Vision Care Technology Platform For Amblyopia Treatment

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11 May 2012

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**

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

Newspaper Clippings (1)

Ta Kung Pao (2009-08-09)

Sing Tao (2009-09-28)

Oriental Daily (2009-09-10)

Newspaper Clippings (2)

Apple Daily (2011-09-09)

科技融入生活 ASTRI

走入醫療新領域

Ming Pao (2011-09-22)

特約專輯

STRI

D SCIENCE AND TECHNOLOGY INSTITUTE COMPANY LIMITED
科技研究院有限公司

應科院 科技以人為本 照顧大眾所需

應科院企業與消費電子群組和生物醫學電子組的研發以人為本，無論是電子學習、機頂盒或醫療儀器，都切合大眾生活需要，改善及提升生活質素。

消費電子（ECE）群組 了解用戶需要開始

生物醫學電子（BME）組 用心研發為提升醫療效益

重視與各方專家合作

與醫護界合作研發產品

2011應科院科技項目推介會

User-Driven Technology

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

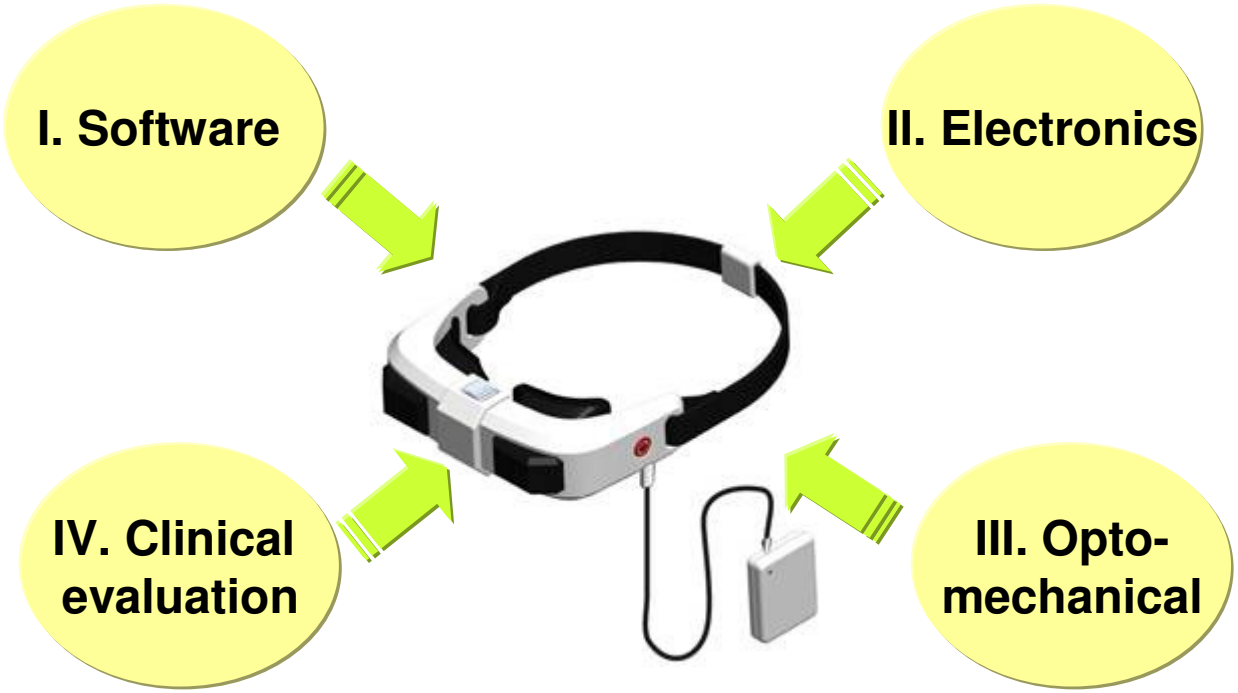
Why Portable Medical Device?

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)**

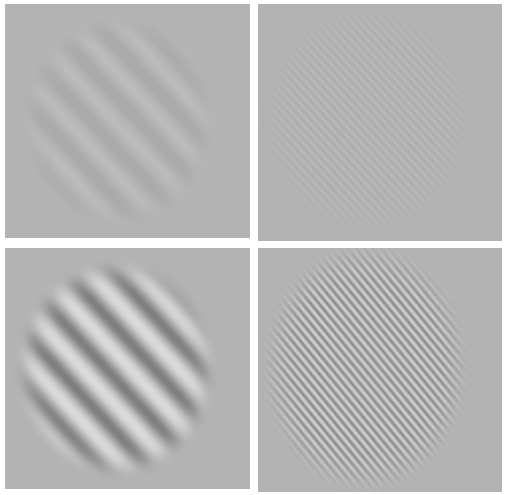
Multi-Technology Integration

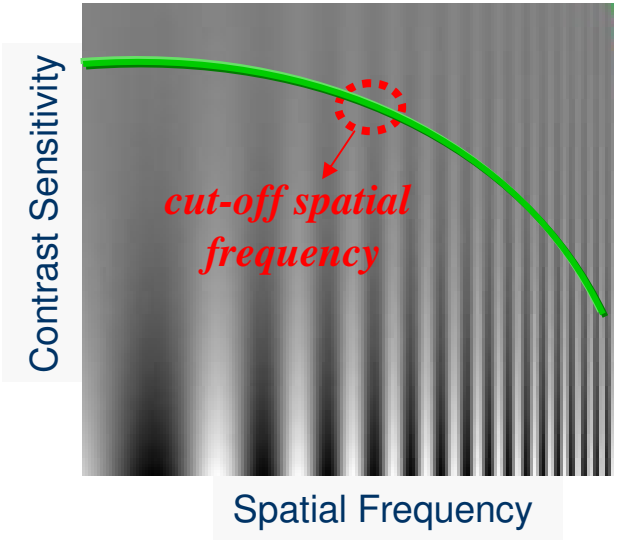
- **MAKE IT INTO A PROMISING PORTABLE MEDICAL TREATMENT DEVICE!**

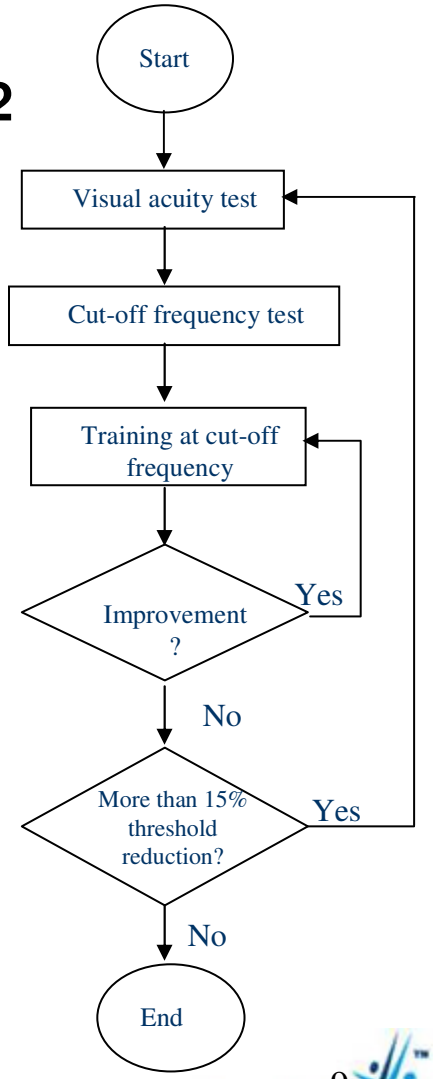


Patented Treatment Method

US Patent Granted: US8,002,409 B2







- 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)

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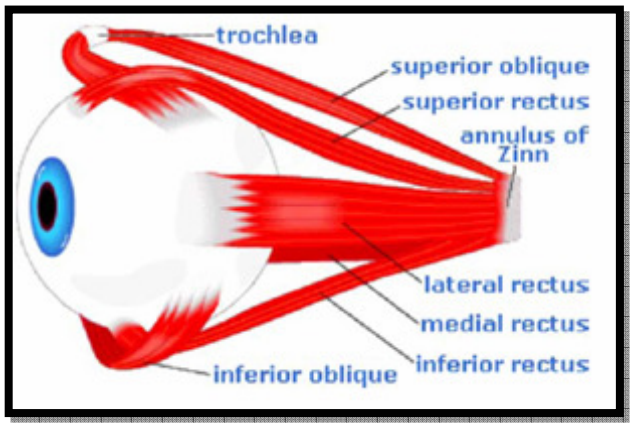
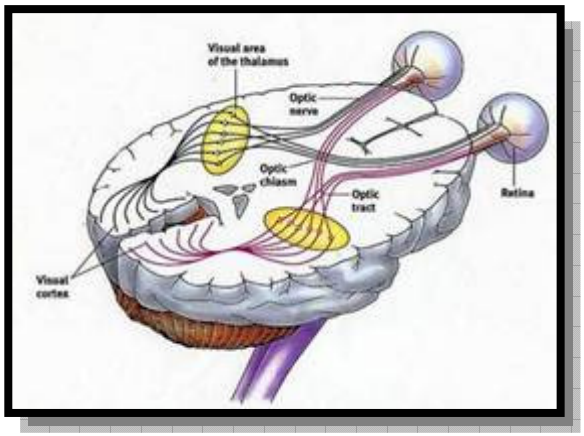
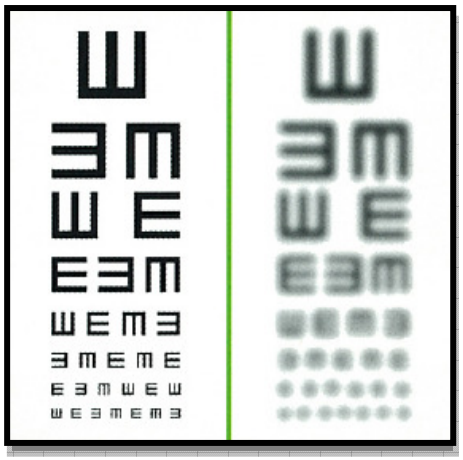
Brain Training Device (BTD)

BRAIN / NEURAL TRAINING







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

Brain Training Device (BTD)

- 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

Patient statistics

Worldwide statistics

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

Vision Problem	Affected population in CHINA	Affected population in Hong Kong
Amblyopia	**30M Adults & 15M Children**	**---**
Strabismus	**15M**	**---**
Myopia	**495M**	**1.76M**
Presbyopia	**135M**	**0.62M**

General concept of amblyopia treatment

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Amblyopia

Treatment and prognosis [edit]

Treatments [edit]

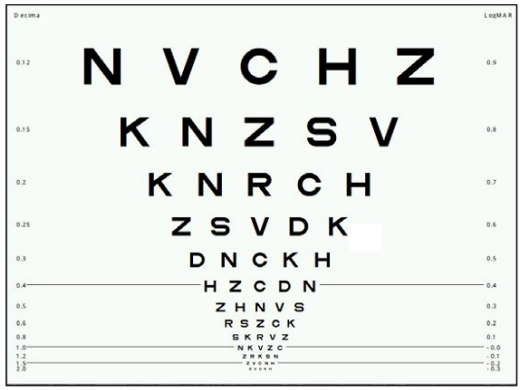
Treatment of *strabismic* or *anisometropic amblyopia* consists of correcting the optical deficit (wearing the necessary spectacle prescription) and often forcing use of the amblyopic eye, either by patching the good eye, or by instilling topical atropine in the eye with better vision.[13] Yet, there is a drawback as the drops can have a side-effect of creating nodules in the eye which a correctional 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.[10][14]

Treatment of individuals age 9 through adult is possible through applied perceptual learning.[15][16]

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.[10] The earlier treatment is initiated, the easier and faster the treatment is and the less psychologically damaging.[*citation needed*] There is also a greater chance of achieving 20/20 vision if treatment is initiated as early as possible.[17]

Clinical trials and experiments [edit]

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.[10][18]



ASTRI

General concept of amblyopia treatment

Zhou, Y., et al. (2006). Vision Research

1998; Kiorpes & McKee, 1999). In clinical practice, only infant and young child amblyopes are treated, while older children (>8 years) and adults are mostly left untreated because it is widely believed that the various therapies are no longer effective for them (Campos, 1995; Flynn,

Levi, D.M., Li, R.W., (2009). Vision Research

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

弱视怎样才算彻底治愈？

全球医院网2011-03-07

根据中华医学会、中华眼科学会、全国儿童弱视、斜视防治组1987年9月制定的弱视治疗疗效评价标准为：

（1）无效：包括视力退步、不变或仅提高一行者；
（2）进步：视力增进二行及二行以上者*；
（3）基本痊愈：视力恢复到≥0.9者；**
（4）痊愈：经过3年随访，视力保持正常者。

* 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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Case of Amblyopia Treatment Study in Hong Kong

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3至6歲兒童治癒率，更比傳統只戴眼鏡的比率高近43個百分點，惟療法暫未在港推行。

中大表示，正計劃在港進行為期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范舒屏估計，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（即俗稱「鴛鴦眼」）、斜視　及其他眼疾（如深度近視、天生白內障　），其中「鴛鴦眼」更佔三分一至5成。

聯合眼鏡針灸 療程每月20次

倘利用「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（即遮蓋視力較強的眼睛，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，包括攢竹（眼周）、跗陽（小腿下方）、太陽、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癒率高達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，釋放神經遞質及賀爾蒙到眼部，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

林續指，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2762 3041查詢。

Current Products in Market (1)

眼博士弱视治疗仪
广州

眼博士弱视综合治疗仪

单价： 360.00 /台

眼博士综合弱视治疗仪

单价： 2500.00 /台

广州博视眼博士综合弱视仪

单价： 2600.00 /台

眼博士综合弱视治疗仪

眼博士弱视治疗仪

单价： 1200.00 /台

【功能介绍】　六功能,单目式,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)

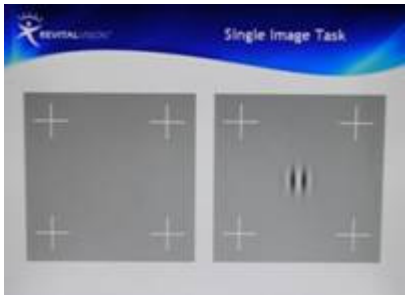
Current Products in Market (2)

EyeRelax from Energie Singapore

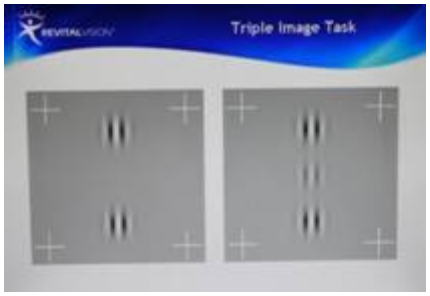
Current Products in Market (3)

RevitalVision neural training

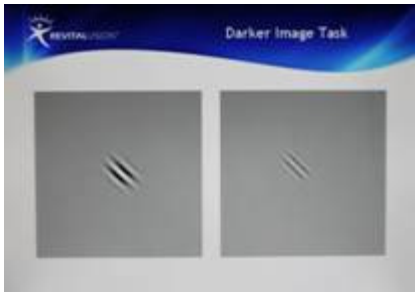
Three type of training patterns :



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 :

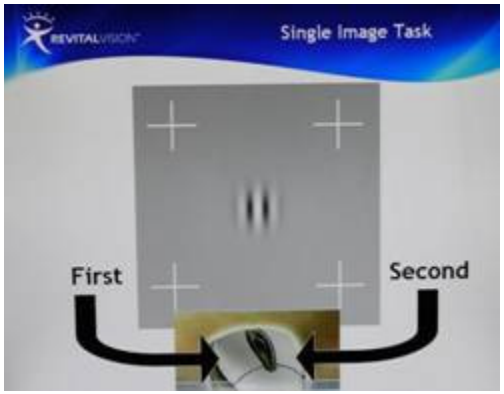
Two flashes are displayed in random order

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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Project Objective

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

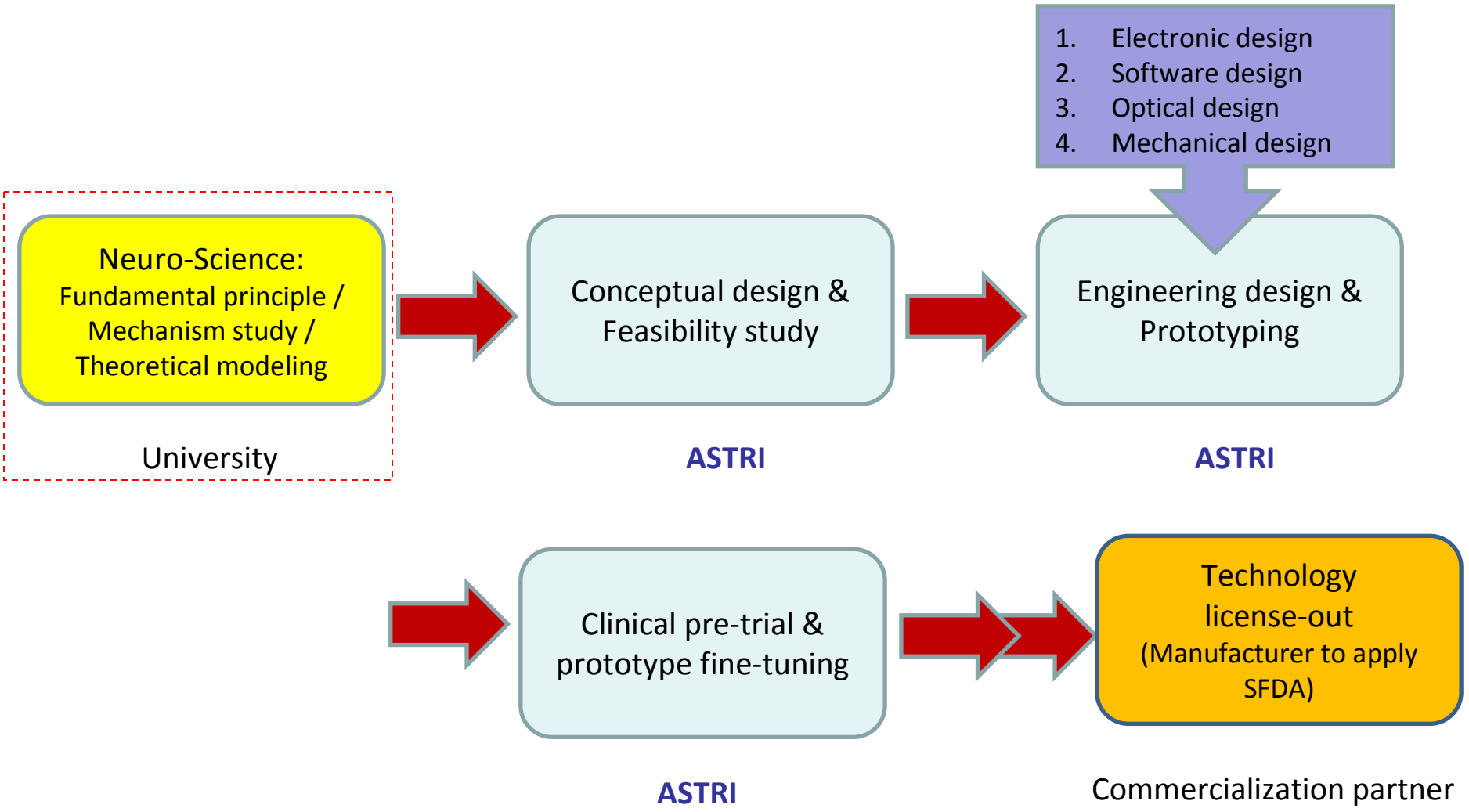
Core Technology

- **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



Amblyopia treatment model: Perceptual template model (PTM)

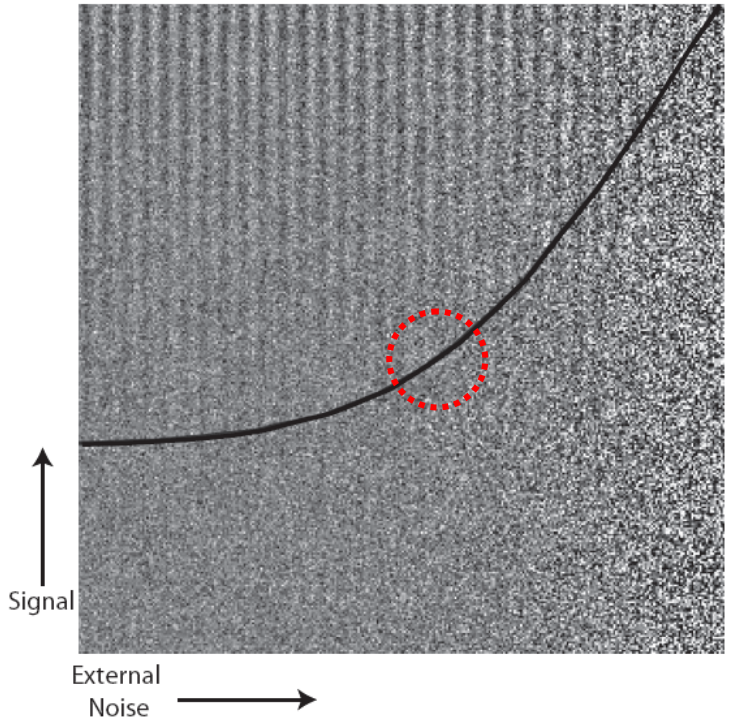
Basic idea - perceptual system of observer functions as noisy amplifier

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

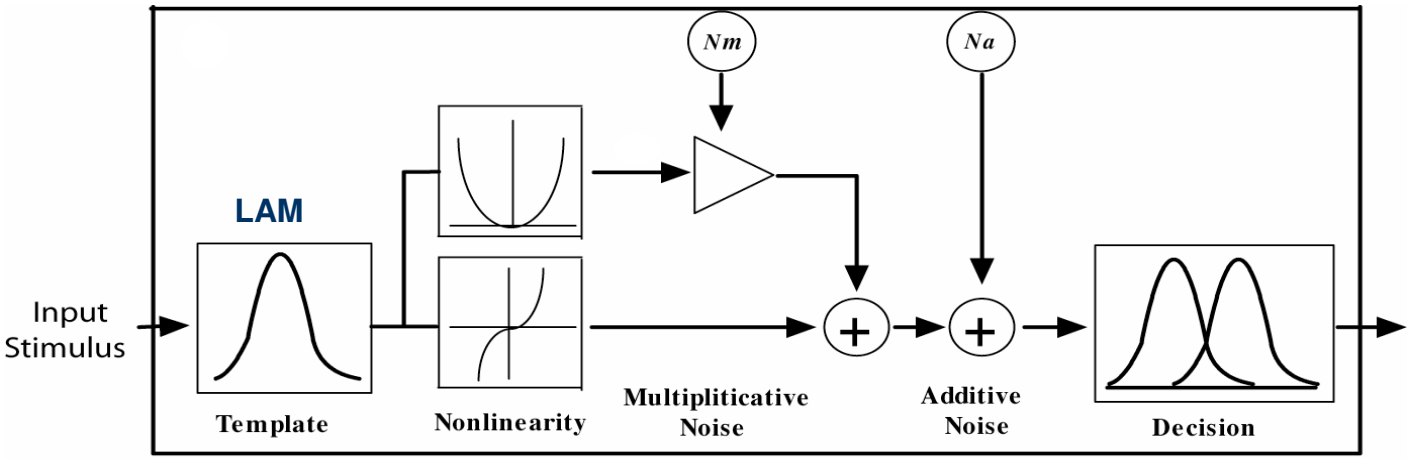
•signal amplitudes required for grating to be visible increase with amount of external noise

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

P. Xu, Z. Lu et al. Vision Research 46 (2006) 3748–3760

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

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

c_τ - contrast threshold at performance criterion τ (e.g., 75% correct)

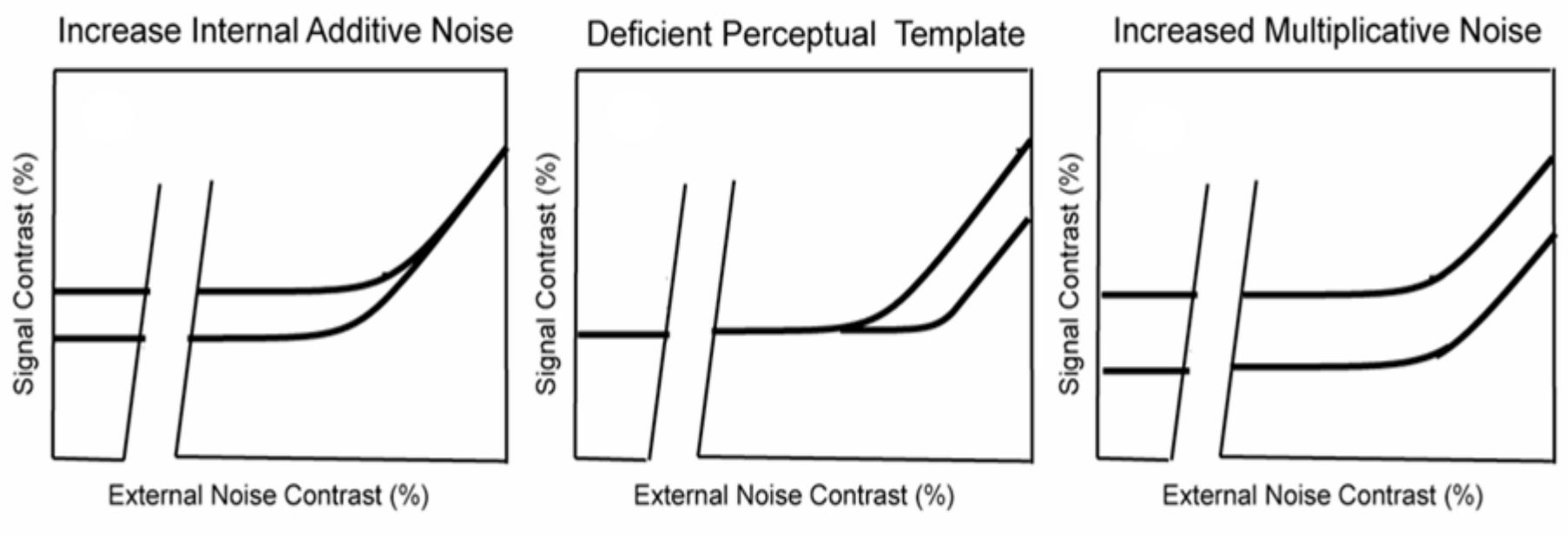
N^2_{ext} - variance of (experimenter-controlled) external noise

d' -signal to noise ratio

P. Xu, Z. Lu et al. Vision Research 46 (2006) 3748–3760

Amblyopia treatment model: Perceptual template model (PTM)

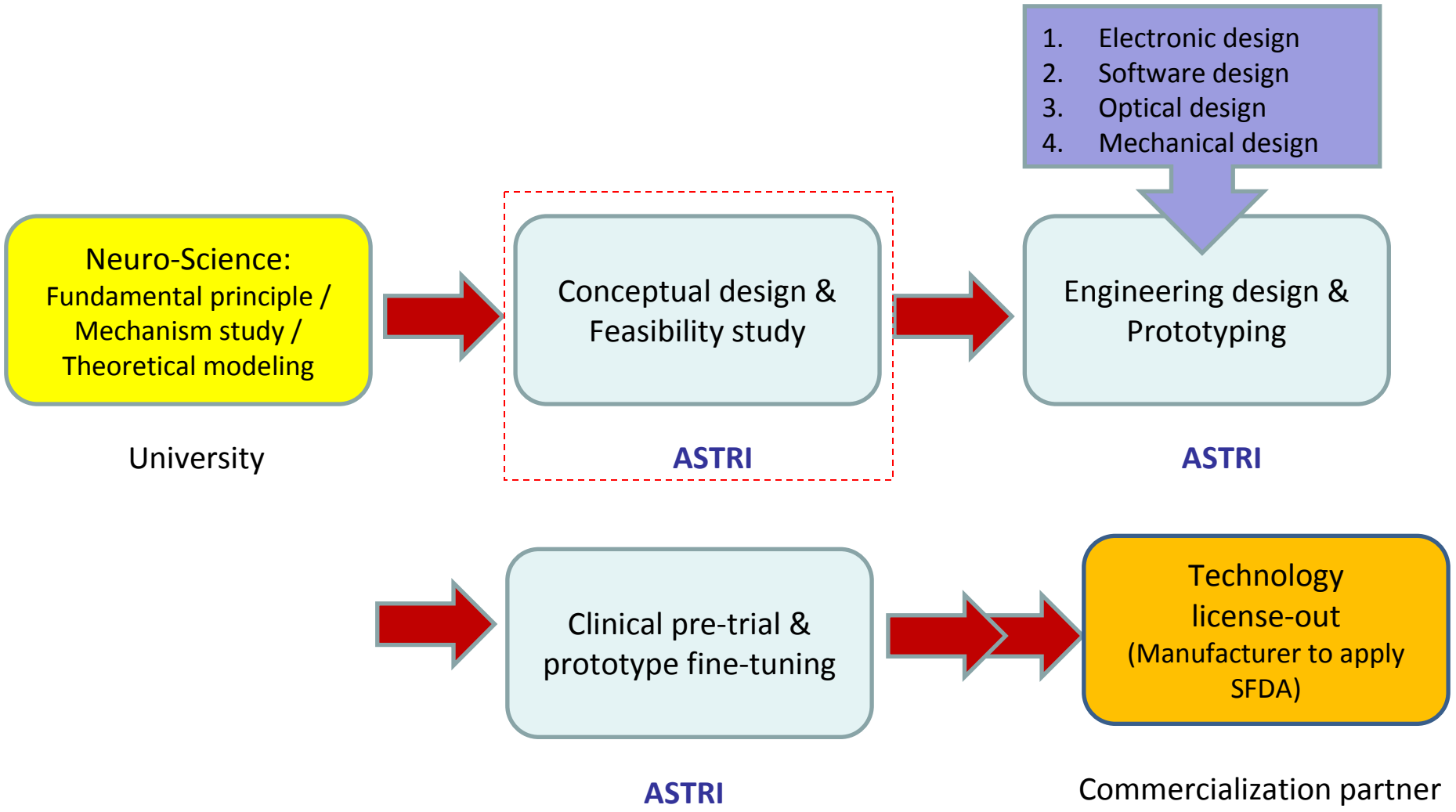
Evaluation of the mechanisms for amblyopic deficits:



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.

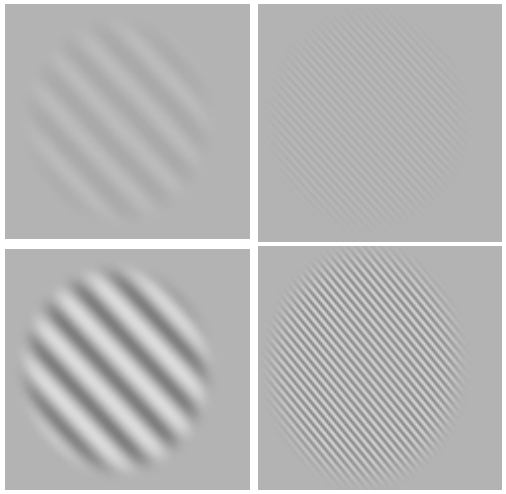
P. Xu, Z. Lu et al. Vision Research 46 (2006) 3748–3760

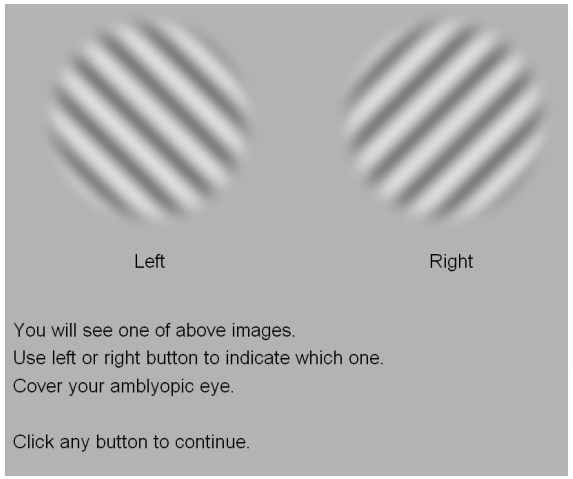
Project Scheme

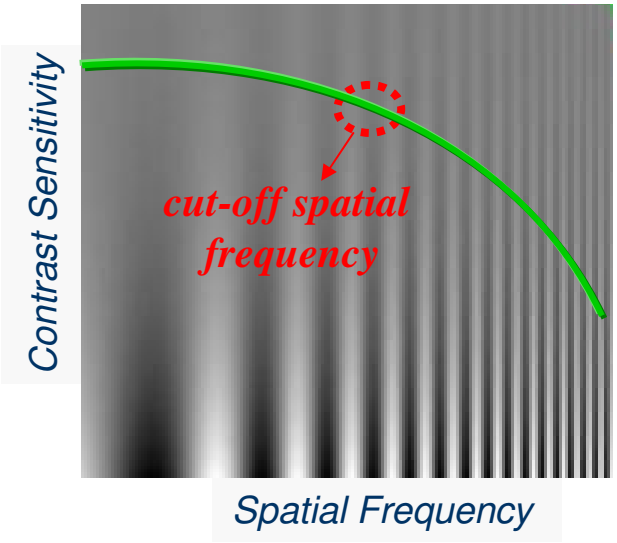


Vision Treatment Program

Design of Perceptual Learning Task & Treatment Protocol



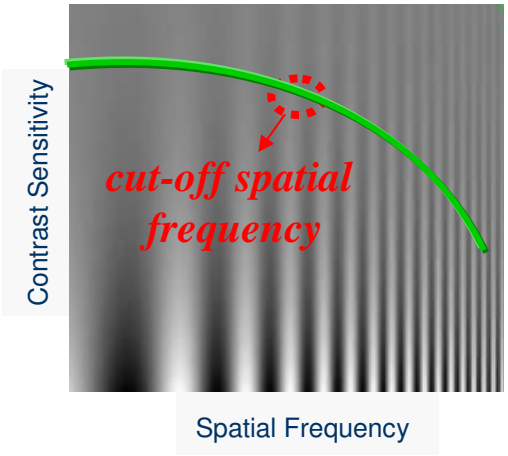


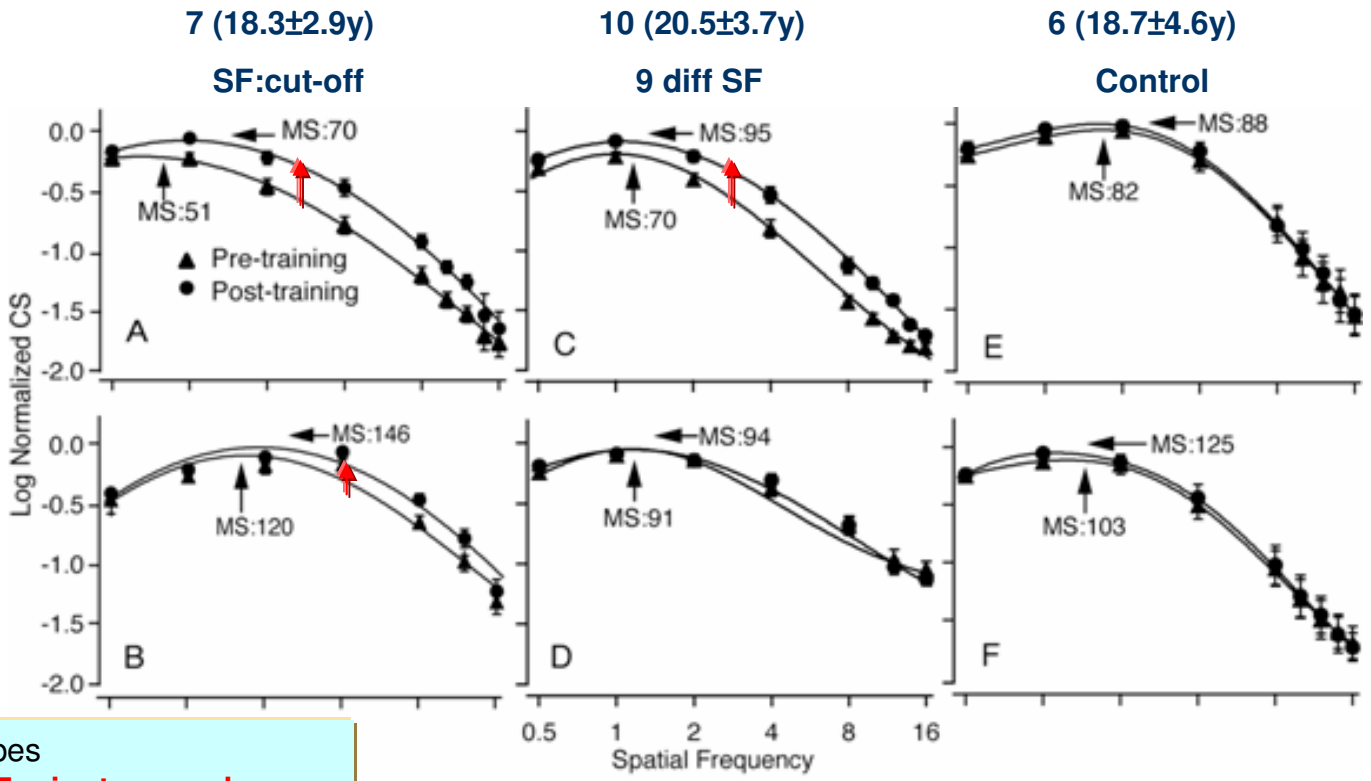


- *Images consist of line patterns with different contrast sensitivity and spatial frequency are shown in different orientations*
- *An equal visibility contour line is obtained*
- *The training procedure is based on measurement of cut-off spatial frequency of the contrast sensitivity function of each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

Initial Validation of Treatment Algorithm

Clinical Evaluation on Grating Detection





- 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

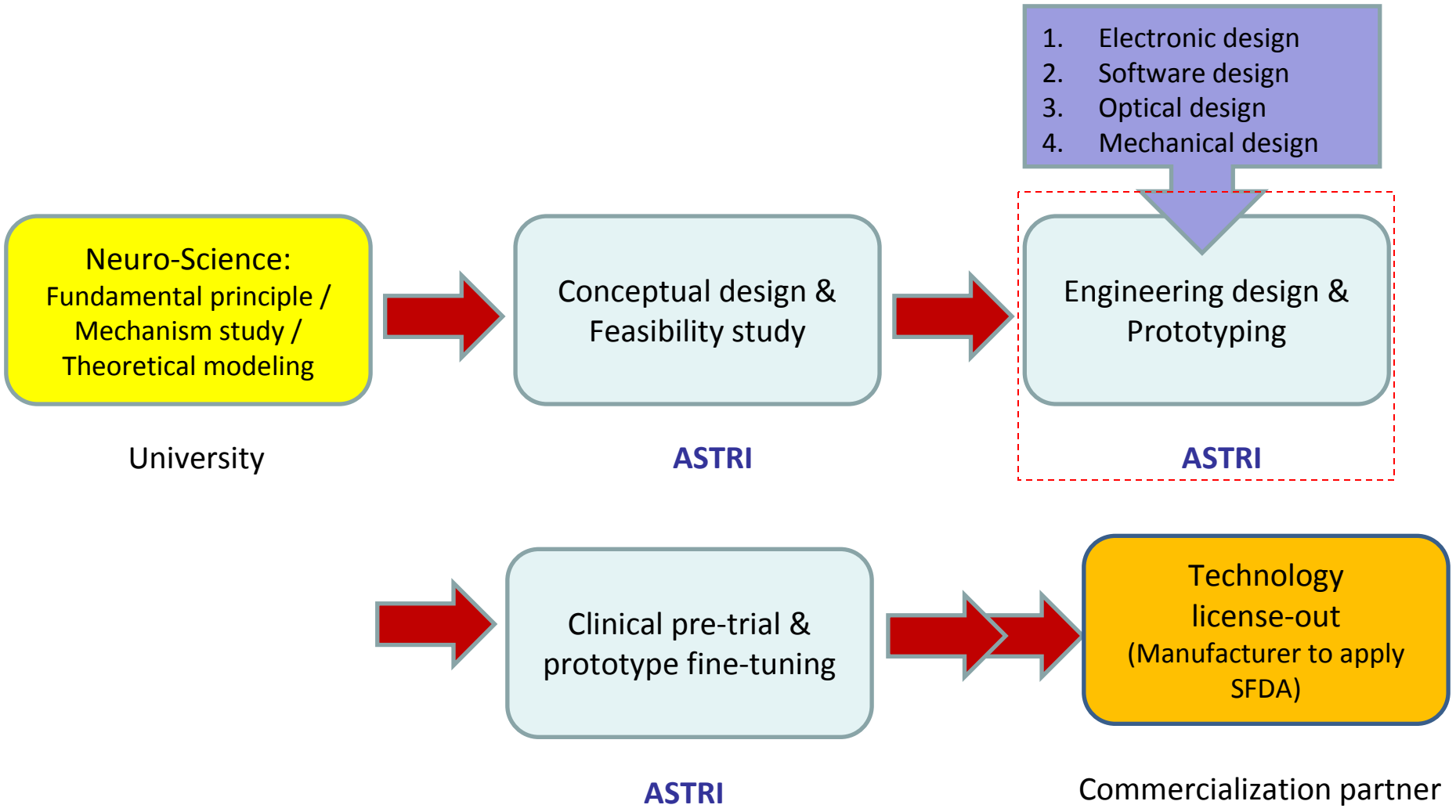
A, C, E: Amblyopia eye
B, D, F: Normal eye

SF: Spatial frequency

MS: The maximum contrast sensitivity

CS: Visual contrast sensitivity

Project Scheme



Understand User's Needs …

❑**Patient screening** in Mainland China (Tangyin, Henan, Dec 2009)

1

•Children lined up

3

•Test step 2a: Wearing **glasses**

5

•Test step 3: Retina examination by doctor

2

•Test step 1: Refractive error test

4

•Test step 2b: Visual acuity test **with glasses**

6

•Eye history record

Understand User's Needs …

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

SEED 1 Prototype
Computer Monitor

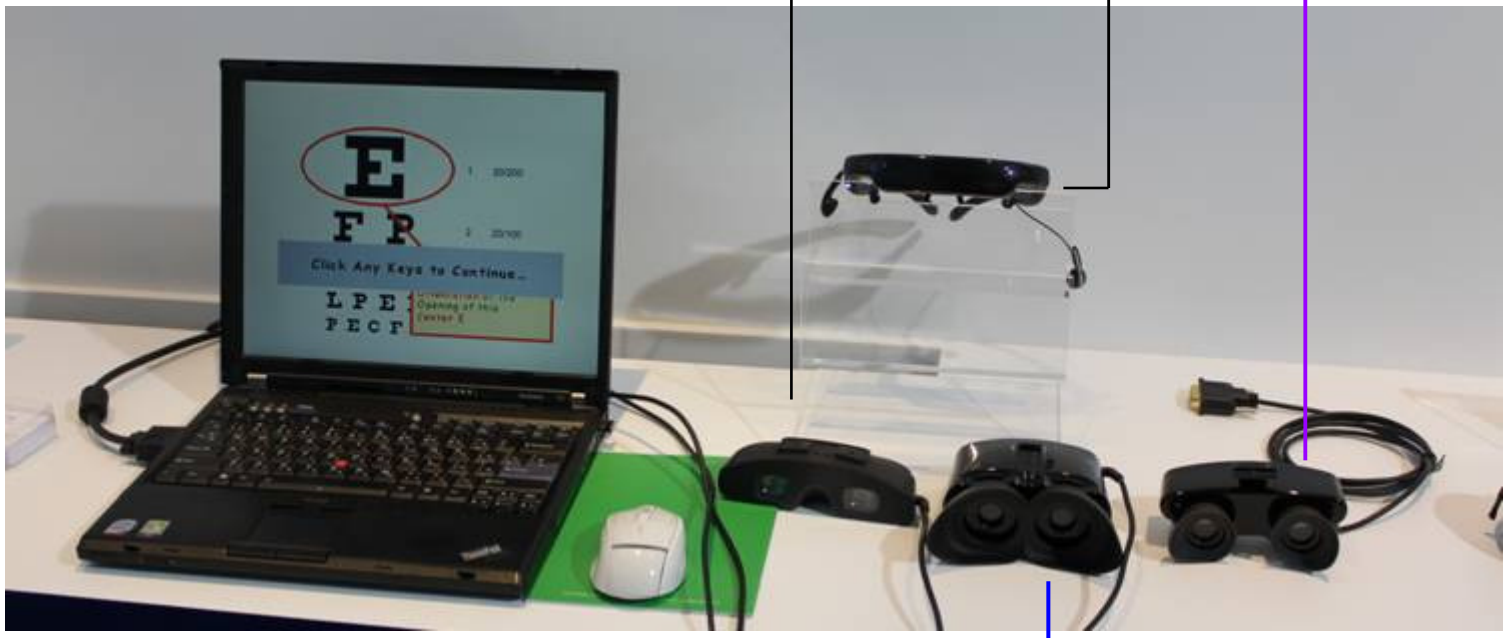
SEED 2 Prototype
Electronic Goggle

Understand User's Needs …

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

Goggle Prototypes

	Optical settings	Goggle barrel length
ASTRI goggle for medical treatment	2 meter, 17”screen	Version 1: 90mm *Version 2: 60mm*
Market product for video watching	4 meter, 60” – 80”screen	55mm



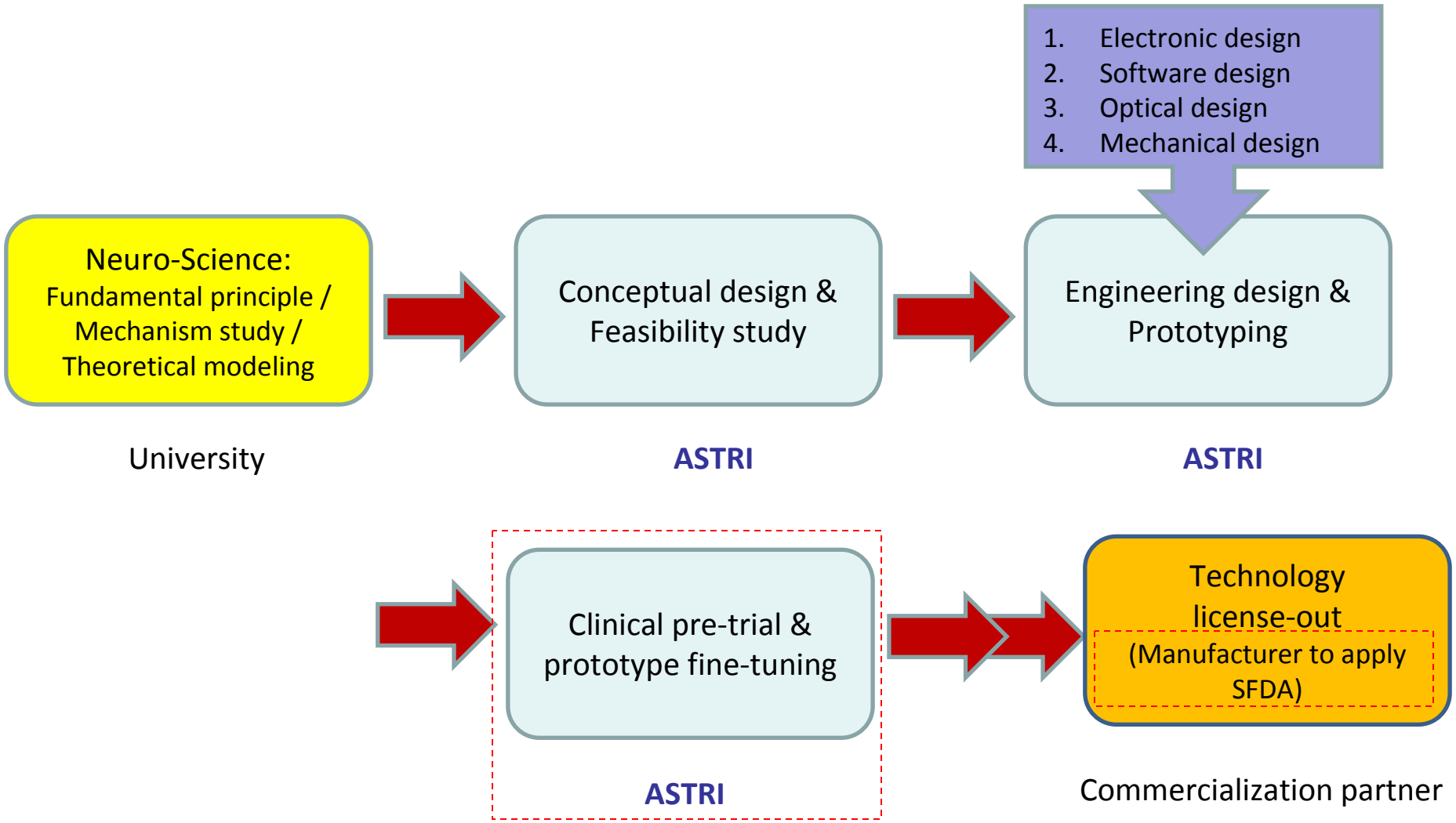
System Integration

Image displayed in Goggle

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

Project Scheme



Subject Recruitment Status

Data till Apr, 2012

	Beijing Tongren Hospital	Radiant Children Hospital	PolyU Optometry Clinic	Family Eye Care	Overall
Trial Period	Feb, 2010 – Dec, 2011	Jan, 2010 – Jul, 2010	Oct, 2011 – Apr, 2012	Oct, 2011 – Dec, 2011	Feb, 2010 – Apr, 2012
Subjects Recruited	66*	27	13*	6	112
Excluded Subjects	7	6	4	--	17
Total Data Points	59	21	9	6	95
Average age	18± 6.5	11 ± 1.9	39 ± 9.2	31± 10.3	
Current Status	Completed	Completed	Users continue	Users continue	

***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.**

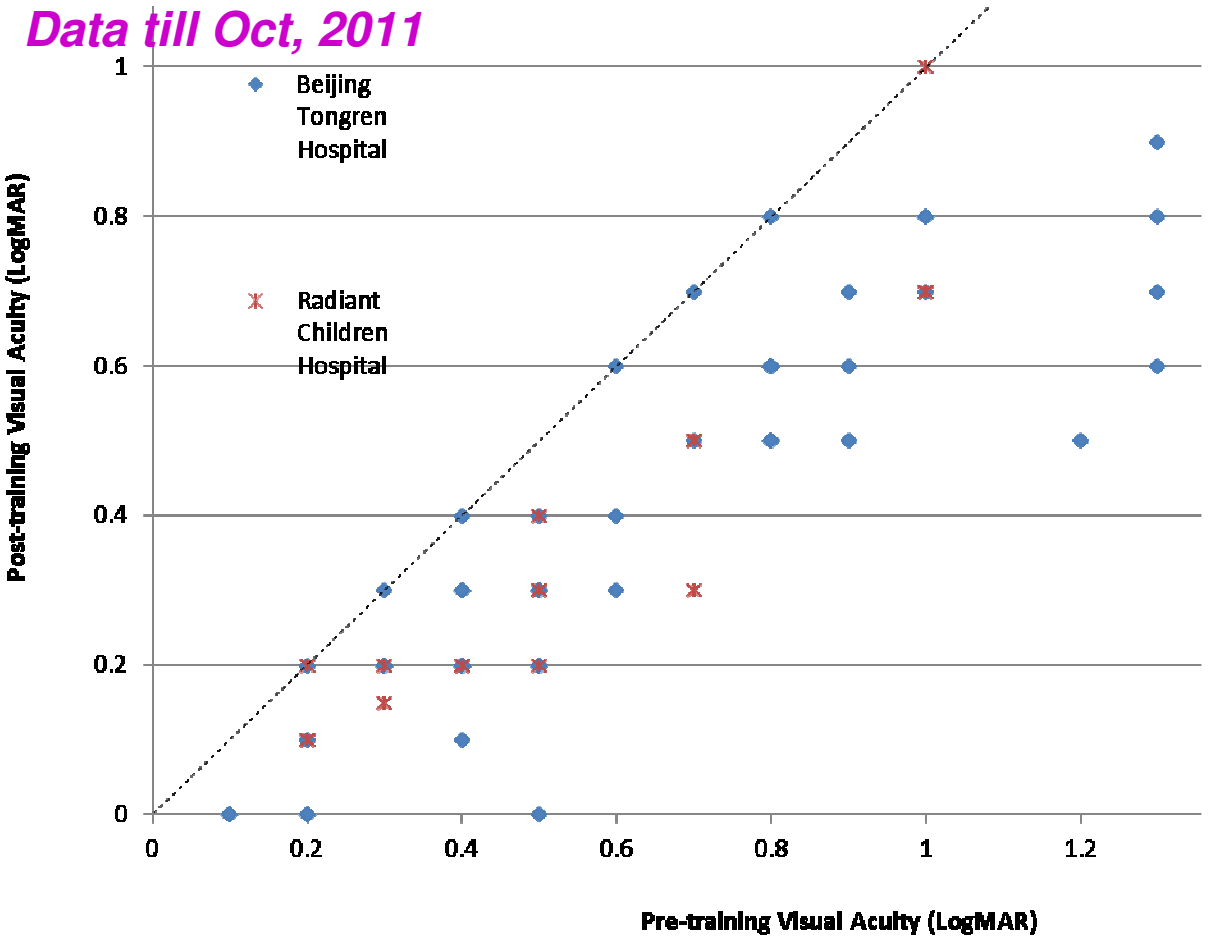
***PolyU has made calls to 60 HK patients**

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

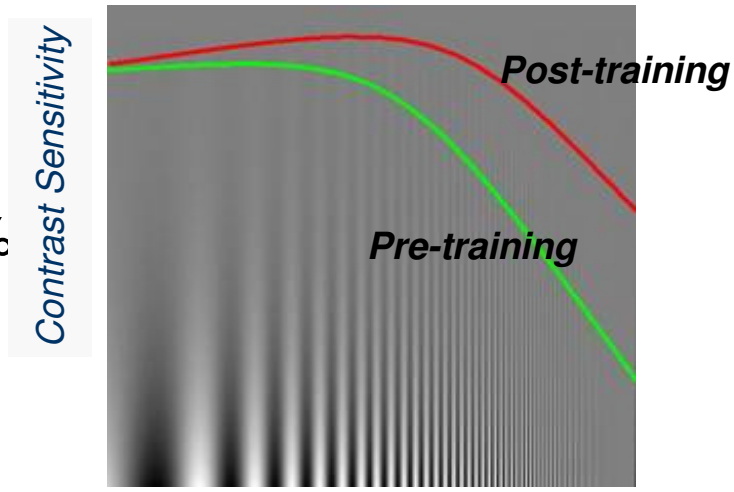
48: VA improved 2 lines or more (68%)

Assessment on other visual functions

Contrast Sensitivity

Tongren data:

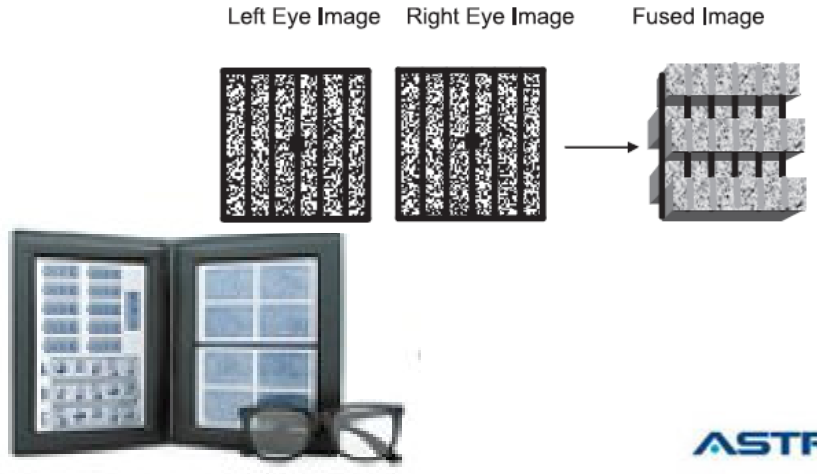
- 54/54: improvement
- 46/54: improvement at high s.f. (85%



Binocular vision function

Tongren data:

- 27/41: improvement (66%)



Suspected critical factor: Training compliance

Tongren

Subject #	2	14	17	18	22	33	43	48	50	53	58	64
Wk1	7	6	7	7	7	7	7	6	6	6	6	7
Wk2	4	7	6	6	6	6	6	7	7	7	7	6

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	6	7	7	6	5	7	7	6	7	7	4	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	5	2	3	2
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	7	7	6	7	7	7	6	6	6	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

Subject #	5	3	4	31	1
Wk1	5	1	1	1	1
Wk2	5	2	7	0	4
Wk3	0	7	5	0	3
Wk4	1	6	0	0	3
Wk5		7	1	3	1
Wk6				7	2
Wk7				2	4
Wk8					2

Family Eye Care

Subject #	3075	769	838	1086	89	649
Wk1	7	3	5	4	1	2
Wk2	6	4	2	3	4	2
Wk3		6	5	4	7	3
Wk4			1	2	1	4
Wk5						2

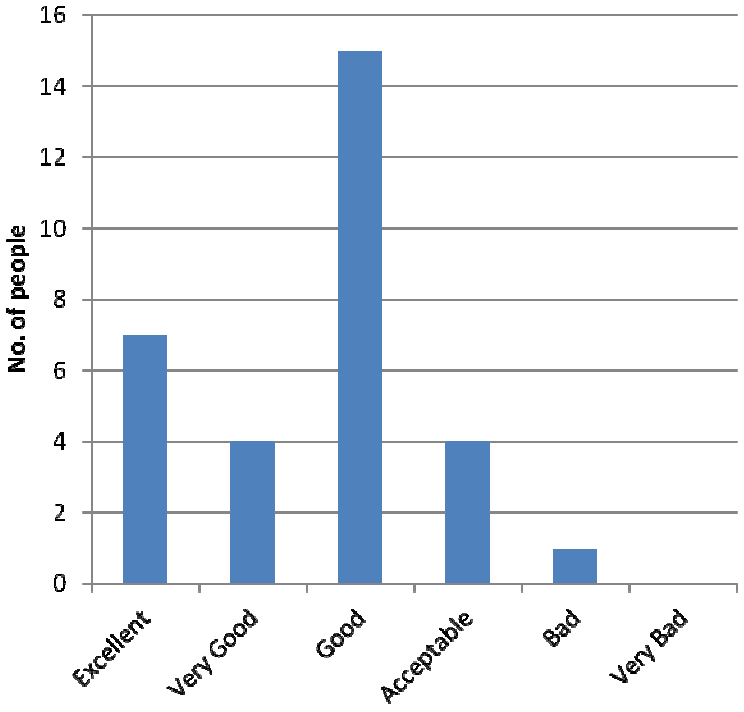
PolyU

Subject #+	1	3	2	5	10	12	6	13	4	11	8	9	7
Wk1	5	3	2	1	1	4	1	3	1	3	3	2	Not Shown Up
Wk2	3	3	2	2	0	2	0	3	0	2	1	2	
Wk3	5	4	3	3	3	2	2	2	3	2	2	1	
Wk4		2	4	0	2	1	4	3	1	2	1	2	
Wk5			2	1	1	2	4	1	2	2	1	3	
Wk6				Dropped Out	Dropped Out	Dropped Out	2	1	3	1	4	2	
Wk7									3	1	0	0	
Wk8											1	1	

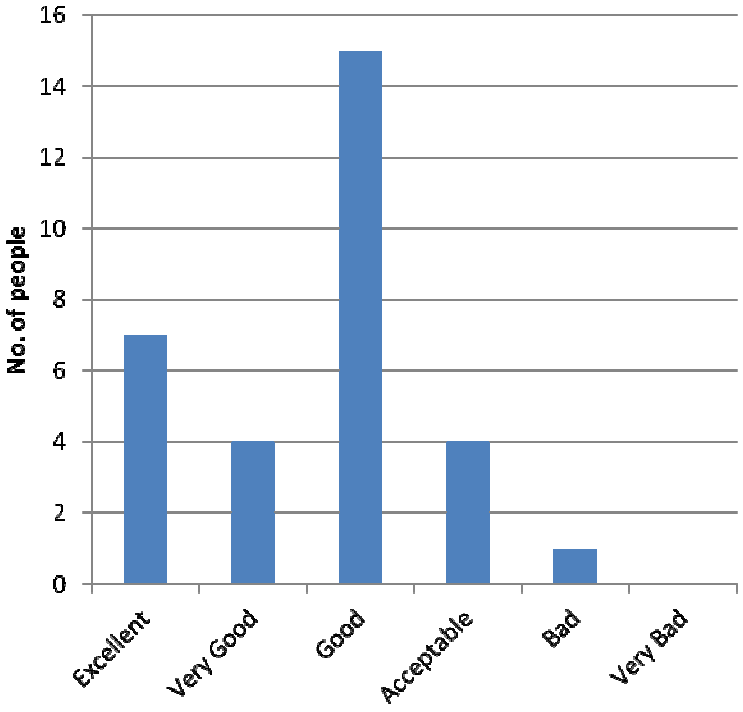
Questionnaire

- Subjects to fill in a questionnaire after BTD training
- 31 questionnaires received

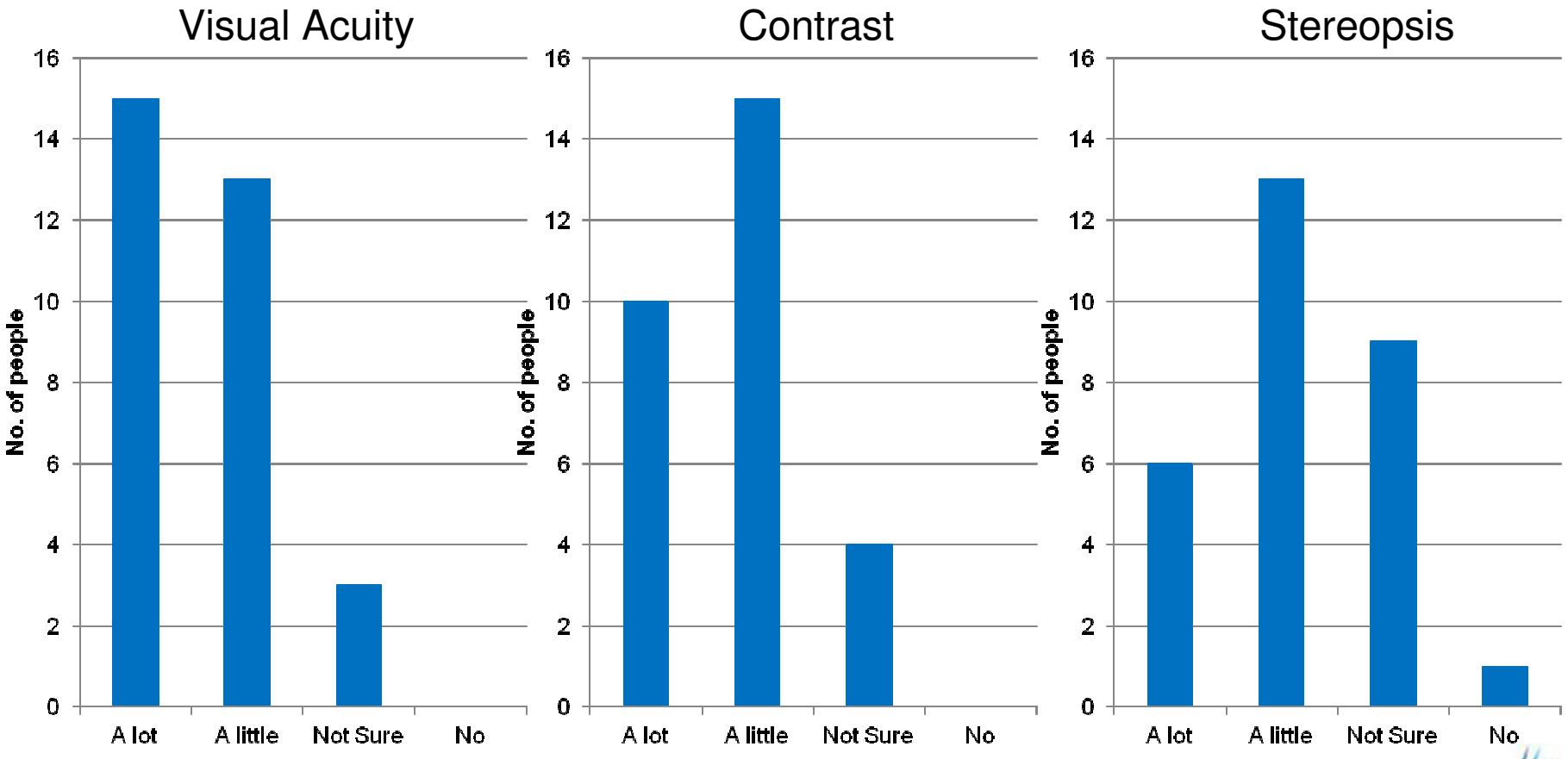
1. Is the device convenient to use?



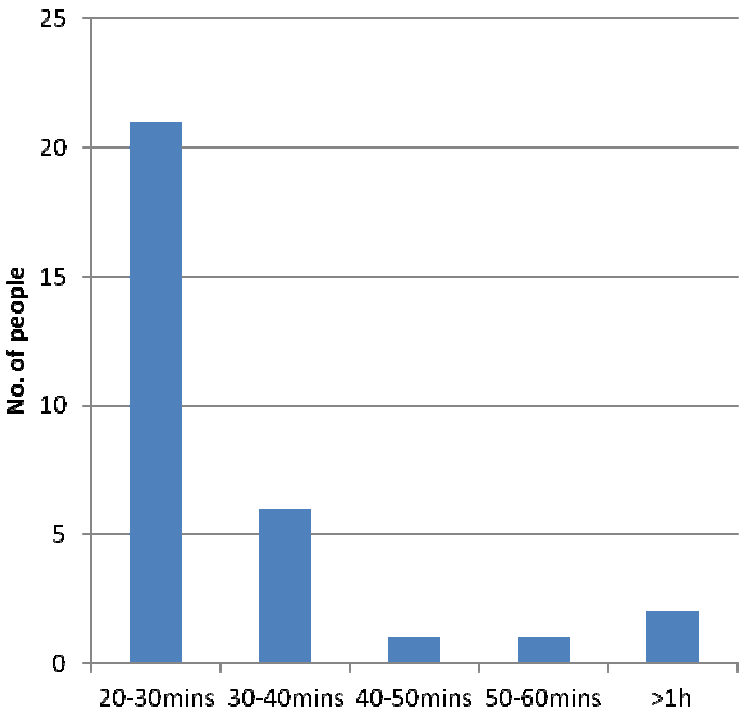
2. Are the instructions clear enough?



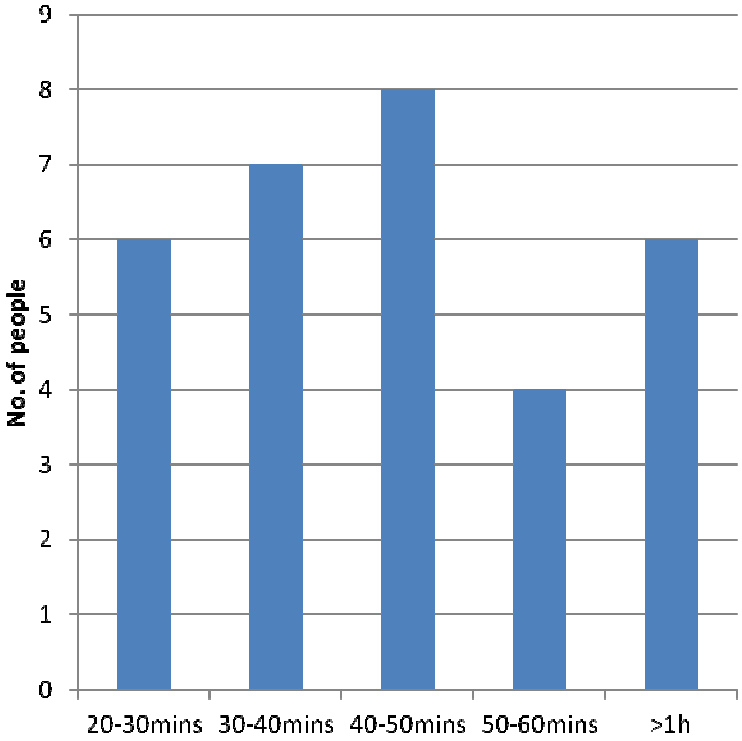
3. Do you think this device is helpful for the following aspects?



4. How long have you spent on daily-training?

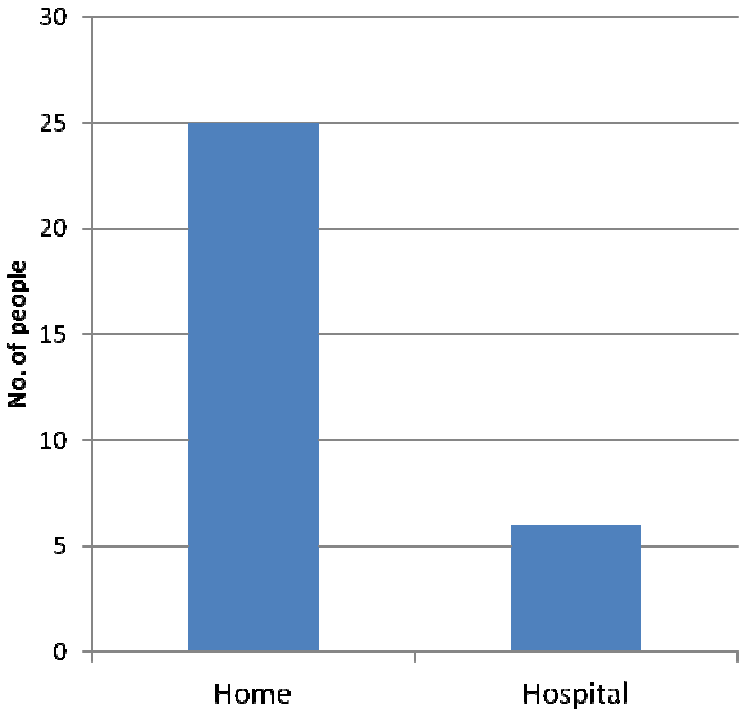


5. How long will you spend on training if time is no longer a concern?



65 % wanted to train for longer time

6. Where would you like to do the training ?



Patients' feedback

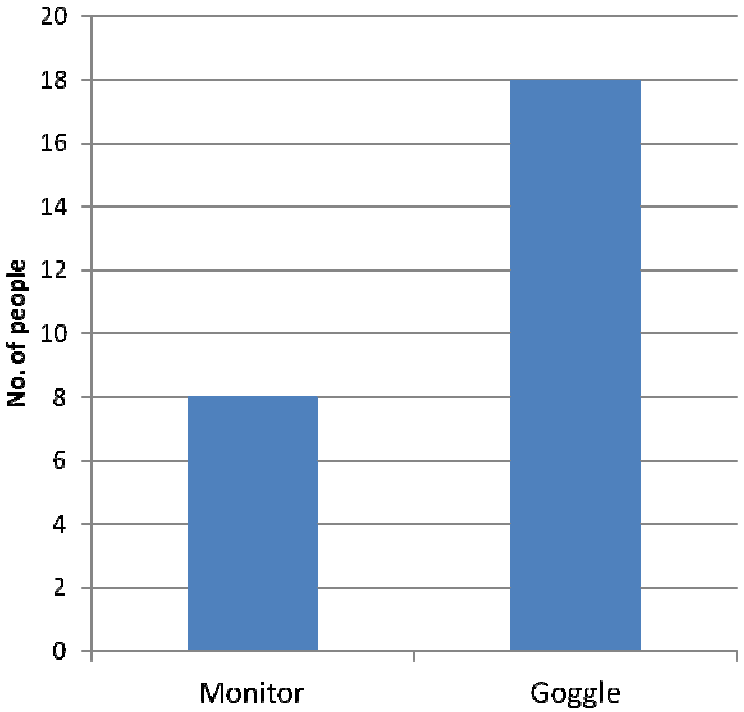
Home (80% preferred)

- More comfortable
- More convenient
- Save travelling time
- Save more time for work

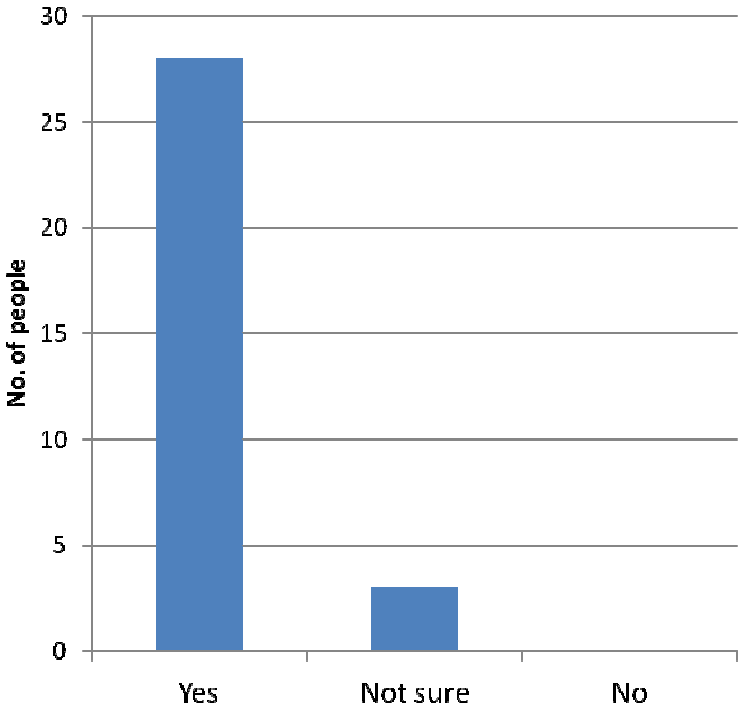
Hospital / Clinic (20% preferred)

- 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

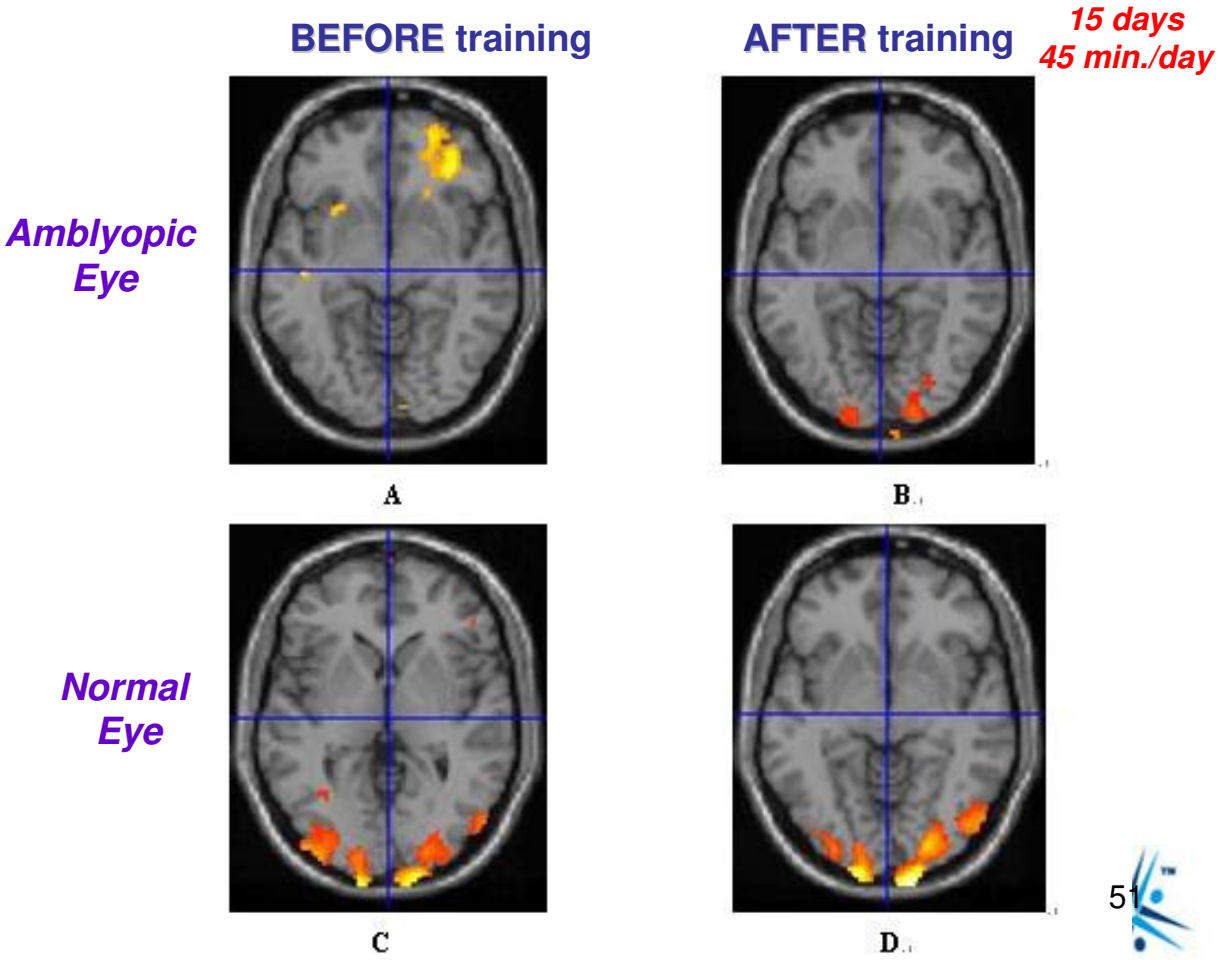
- 希望有不同粗幼的線條，可以調節一下眼睛的疲勞程度和心理承受力
- 希望時間短些
- 訓練時間太短
- 每節結果的數字字體太小
- Can have "not sure" button

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



Case study: Retention rate

- **Patient A**
  - Had done 2 rounds of BTD trainings
  - With a resting period of10 months

	1st training	2nd training
Pre-training VA (LogMAR)	0.3	0.2
Post-training VA (LogMAR)	0.1	0.1

- **Patient B**
  - Had done 2 rounds of BTD trainings
  - With a resting period of 5 months

	1st training	2nd training
Pre-training VA (LogMar)	0.5	0.5
Post-training VA (LogMAR)	0.3	0.2

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**

Design of Binocular Vision Training Protocol

Normal binocular vision requires:

- Two normal monocular visual systems (by Amblyopia treatment program)
- Normal interactions between the two (by Binocular vision training program)

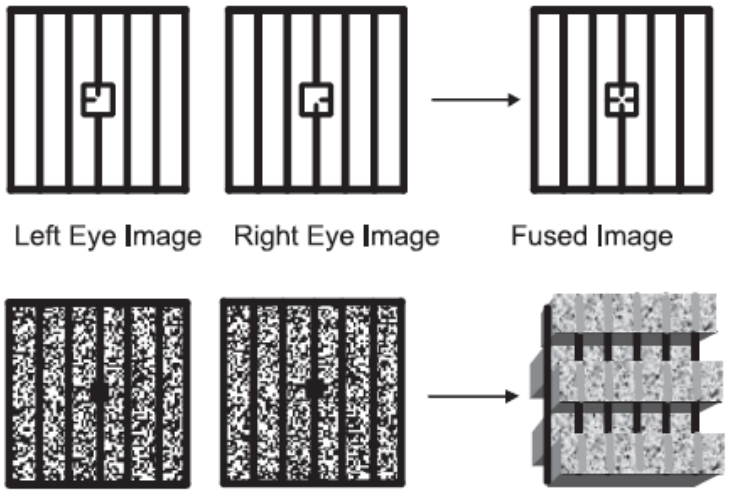
Proposed training methodology:

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

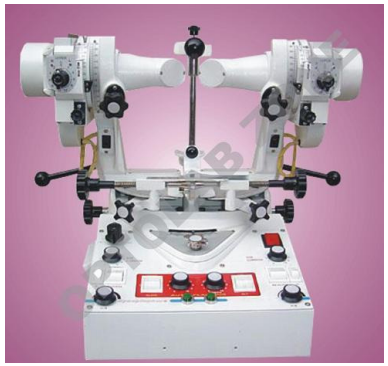


Medical Goggle for Binocular Vision Training

U.S. patent application No. 12/886,357

Systems And Methods For Binocular Vision Diagnosis And Treatment

Conventional Optometric Equipment: Synoptophore

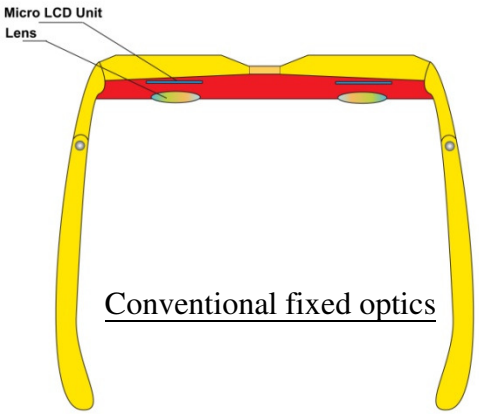


Left-side display image

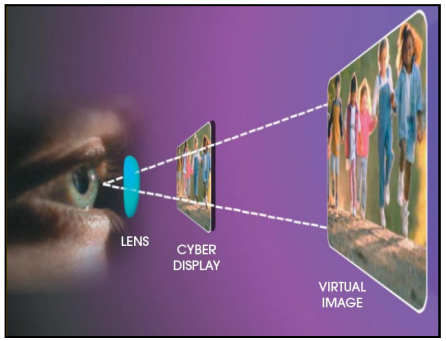
Right-side display image

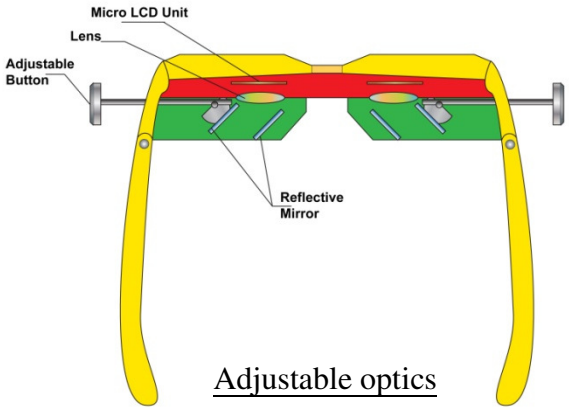
Normal people

Patients

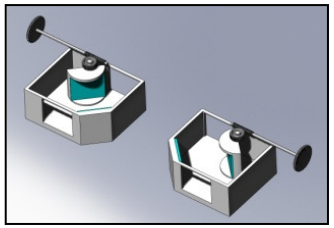


Conventional fixed optics





Adjustable optics



End of Presentation

Thank you. Questions are welcome.