>
<th>Affected population in Hong Kong</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amblyopia</td>
<td>30M Adults &amp; 15M Children</td>
<td>---</td>
</tr>
<tr>
<td>Strabismus</td>
<td>15M</td>
<td>---</td>
</tr>
<tr>
<td>Myopia</td>
<td>495M</td>
<td>1.76M</td>
</tr>
<tr>
<td>Presbyopia</td>
<td>135M</td>
<td>0.62M</td>
</tr>
</tbody>
</table>
General concept of amblyopia treatment

Amblyopia

Treatment and prognosis

Treatments

Treatment of strabismic or anisometropic amblyopia consists of correcting the optical defect (wearing the necessary spectacle prescription) and often forcing use of the amblyopic eye, either by

 capturing the good eye, or by instilling topical atropine in the eye with better vision. Yet, there is a drawback as the drops can have a side-effect of creating nodules in the eye which a corrective ointment can counteract. One should also be wary of over-patching or over-penalizing the good eye when treating for amblyopia, as this can create so-called "reverse amblyopia" in the other eye. Treatment of individuals age 9 through adult is possible through applied perceptual learning.

Form deprivation amblyopia is treated by removing the opacity as soon as possible followed by patching or penalizing the good eye to encourage use of the amblyopic eye. The earlier treatment is initiated, the easier and faster the treatment is and the less psychologically damaging. There is also a greater chance of achieving 20/20 vision if treatment is initiated as early as possible.

Clinical trials and experiments

Although the best outcome is achieved if treatment is started before age 8, research has shown that children older than age 12 and some adults can show improvement in the affected eye. Children from 9 to 11 who wore an eye patch and performed near point activities (vision therapy) were four times as likely to show a two line improvement on a standard, 11 line eye chart than amblyopic children who did not receive treatment. Adolescents aged 13 to 17 showed improvement as well, albeit in smaller amounts than younger children. It is uncertain whether such improvements are only temporary, however, particularly if treatment is discontinued.
General concept of amblyopia treatment


Because amblyopia only occurs when there is abnormal binocular visual input during the “sensitive period” early in life, it is often assumed that it can only be treated effectively in infants and young children. The studies listed in Table 1 span a broad range of outcomes.

**Improvement: when Visual Acuity is improved with 2 lines or above**

**“0.9”** is in decimal scale, which is equivalent to around 0.05 in LogMAR scale
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针灸治愈弱视 超戴眼镜近半

《經濟日報》2010年6月15日 星期二 06:00

【經濟日報專訊】中文大學及汕頭大學一項合作研究發現，針灸有效治療弱視，其中約3至6歲兒童治療率，更比傳統只戴眼鏡的比率高近43個百分點，惟療法暫未在香港推行。

中大表示，正計劃在港進行为期1年的研究，招募200名兒童患者接受免費治療。

中大眼科及視覺科學學系教授葉舒屏估計，現時本港約3%兒童患有弱視，主要有3個成因，包括兩眼屈光參差（即通俗稱「鸚鵡眼」）、斜視及其它眼疾（如深度近視、天生白內障），其中「鸚鵡眼」更佔三分一至5成。

聯合眼鏡針灸療程每月20次

葉舒屏利用「視力檢查方法」（即英文字母驗眼表）檢查視力，雙眼最佳視力相差兩行或以上，就屬於弱視。現時只有眼鏡及遮眼（即遮蓋視力較弱的眼睛，從而訓練另一眼睛）療法，最佳治療期為3至6歲。

中大汕頭聯合國際眼科中心在06至10年，研究171名內地弱視兒童，分為3至6歲及7至12歲兩組，每組再分兩批，分別接受眼鏡及眼鏡針灸聯合治療，7至12歲組於眼鏡治療中多加遮眼治療，3至6歲組治療期為15周，7至12歲組治療期為25周。

患者需接受每月20次，每次20分鐘的針灸，於5組穴位施針，包括攬竹（眼周）及合谷（手部虎口），及百會（頭頂）。

研究結果發現，3至6歲組接受眼鏡治療者，視力由第6行增至第8行，而眼鏡針灸聯合治療者，視力更由第6行增至第9行。眼鏡針灸聯合治療者的治療率高達57.5%，較眼鏡治療的14.6%高出42.9個百分點。

中大眼科及視覺科學學系主任林順潮解釋，正常人視力為第11行，針灸可調節神經系統，刺激相關腦部皮層區域，釋放神經遞質及刺激腦部視力，修補損毀部分。由於傳統遮眼療法服從性低，小朋友很容易揭開眼罩偷看。

招200患者 免費治療研究

林順潮指，暫未發現針灸的副作用，須繼續研究其成效及最佳治療周期，已將15周治療期調高為30周。不過，有關治療方法仍未能在香港推行，但未來1年會研究本港弱視兒童，正募集200名患者進行免費治療研究，市民可致電27623041查詢。
# Current Products in Market (1)

<table>
<thead>
<tr>
<th>Product Name</th>
<th>Image</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>眼博士弱视治疗仪</td>
<td><img src="images/1.png" alt="Image" /></td>
<td>360.00 /台</td>
</tr>
<tr>
<td>眼博士综合弱视治疗仪</td>
<td><img src="images/2.png" alt="Image" /></td>
<td>2500.00 /台</td>
</tr>
<tr>
<td>广州博视眼博士综合弱视仪</td>
<td><img src="images/3.png" alt="Image" /></td>
<td>2600.00 /台</td>
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<tr>
<td>眼博士综合弱视治疗仪</td>
<td><img src="images/4.png" alt="Image" /></td>
<td>1200.00 /台</td>
</tr>
</tbody>
</table>

【功能介绍】
六功能，单目的，精细度0.01，三功能盒

【产品特点】
数码调控，语音提示操作

产品简介

**第三代综合弱视仪，六功能：**
1. 光刷
2. 等级精细视力-对比敏感度
3. 红闪视标
4. 后像图形
5. 后像视力
6. 手脑眼协调
(机内视力表)

ASTRI Proprietary
EyeRelax from Energie Singapore

EyeRelax is an award winning visual-spectrum medical device clinically programmed to improve shortsightedness or myopia commonly cause by tired eyes.

Its patented light-spectrum technology stimulates the retina cells and vision nerves to improve the photosensitivity of the eyes. It is also enhanced with visual near-far stimulation to effectively prevent and control myopia caused by tired ciliary muscle.

EyeRelax is the most effective, safe, non-invasive, non-medicinal device for the control of myopia.

National University of Malaysia (UKM) and SIM University Singapore, have just successfully concluded a study on the effectiveness of EyeRelax therapy.

Price: $580 USD
HKD 4,524
RevitalVision neural training

Three type of training patterns:

- **Single Image Task**
  - (black & white strip with different size, contrast and orientation)

- **Triple Image Task**
  - (black & white strip with different size, contrast and orientation)

- **Darker Image Task**
  - (black & white strip with different size, contrast and orientation)

Method to feedback:

Two flashes are displayed in random order

- without single image
- with single image

Two flashes in each task,

left-click to indicate that the first flash with single image OR right-click to indicate that the second flash with single image
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♦ Future Development
**Project Objective**

- To **IMPROVE LIFE** of visual-problem patients
- To promote **PORTABLE** eye care device
- To promote **BRAIN TRAINING** device.
Core Technology

• **Vision treatment technology**
  which is a **patient-specific computerized treatment** to facilitate **neural connection**

• Licensable technologies and IPs for industry
  1. Amblyopia treatment software
  2. Binocular vision training software
  3. Optical adjustment technology for medical goggle
Project Scheme

Neuro-Science:
Fundamental principle / Mechanism study / Theoretical modeling

1. Electronic design
2. Software design
3. Optical design
4. Mechanical design

University

Conceptual design & Feasibility study
ASTRI

Engineering design & Prototyping
ASTRI

Clinical pre-trial & prototype fine-tuning
ASTRI

Technology license-out (Manufacturer to apply SFDA)
Commercialization partner

ASTRI Proprietary
Basic idea - perceptual system of observer functions as noisy amplifier

Superposition of three images:
1. Signal grating with increasing contrast in vertical direction
2. An external noise image with increasing variance in horizontal direction
3. A simulated internal noise image with a constant variance

→ An equal visibility contour of signal grating
→ Contour is flat in low-external-noise conditions - rises with external noise in high-external-noise conditions

• visibility of grating - greatly affected by amount of external noise
• signal amplitudes required for grating to be visible increase with amount of external noise

=> Amplitude of external noise at elbow of contour provides an estimate of variance of internal noise in our perceptual system

Amblyopia treatment model: Perceptual template model (PTM)

LAM: linear amplifier model; $N_m$: Gaussian internal noise; $N_a$: additive internal noise

**Consists of five components:**
1. a perceptual template
2. a non-linear transducer function
3. a Gaussian internal noise whose standard deviation is proportional (with a factor of $N_{mul}$) to the total energy in the stimulus after the non-linear transformation
4. an additive internal noise whose amplitude ($N_{add}$) is independent of the stimulus strength
5. a decision process

$$c_{\tau} = \frac{1}{\beta} \left[ \frac{(1 + N_{mul}^2) N_{ext}^2 + N_{add}^2}{1/d' - N_{mul}^2} \right]^{1/2}$$

$c_{\tau}$ - contrast threshold at performance criterion $\tau$ (e.g., 75% correct)

$N_{ext}^2$ - variance of (experimenter-controlled) external noise

$d'$ - signal to noise ratio

With noise functions, we can understand the cause of amblyopic deficits and be able to design more effective training procedures for each individual, including training in both clear and noisy displays.

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**Design of Perceptual Learning Task & Treatment Protocol**

- Images consist of line patterns with different contrast sensitivity and spatial frequency are shown in different orientations.
- An equal visibility contour line is obtained.
- The training procedure is based on measurement of cut-off spatial frequency of the contrast sensitivity function of each individual.
- Training is focused at detecting gratings at the cut-off spatial frequency (based on PTM analysis, *training at cutoff frequency is most effective*).
Three groups of ADULT amblyopes

- Total training period: 1 month, 45 minutes per day
- Group 1: Training at the cut-off spatial frequency
  - CS increased by 76% on average
  - CS at other spatial frequencies also increased!
  - CS improvement brings to the fellow relative normal eye!
- Group 2: Training at 9 spatial frequencies
  - CS increased by 66% on average
  - No CS improvement on fellow untrained eye
- Group 3: Control group without training
  - No CS improvement

SF: Spatial frequency
MS: The maximum contrast sensitivity
CS: Visual contrast sensitivity

A, C, E: Amblyopia eye
B, D, F: Normal eye
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Patient screening in Mainland China (Tangyin, Henan, Dec 2009)

1. Children lined up

2. Test step 1: Refractive error test

3. Test step 2a: Wearing glasses

4. Test step 2b: Visual acuity test with glasses

5. Test step 3: Retina examination by doctor

6. Eye history record

Understand User’s Needs ...
Understand User’s Needs …

- ASTRI brain-vision training device pre-trial
  at Beijing Tongren Hospital (Dec 2009)

SEED 1 Prototype
Computer Monitor

SEED 2 Prototype
Electronic Goggle
Understand User’s Needs …

- **ASTRI brain-vision training device pre-trial**
  by children patients at Beijing Radiant Hospital (Jan 2010)
### Goggle Prototypes

<table>
<thead>
<tr>
<th>ASTRI goggle for medical treatment</th>
<th>Optical settings</th>
<th>Goggle barrel length</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2 meter, 17”screen</td>
<td>Version 1: 90mm</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Version 2: 60mm</td>
</tr>
<tr>
<td>Market product for video watching</td>
<td>4 meter, 60” – 80”screen</td>
<td>55mm</td>
</tr>
</tbody>
</table>
System Integration

Image displayed in Goggle
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ASTRI

ASTRI Proprietary
### Subject Recruitment Status

#### Data till Apr, 2012

<table>
<thead>
<tr>
<th>Trial Period</th>
<th>Beijing Tongren Hospital</th>
<th>Radiant Children Hospital</th>
<th>PolyU Optometry Clinic</th>
<th>Family Eye Care</th>
<th>Overall</th>
</tr>
</thead>
<tbody>
<tr>
<td>Subjects Recruited</td>
<td>66*</td>
<td>27</td>
<td>13*</td>
<td>6</td>
<td>112</td>
</tr>
<tr>
<td>Excluded Subjects</td>
<td>7</td>
<td>6</td>
<td>4</td>
<td>--</td>
<td>17</td>
</tr>
<tr>
<td>Total Data Points</td>
<td>59</td>
<td>21</td>
<td>9</td>
<td>6</td>
<td>95</td>
</tr>
<tr>
<td>Average age</td>
<td>18± 6.5</td>
<td>11 ± 1.9</td>
<td>39 ± 9.2</td>
<td>31± 10.3</td>
<td></td>
</tr>
<tr>
<td>Current Status</td>
<td>Completed</td>
<td>Completed</td>
<td>Users continue</td>
<td>Users continue</td>
<td></td>
</tr>
</tbody>
</table>

*There were 64 subjects in Tongren Hospital, but 2 of the subjects had done the training for both eyes, as both eyes were regarded as amblyopic eyes by doctors.*  

*PolyU has made calls to 60 HK patients*  

**Exclusion Criteria**  
- Having vision-related disease other than amblyopia, e.g. Cataract  
- Having eye-related operation before training  
- Patient not shown up before completing the whole training
Assessment on visual acuity (VA)

Data till Oct, 2011

71 subject data in total

9: no VA improvement
14: VA improved 1 line
48: VA improved 2 lines or more (68%)
Assessment on other visual functions

**Contrast Sensitivity**
Tongren data:
- 54/54: improvement
- 46/54: improvement at high s.f. (85%)  

**Binocular vision function**
Tongren data:
- 27/41: improvement (66%)
## Suspected critical factor: Training compliance

<table>
<thead>
<tr>
<th>Subject #</th>
<th>2</th>
<th>14</th>
<th>17</th>
<th>18</th>
<th>22</th>
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<th>50</th>
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<tbody>
<tr>
<td><strong>Wk1</strong></td>
<td>7</td>
<td>6</td>
<td>7</td>
<td>7</td>
<td>7</td>
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<td>6</td>
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<td>7</td>
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<tr>
<td><strong>Wk2</strong></td>
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<td>7</td>
<td>6</td>
<td>6</td>
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<td>6</td>
<td>7</td>
<td>7</td>
<td>7</td>
<td>7</td>
<td>6</td>
</tr>
</tbody>
</table>

| Subject # | 6 | 7 | 10 | 11 | 12 | 13 | 15 | 16 | 19 | 20 | 23 | 24 | 25 | 26 | 28 | 29 | 30 | 32 | 34 | 35 | 36 |
|-----------|---|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|
| **Wk1**   | 6 | 7 | 6 | 4 | 5 | 3 | 4 | 3 | 3 | 2 | 4 | 4 | 3 | 5 | 3 | 3 | 3 | 1 | 4 | 3 | 4 |
| **Wk2**   | 7 | 7 | 7 | 6 | 5 | 7 | 7 | 6 | 7 | 4 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 |
| **Wk3**   | 2 | 2 | 3 | 1 | 3 | 3 | 2 | 3 | 3 | 4 | 5 | 1 | 3 | 1 | 3 | 3 | 3 | 3 | 5 | 2 | 3 |

| Subject # | 37 | 38 | 39 | 41 | 42 | 44 | 45 | 46 | 47 | 49 | 51 | 52 | 54 | 55 | 56 | 57 | 59 | 60 | 61 | 62 | 63 |
|-----------|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|
| **Wk1**   | 1 | 4 | 5 | 3 | 4 | 5 | 3 | 4 | 4 | 3 | 3 | 3 | 2 | 6 | 6 | 5 | 3 | 3 | 4 | 2 | 6 |
| **Wk2**   | 7 | 7 | 7 | 7 | 7 | 7 | 6 | 7 | 7 | 7 | 6 | 6 | 7 | 7 | 7 | 7 | 7 | 5 | 6 |    |    |
| **Wk3**   | 5 | 2 | 1 | 3 | 2 | 1 | 3 | 2 | 3 | 3 | 3 | 3 | 5 | 1 | 1 | 1 | 3 | 3 | 2 | 7 | 1 |

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## Family Eye Care

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Questionnaire

- Subjects to fill in a questionnaire after BTD training
- 31 questionnaires received
1. Is the device convenient to use?

2. Are the instructions clear enough?
3. Do you think this device is helpful for the following aspects?

**Visual Acuity**
- A lot: 16
- A little: 14
- Not Sure: 2
- No: 4

**Contrast**
- A lot: 16
- A little: 14
- Not Sure: 2
- No: 4

**Stereopsis**
- A lot: 12
- A little: 14
- Not Sure: 6
- No: 4
4. How long have you spent on daily-training?

5. How long will you spend on training if time is no longer a concern?

65% wanted to train for longer time.
6. Where would you like to do the training?

Patients’ feedback

Home (80% preferred)
- More comfortable
- More convenient
- Save travelling time
- Save more time for work

Hospital / Clinic (20% preferred)
- Can get help from doctors
- Can have doctor’s advises
7. Which platform do you prefer to do the training?

8. Will you try to use a portable device so that you can have the training at home?
Patient comments

Whole Training System
- 可換成無線式，類似藍牙，更方便使用
- 儀器副件太多，使用起來不方便
- 線路太多，操作複雜不方便
- 希望攜帶更加方便
- 最好能帶到家裏或學校進行，比較方便

Goggle
- 希望配戴更加方便，現在比較沉，需要用手扶著
- 太重了，不方便使用
- Adaptable to people wearing glasses

Training
- 希望有不同粗幼的線條，可以調節一下眼睛的疲勞程度和心理承受力
- 希望時間短些
- 訓練時間太短
- 每節結果的數字字體太小
- Can have "not sure" button
Case study: Neuroscience study

Neuro-pathway Set-up Process

*Functional MRI Study of Visual Cortex Area in Amblyopia Patients*

- a 26-years-old eye patient from Beijing Tongren Hospital
- fMRI result from Department of Radiology, Beijing Hospital
- based on Blood Oxygenation Level Dependent (BOLD) effect

**BEFORE training**

**AFTER training**

15 days
45 min./day

AMBLYOPIC EYE

NORMAL EYE

ASTRI Proprietary
Case study: Retention rate

- **Patient A**
  - Had done 2 rounds of BTD trainings
  - With a resting period of 10 months

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<tr>
<td>Post-training VA (LogMAR)</td>
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- **Patient B**
  - Had done 2 rounds of BTD trainings
  - With a resting period of 5 months

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Outlines

- Medical Background of Amblyopia
- State-of-the-art “Technology” for Amblyopia Treatment & Other Vision Care
- ASTRI’s v-Trainer® Technology
  - Medical Treatment Software
  - Portable Electronic System
  - Wearable Optomechanical Platform
- Clinical Findings of ASTRI Amblyopia Treatment System
- Future Development
Normal binocular vision requires:
- Two normal monocular visual systems (by Amblyopia treatment program)
- Normal interactions between the two (by Binocular vision training program)

Proposed training methodology:
**Stage 1 – Binocular combination / fusion training**
- Program training the patients to do binocular combination with two eyes

**Stage 2 – Stereo-acuity training**
- Program presenting two different images to each eye in a way that the patient’s brain must combine the two images in order to successfully identify the whole picture
Medical Goggle for Binocular Vision Training

U.S. patent application No. 12/886,357
Systems And Methods For Binocular Vision Diagnosis And Treatment

Conventional Optometric Equipment: Synoptophore

Left-side display image
Right-side display image

Normal people
Patients

Conventional fixed optics

Adjustable optics
End of Presentation
Thank you. Questions are welcome.