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Proposing an Alternative: Analyzing Patient Perspective On Recycled Versus Ready-Made Glasses as a Global Refractive Error Solution

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Abstract

Purpose: Refractive error impairs a large percentage of the world population and many populations do not have access to eye health care services. VOSH groups visit these underserved areas providing comprehensive eye health care, including prescribing options for refractive error correction. This study analyzes two of those options, recycled and ready-made spectacles, and details patient preferences.

Methods: 94 patients volunteered to be part of a survey process, that had patients compare and select recycled or ready-made glasses as their preference in independent questions regarding better vision, comfort, style, and overall choice of spectacles to take home.

Results: Statistical analysis showed the majority of patients preferred recycled spectacles in regards to better vision (63.8%), comfort (61.7%), and style (56.4%). It was also shown that this option was preferred overall (70.2%) as a prescribing option versus ready-made spectacles.

Conclusions: Our results showed that for each of the three independent aspects above, recycled glasses were preferable over ready-made to the majority of those surveyed. In addition, the majority also chose recycled spectacles as their overall preference/final choice of glasses to be prescribed. These results provide implications for shaping the future of VOSH prescribing options, based on patient preferences.

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Master of Science in Vision Science

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Keywords

Refractive error, Recycled, Ready-made, Glasses, Spectacles, VOSH

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PROPOSING AN ALTERNATIVE: ANALYZING PATIENT PERSPECTIVE ON RECYCLED VERSUS READY-MADE GLASSES AS A GLOBAL REFRACTIVE ERROR SOLUTION

SONAM A. NARAYAN

THESIS

Submitted in partial fulfillment of the requirements
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INTRODUCTION

The presence or absence of vision care in an individual's life can greatly affect quality of life. According to the World Health Organization (WHO), "…Millions of children are losing educational opportunities and adults are excluded from productive working lives, with severe economic and social consequences. Individuals and families are frequently pushed into a cycle of deepening poverty because of their inability to see well".[1] The major cause of this inability to see well is refractive error, "…the most common cause of vision impairment worldwide and the second most common cause of blindness".[2] A large portion of this need to correct refractive error is unmet, with an estimated 153 million individuals affected, per WHO studies[3].

Aiding in solving this problem is the mission of worldwide VOSH organizations (Volunteer Optometric Services to Humanity).[4] These organizations help to meet the demand for vision care in developing countries, via humanitarian missions. One example of an organization in VOSH is TWECS (Third World Eye Care Society), whose mission trip data is studied in this paper. Subgroups under VOSH, such as TWECS, often aid in serving refractive error correction needs via recycled eyeglasses, often collected in the USA and Canada. These glasses are gathered via donation, sorted, cleaned, quality assured and prescription inventoried, then transported to developing countries where the mission trips take place. These

[1] World Health Organization, 'Sight Test and Glasses Could Dramatically Improve the Lives of 150 Million People with Poor Vision', 2006 <http://www.who.int/mediacentre/news/releases/2006/pr55/en/>.
[2] 'WHO | Global Cost of Correcting Vision Impairment from Uncorrected Refractive Error', *WHO* <https://doi.org//entity/bulletin/volumes/90/10/12-104034/en/index.html>.
[3] World Health Organization.
[4] 'VOSH International – Volunteer Optometric Services to Humanity' <http://vosh.org/> [accessed 24 April 2018].

recycled glasses are of low cost (regarding the entire process aforementioned) to the VOSH mission groups, and ideally a perfect solution to aid populations in underserved areas that cannot afford refractive error correction otherwise. There are many different systems in place, based on VOSH subgroup, to create organized lens libraries for dispensing recycled eyewear, continually updating their processes to become more effective and efficient on their trip deliveries.

The cost of an alternative that may be cheaper has also been studied, an option called ready-made glasses. These glasses are often manufactured specially for these mission trips, and consist of uniform lens material, color and style of frames, and often only come in spherical lens powers. This option can cut down on the labors mentioned above, and even be manufactured in countries being served. With local manufacturing, it may also be an aid in establishing a more permanent relief option in underserved countries for refractive error services, recognizing "the need for increasing the local eye-care workforce in developing countries"[5] versus having those populations depend more on recycled eyewear from developed countries. VOSH group assistance to areas in need is a good temporary solution, but "provision of direct clinical services by most foreign volunteers does not directly build local capacity and may hinder development of sustainable local services"[6], and "sustainable community services cannot rely

[5] Matthew G Pearce and Nicole Pearce, 'Addressing Refractive Error Visual Impairment: Volunteer Organisations' Alignment with Vision 2020 and Public Health Principles', *Clinical and Experimental Optometry*, 95.6 (2012), 583–589 <https://doi.org/10.1111/j.1444-0938.2012.00710.x>.
[6] Jerry E Vincent and others, 'The Rationale for Shifting from a Voluntary Clinical Approach to a Public Health Approach in Addressing Refractive Errors', *Clinical and Experimental Optometry*, 90.6 (2007), 429–433 <https://doi.org/10.1111/j.1444-0938.2007.00193.x>.

on uncertain or erratic supplies of spectacles"[7]. The idea behind ready-made glasses, besides being a potential prescribing option for VOSH missions, is that "In many countries, poor supply of refraction services, supply of spectacles, and economic factors may limit access of the general population to refractive correction. The cost of individually made up spectacles would be prohibitive for large scale supply in many developing areas. The provision of ready-made spectacles provided in bulk at low cost across a range of refractive corrections could potentially reduce this cost. "Ready-made spectacles have already shown great benefit with reading spectacles readily available for the presbyopic population".[8]. However there are disadvantages to ready-mades as a temporary or permanent/sustainable solution, as "Ready-made glasses, with their spherical design, cannot fully treat refractive error due to high astigmatism….also do not treat anisometropia, given that they are made with the same spherical power in both eyes. In addition, these glasses are manufactured with a generic pupillary distance, which may induce horizontal prism when fit to patients with pupillary distances away from the norm"[9]. In addition to this it should be noted that these low cost, mass produced spectacles of uniform frame and lens material may not be durable enough to make a difference to populations over time (i.e. resist breakage). Ready-made glasses are also designed to be all the same style/appearance, which may create a stigma towards their use (i.e. not wanting to wear the same glasses as many others in the local population).

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[7] Vincent and others.
[8] Jill Keeffe and others, 'Correction of Refractive Error in the Victorian Population: The Feasibility of "off the Shelf" Spectacles', *British Journal of Ophthalmology*, 85.11 (2001), 1283.
[9] Thomas S. Shane and others, 'Used Glasses Versus Ready-Made Spectacles for the Treatment of Refractive Error', *Ophthalmic Surgery, Lasers and Imaging Retina*, 43.3 (2012), 235–40 <https://doi.org/10.3928/15428877-20120223-02>.

The past literature has studied costs of both recycled and ready-made options, with results arguable based on variables such as sourcing, cleaning, sorting, inventory, method of transport , and method of prescribing glasses (i.e. patients sorting through a box versus optician or optometrist choosing)[10]. Some studies have attempted to estimate the cost of recycled eyeglasses, placing best calculated monetary values on independent components of the entire donation process[11]. These components include sorting through useable donations versus damaged, transportation, overall labor hours, etc. However this approach is non-applicable, due to the fact that recycled eyeglasses are made useful strictly by volunteer efforts, no monetary values can be assigned to these components aforementioned. It has also been studied whether or not populations value refractive error correction enough to consider paying for it, both immediately[12] and at follow up visit, with results showing they value the benefit enough to pay for future glasses.[13] However, there is little data in the literature on detailed patient preferences on recycled versus ready-made glasses. Speculations on patient option have been made, such as in a study reviewing a mission trip to Tuvalu, venturing that "seldom will someone prefer to wear a used appliance instead of a new one. People in developing countries have the same awareness of appearance and expectation of comfort as those in other

[10] Narayan, Sonam, 'Addressing the Unmet Need : An Analysis of the Global Prevalence of Refractive Error and Its Possible Solutions', 2014 <https://pdxscholar.library.pdx.edu/cgi/viewcontent.cgi?article=1090&context=honorstheses> [accessed 26 April 2018].

[11] David A Wilson and others, 'Real Cost of Recycled Spectacles', *Optometry and Vision Science: Official Publication of the American Academy of Optometry*, 89.3 (2012), 304–9 <https://doi.org/10.1097/OPX.0b013e318242cfae>.

[12] 'Use of Ready-Made Spectacles to Meet Visual Needs in a Low-Resource Adult Population' <http://www.vosh.org/files/presbyopia%20study.pdf>.

[13] Heidi R. Laviers and others, 'Presbyopic Spectacle Coverage, Willingness to Pay for Near Correction, and the Impact of Correcting Uncorrected Presbyopia in Adults in Zanzibar, East Africa', *Investigative Ophthalmology & Visual Science*, 51.2 (2010), 1234–41 <https://doi.org/10.1167/iovs.08-3154>.

countries. Anything less than comfortable cosmetically appealing eye wear is unsatisfactory", regarding recycled spectacles.[14] Another study by Shane et al.[15] compared only acuity outcomes between used and ready-made spectacles, and found a statistically significant greater improvement with used spectacles, as well as the majority of patients preferring the option that gave them better acuity.

The goal of this study is to evaluate patient preferences on recycled versus ready-made glasses in detail, regarding preference in vision, comfort, style, and overall preferred choice. This is to gain a better understanding of patient desires of what drives selection of one option versus the other, as well as provide information to VOSH groups for consideration on future changes to their programs. My hypothesis is that patients prefer recycled glasses, due to the fact that despite being previously used, they have capability to offer more accurate vision correction (due to astigmatism compensation), as well as come in a range of frames and lens materials, providing style choice, unlike ready-made spectacles.

[14] Jacqueline Ramke, Renee Du Toit, and Garry Brian, 'An Assessment of Recycled Spectacles Donated to a Developing Country', *Clinical & Experimental Ophthalmology*, 34.7 (2006), 671–676 <https://doi.org/10.1111/j.1442-9071.2006.01306.x>.
[15] Shane and others.

METHODS

The purpose of this study is to determine patient preference for recycled versus ready-made spectacles, evaluating the components vision, comfort, style, and finally overall choice with all factors considered.

Subjects

All subjects were patients self referred to be seen at a TWECS/VOSH international health service, designed to provide eye care services in developing countries that otherwise have barriers to access. This particular service was located in Tacloban City of the Philippines, as well as the adjacent suburbs (Anibong, Tanauan). These areas have socioeconomic demographics of 80% no to low income, and 20% low to middle income. In all these locations combined, 5077 patients were served over the course of ten days. All patients seen at this service were given comprehensive eye health exams by a team of doctors, opticians, and volunteers, and treated for conditions varying in severity from refractive error only to comorbid with ocular disease conditions. Of these patients seen, 94 participated in our study's survey. These patients comprised of 75 females and 19 males, spanning ages 8 to 73. These participating patients again received the same level of healthcare as other patients at the screening, but were asked to complete the additional survey portion. This survey process was determined to be exempt from human subjects review by the Pacific University Institutional Review Board, as researchers only analyzed de-identified data.

For participation in the survey, exclusion criteria included having an entering visual acuity better than 20/40, anterior or posterior ocular disease conditions (refractive error

needed to be primary cause of reduced visual acuity), myopia greater than 6.00D (diopters) sphere power, or astigmatism greater than -1.75 diopters. If astigmatism was present, axes not within 30 degrees of with the rule or against the rule (180, and 90 degrees, respectively) were also exclusion criteria due to specific availability of recycled glasses inventory (see materials section below). Recycled glasses inventory limitations were also the reason for -1.75 diopters being the maximum accepted astigmatism for this study. The spherical power criterion was necessary due to the limited availability of ready-made glasses, which were only available in the range from -1.00 to -6.00D, therefore it was not possible to evaluate patient preferences with hyperopic corrections for the purposes of this survey.

Materials

Supply of the recycled glasses were inventoried in detail, using a seven station inventorying process, with cataloging only done by optometrists and opticians. The first station involved discarding glasses that didn't meet TWECS inventory criteria: any scratched, excessively dirty, excessively large, bifocal, progressive, or prescription sunglass donations. The second station involved doing this same process again as a double check. The third station separated glasses into plus and minus boxes by sphere power, as well as repeating steps one and two to discard any glasses that weren't purged in previous stations. The fourth station involved cleaning all the previously sorted plus and minus power sorted glasses. The fifth station involved lensometry neutralization of the exact prescription in the previously mentioned plus and minus spectacles. These glasses were then each individually bagged, with a

prescription label placed on the bag. A color code was also stamped to indicate male, female, or kids frame based on best optometrist or optician judgment At the fifth station again glasses were also discarded if they did not meet criteria and had not been removed in previous stations. In the sixth station these bagged glasses were placed in inventory bins organized by gender and prescription sphere power. Lastly at the seventh station an optometrist or optician cataloged a detailed list of the glasses prescriptions as they were packed into a mission trip box (200 pairs of each power from +20.00D sphere to -20.00D sphere taken per trip, on average).

The organization/cataloging of these glasses were done by OD spherical power (in -0.25D steps) and gender. Cylinder power was available in half of this inventory. 25-50 pairs each were available in quarter diopter steps of cylinder (from -0.25D to -1.50D). In general higher cylinder powers were not stocked due to patients with higher astigmatism being more sensitive to prescriptions given slightly off axis. Cylinder axes available were mainly either with or against the rule (180, and 90 degrees, respectively), with 15 degrees off any of these axes still considered to fall within these categories. Only a minority of oblique axis powers were available (as these would be difficult prescriptions to fit). Recycled glasses lens materials consisted of CR39, polycarbonate, or a high index material. All pairs had anti-reflective coating.

Ready-made glasses were similarly inventoried and available in powers of -1.00 to -6.00D, in -0.5D steps, all the same style and color (a black colored metal frame, see Figure 1), with acrylic material lenses without anti-reflective coating, provided by VOSH SE of Florida. and were matched to the patient prescription via equivalent sphere calculation. The entire

inventory selection of both recycled and ready-made spectacles were available to select from each day of the TWECS service.

Figure 1: Ready-made spectacles (bottom) photographed next to a recycled spectacles option. Recycled glasses frames and lens materials varied per patient, but ready-made frame, material, and color was uniform.

Procedures

After patient history, triage, auto refraction, subjective refraction, and eye health examination, patients matching the eligibility criteria noted above were referred to a separate

dispensing station. Qualifying patients were explained the purpose of this study and given the opportunity to participate in the survey. At the dispensing station, one person ran all subjects through procedural protocol. Two pairs of glasses, one pair recycled and one ready-made, were matched to the patient's distance prescription (as measured by the doctor) from available supplies of both. Any sphere or cylinder power present in a patient prescription was matched exactly or knocked down in quarter diopter amounts until a recycled glasses prescription match was found, with sphere power being matched first, then cylinder. Axis powers were matched within 20 degrees maximum difference, for all cylinder powers above -0.25D. If this was not possible due to inventory, an equivalent sphere calculated pair of recycled glasses was chosen, although this was rarely necessary.

Subjects were separated into a private area so that others could not bias the selection responses. The procedure and survey was explained, with patients told there would be a choice between two pairs of glasses (glasses #1 versus glasses #2), and that the survey questions would ask patients to select which pair they prefer for better vision, comfort, and style independently (questions 1 through 3), and then their overall preference of glasses to take home (question 4). Each pair of glasses was placed in a pouch so that the patient was masked to the appearance of the glasses. They were also told to not handle/touch the glasses at this time. The pairs were each adjusted and fit, and glasses were then placed on the patient while their eyes were closed so they could not see them. The order of glasses presentation was alternated per patient, i.e. sometimes recycled was first to check acuities, sometimes ready-made. Each pair was trialed in two short periods (roughly 15-30 seconds). The patient was then

given the first 2 questions of the survey to answer (vision and comfort preference questions), then allowed to see and handle both glasses prior to answering the third survey question (style preference question) and final question (which pair they prefer to keep). Survey forms were translated into the patient population's native language of Visayan dialect (specifically Waray Waray), and also read aloud in native language to the patient. Patient answers were verbally confirmed as well. The time of the study was done during daylight only as to not cause bias in any patient results based on environmental lighting. The survey can be seen in Appendix A at the bottom of this paper. It was designed as a Likert Scale survey, with 5 options, each of the opposite ends being ranked as recycled or ready-made, and the middle option being equal. Specifically, the five response categories read, in order, 'prefer glasses #1', 'slightly prefer glasses #1', 'same/equal', 'slightly prefer glasses #2', and 'prefer glasses #2'.

Statistical Analysis

Statistical analysis was done using IBM SPSS Statistics program. This was used to compute frequency percentages of survey answers, as well as do Chi Square and t-test analysis. Microsoft Excel was used to compute effect sizes. A critical p-value of 0.05 was chosen to indicate statistical significance. An effect size of greater than 0.5 was considered a moderate clinical effect.

RESULTS

The total number of patients seen on this mission trip were 5077, and of those 704 were myopes. Of this 704, the number of myopes with clear and healthy ocular media seen during

this trip totaled 226. Out of this number, 98 were willing to participate in the survey as matched exclusion criteria. 94 of these patient records and surveys were analyzed in total. As noted, 98 records could have been potentially available, but only 4 patients chose options on the survey saying “slightly prefer glasses #1” or “slightly prefer glasses #2”, all others chose the remaining survey options only. Due to the low number of patients choosing this survey option, these 4 records were excluded from analysis. When analyzing age versus overall choice (question 4), age 31.3 was the average, with those that chose recycled averaging age 31.6, and those that chose ready-made averaging age 30.6. The frequency percentages of each chosen option per survey question are shown in table 1 below.

Table 1. Frequency percentages of recycled versus ready-made option chosen per survey question

Survey Question	Percent choosing Recycled	Percent choosing Ready-Made
1 - vision	63.8%	28.7%
2 - comfort	61.7%	31.9%
3 - style	56.4%	42.6%
4 - overall choice	70.2%	29.8%

Chi-Square testing was done to rule out chance as a factor when trying to find significant correlation between questions. For questions 1 and 4 (vision and overall choice), it was seen that the correlation was not due to chance (with chi square=36.5, and p=<0.001). For questions 2 and 4 (comfort and overall choice), and questions 3 and 4 (style and overall choice), this was also the case (chi square=18.6, p=<0.001 for questions 2 and 4, chi square=13.7, p=0.001 for questions 3 and 4.

T-tests evaluated the effect of spectacle choice on average cylinder power of both eyes (as measured by doctor), spherical equivalent power measured by doctor, age, and gender. All cases of patients selecting 'same' rather than ready-made or recycled were removed from this analysis.

Analysis of these variables versus answer to question 4 showed no significant p values, indicating that any associations seen between average cylinder power, spherical equivalent, gender, or age to the answers on question 4 could be due to chance.

Then analysis of these independent variables were each compared with question 1 (regarding vision), question 2 (regarding comfort), and question 3 (regarding style), respectively. This did not show any significant p-values to imply correlations were not simply due to chance, except for with question 1 and average cylinder power (t test showing p=0.0, t=2.4, df=85), and with question 3 and gender (chi square test showing chi square= 3.9, p=0.04).

For the association seen between question 1 and average cylinder power, an effect size of .7 was seen, and clinically relevant, per our standards noted in the 'analysis' section.

Other findings included comparison of measured similarities and differences in those that chose ready-made vs. recycled. Doctor prescribed sphere amount (averaged for OD and OS) was near equal in patients that chose either, at -2.5 diopters (Standard deviation/SD=1.5) for ready-made and -2.7 diopters (SD=1.4) for recycled. Regarding doctor measured cylinder (also averaged between OD and OS), those who chose ready-made had an average of -0.2 D cylinder (SD=0.5), versus -0.5 D (SD=0.7) in the recycled group. Analysis of choice on question 1 (regarding vision) and average cylinder between both eyes yields nearly the same values as noted above for both groups.

Average exit VA OD and OS for those that chose ready-made was 20/22.5 OD (p=0.2), 20/23.9 OS (p=0.1). Average exit VA OS and OS for those that chose recycled was 20/24.7 OD (p=0.2), 20/27.1 OS (p=0.1). These values were calculated initially in logMAR, then converted back to Snellen for reporting. The p-values noted showed that chance could not be ruled out when looking for association between exit acuities and answer to question 4/overall choice, so it cannot be concluded that one option delivered better exit acuities than the other.

To ensure quality of prescription matching, statistics were done calculating the difference between equivalent sphere recycled (rx) prescription and equivalent sphere doctor's prescription, then the difference between ready-made (rm) prescription and equivalent sphere doctor's prescription. This was done for OD and OS separately. This analysis was then repeated with cylinder prescription. Results are shown in table 2 below. It can be seen that averages fall close to zero for both spectacle types. Standard deviations are slightly greater for all ready-

made averages. Also, as noted in the procedures, cylinder axis was matched within 20 degrees of what was prescribed, for all amounts greater than -0.25 D. However, it was seen that on average deviation was only 7.1 degrees OD and 9.2 degrees OS.

Table 2. Analysis of closeness of match between doctor prescription versus recycled and ready-made prescriptions

	Sphere				Cylinder			
Mean Doctor Sphere	OD RC minus DR Rx	OS RC minus DR Rx	OD RM minus DR Rx	OS RM minus DR Rx	OD RC minus DR Rx	OS RC minus DR Rx	OD RM minus DR Rx	OS RM minus DR Rx
Mean difference	-0.06	-0.04	-0.01	-0.06	0.25	0.30	0.41	0.46
SD	0.24	0.56	0.39	0.59	0.61	0.62	0.72	0.70

Lastly, at the end of our survey was a section where the patient could note why they chose what they did for their overall choice. Patient answers of keywords vision, clarity or clearer were tallied as related to vision. Keywords lighter, or comfort were assumed to be related to comfort. Keywords color, pretty, shape, or style were noted as related to style. Some patients did not answer this portion, and some answered two answers. All answers noted to fall under the keywords above were tallied, to a total of 106 responses. 60.3% of these patients answered vision, 27.2% comfort, and 12.2% style as their reason for their overall choice.

DISCUSSION

Results showed that each of the first three survey questions, regarding vision, comfort, and style, all statistically influenced answers to question 4, overall glasses choice. This determined that no questions on the survey needed to be removed from further analysis regarding a patient's overall/final choice of glasses to take home. Frequency percentages showed that recycled glasses were chosen the by the majority of those surveyed for each question (questions 1-4), and 70.2% of those surveyed chose recycled glasses as their end choice to take home (question 4). The question that came closest to being equal percentage proportions of each was question 3 regarding style, with the majority still choosing recycled at 56.4%. Overall frequency results indicated that in the majority of cases recycled glasses were preferred over ready-made.

It was seen that neither spherical equivalent prescription (as measured by the doctor) nor age of the patient had any association to patient answers on any of the survey questions.

It was seen that average cylinder power of the patient (as measured by the doctor) was associated with answer to question 1 of the survey, regarding which pair gave better vision. This makes sense because the ready-made spectacles were all spherical in power, and those with higher astigmatism would be interested in the only glasses option that compensates for this, recycled. This finding was also calculated to have a moderate clinical relevance. Analysis of average cylinder power in ready-made and recycled spectacles choosers showed that at on

average those that chose recycled had nearly double the astigmatism present compared to the ready-made choosing group.

A very small association was found between the gender of the patient and style preference of the glasses.

In regards to prescription matching accuracy and exit acuities, the difference in cylinder between doctor and ready-made glasses prescription was shown to be slightly greater (as expected, due to no cylinder compensation in these glasses), but as noted earlier exit acuity was not significantly different between either spectacle option prescribed.

Another important note to be made regarding exit acuities is that acuities were only measured through the pair that the patient chose as their overall choice. Acuities were not measured through the option they did not choose to take home. With the aforementioned note that exit acuities on average are not statistically different between patient groups that chose recycled versus ready-made, it can essentially only be said that patients that chose either as their final option saw well through them. It cannot be said that the majority of patients objectively saw better through one option versus the other.

The final part of our survey, where patients noted why they made their overall choice, showed that the majority chose the option that gave them better vision. This resonates with the study mentioned in the introduction, by Shane et al, which also noted 77.3% of their patients preferred the option that gave them better distance acuity. An interesting point to note, although it did not affect our statistical analysis of this portion, was that there were 3

reported cases where besides noting vision as the driving factor for overall choice, patients noted the other spectacles option made them “dizzy” or feel like they were “swimming”. In all these 3 cases, ready-made and recycled options presented happened to be spherical, and prescriptions only varied by 0.25D in one or both eyes (i.e. no cylinder options given). However 2 out of the 3 patients noted the ready-made option made them dizzy. This could likely be due to the lens quality of the ready-made spectacles being very poor (a acrylic based lens, known to not be manufactured to ophthalmic quality), although we cannot be certain. However, the very poor quality of the ready-mades can be attested to by difficulties in adjustment during the study procedures—a large number of ready-made frames broke during the adjustment procedure step, much outnumbering breakage rates of recycled eyeglasses.

Limitations of this study include sample size and demographic surveyed. Future studies sampling a bigger VOSH outreach service may yield more positive statistical findings. Out of the potential number of participants available for this study, difficulties were met in running both the study and seeing all other patients that were waiting for care. In addition, expanding to include different world regions may yield different results. The range of available ready-made spectacles was also a limitation, as we only studied myopic patients. Future studies could study both hyperopic and myopic patients combined, if made possible by the appropriate ready-made glasses production labs. The particular style of the ready-mades used in this study may have some influence as well (see Appendix B), this study could be repeated with a different stock style of ready-mades spectacles. Lastly one difficult to control variable is style selection of the recycled pair of glasses, although style was randomized (glasses chosen for best

prescription match), inventory was presorted into female and male selections, as best judged by those arranging the inventory.

Factors that could not be controlled as easily are those of recycled eyewear availability nor data collector's ability to match recycled glasses to the doctor's provided prescription. Recycled spectacle stock likely changed daily based on resources used, and matches were made using human judgment rather than a computer system to match the closest prescription. These factors likely cannot be better controlled in a future study due to the nature of how VOSH outreach services are designed (to be as accurate as possible in a manner timely enough to see a plethora of patients).

CONCLUSION

Our study sought out to survey patient opinion on recycled versus ready-made spectacles, in regards to better vision, comfort, and style, independently. In addition our goal was to identify overall patient preference of which of these they prefer to be prescribed. Our results showed that for each of the three independent aspects above, recycled glasses were preferable over ready-made to the majority of those surveyed. In addition, the majority also chose recycled spectacles as their overall preference/final choice of glasses to be prescribed. There is potential that the statistics outlined in this paper as not statistically significant could change with a bigger sample size. It would be worthwhile to repeat this study and analysis with a larger number of subjects. It is also important to evaluate patient opinions some time after initial prescribing, at a follow up visit. Unfortunately the efforts and planning necessary to reach

the locations of VOSH missions, as well as difficulty/poor reliability of patients returning for follow up limit answering this question. Regardless, an initial evaluation of detailed patient opinions like this study holds purpose, as studies have already shown patients value the positive change refractive error correction provides, and would consider paying for it immediately[16], and sustain this opinion at follow-up visit[17]. This is because providing patients a first pair of glasses is a fundamental life change, those that have seen the benefits of improved vision are likely to buy another pair if they lose their glasses or experience prescription changes[18].

[16] 'Use of Ready-Made Spectacles to Meet Visual Needs in a Low-Resource Adult Population'.
[17] Laviers and others.
[18] 'A Simple Way to Improve a Billion Lives: Eyeglasses - The New York Times' <https://www.nytimes.com/2018/05/05/health/glasses-developing-world-global-health.html> [accessed 2 June 2018].

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APPENDIX A

Dispensing Glasses Survey

Patient #_____ Age_____

Gender: M / F

Instructions:

"You will be allowed to try on two pairs of glasses, Glasses #1 and Glasses #2. After we adjust and check your vision with each pair, we would like you to compare the two pairs of glasses for comfort (how they feel on your face), vision (how well you see) and style (how the glasses look)."

You will be asked to answer these questions:

Which pair of glasses, glasses #1 or glasses #2, give you better vision?

Prefer Glasses #1	Slightly Prefer Glasses #1	Same/Equal	Slightly Prefer Glasses #2	Prefer Glasses #2

Which pair of glasses, glasses #1 or glasses #2, feels more comfortable on your face?

Prefer Glasses #1	Slightly Prefer Glasses #1	Same/Equal	Slightly Prefer Glasses #2	Prefer Glasses #2

Which pair of glasses, glasses #1 or glasses #2, do you like the style?

Prefer Glasses #1	Slightly Prefer Glasses #1	Same/Equal	Slightly Prefer Glasses #2	Prefer Glasses #2

Overall which pair of glasses, glasses #1 or glasses #2, do you prefer?

Prefer Glasses #1	Slightly Prefer Glasses #1	Same/Equal	Slightly Prefer Glasses #2	Prefer Glasses #2

Why? _____

Sonam Narayan

Email: nara4347@pacificu.edu

Education and Achievements

- **Pacific University College of Optometry (August 2014-Current), *Doctor of Optometry and Masters of Vision Science degrees to be conferred in 2018* – Forest Grove, OR**
- **Optometry Endowed Scholarship for Diversity (August 2014) – Pacific University College of Optometry**
- **Hoya Opt Minority Student Scholarship (August 2014) – Pacific University College of Optometry**
- **Portland State University, Bachelor of Science with Honors (September 2010-June 2014) – Portland, OR**

  Student in PSU Honors College.Cumulative GPA 3.57. Bachelor of Science in General Science, Physics Minor; Pre-Optometry.
- **Leadership Fellows Scholarship (September 2012-June 2014) - Portland State University**
- **Student Speaker, Viking Scholar Awards (May 2014) – Portland State University Honors College**

  Was chosen from previous Viking Scholar Award recipients to speak of my educational and leadership experience, on behalf of the University Honors College. Delivered a speech in the university ballroom to a crowd of 300-500 people, as well as distributed certificates to all the new Viking Scholars selected for 2014.
- **Dean's List (June 2013) - Portland State University**
- **Honors Merit Award (April 2013) - Portland State University**
- **Viking Scholar (2010-2011) - Portland State University**
- **Salutatorian (2010) - Aloha High School**

Research and Publications

Laukkanen, Hannu, Narayan, Sonam, et al. "Visual Perceptual Test Manual". *Pacific University College of Optometry,* 1988-2017, pp. 1-507.

Narayan, Sonam, " Addressing the Unmet Need: An Analysis of the Global Prevalence of Refractive Error and its Possible Solutions" (2014). Undergraduate Honors Theses. Paper 42.
http://pdxscholar.library.pdx.edu/honorstheses/42

Employment

- **Elemental Eyecare,** Bend, Oregon

  Optometric Student Extern.....**February 2018 to May 2018**

  Student rotation four via Pacific University College of Optometry. Externship in a binocular vision focused private practice, encompassing vision therapy as well as routine pediatric care with a focus on testing eye teaming, focusing, tracking, and motor reflexes. Opportunity to work with and be taught by COVD certified vision therapists.
- **Kaiser Permanente Northwest,** Vancouver and Salem, Oregon

Optometric Student Extern.....**November 2017 to February 2018**

Student rotation three via Pacific University College of Optometry. Externship at health maintenance organization with role as full student doctor, including personal schedule of 10 patients a day. Examinations ranging from primary care of all ages, to specific ocular disease management, including ordering imaging/visual fields and referrals to specialty care.

- **Pacific University Eye Clinic,** Forest Grove, Oregon

Optometric Student Extern.....**August 2017 to November 2017**

Student rotation two via Pacific University College of Optometry. Externship involving patient care of all ages of binocular dysfunction patients, including TBI. Performed both comprehensive exams and vision therapy programming and conduction, two full clinic days a week. Primary pediatric exams done one full day a week, and teaching students/guiding student exams in vision therapy clinics done two full clinic days a week.

- **Roseburg Vetrans Administration Healthcare System,** Roseburg, Oregon

Optometric Student Extern.....**May 2017 to August 2018**

Student rotation one via Pacific University College of Optometry. Extern in a high paced, ocular disease focused VA hospital, scheduled with 14 patients in a 7 hour workday. Daily exposure to anterior and posterior segment eye conditions, as well as in conducting imaging/visual fields.

- **Pacific University College of Optometry,** Forest Grove, Oregon

Research Assistant.....**Fall 2016 to Winter 2017**

Research assistant to Dr. Hannu Laukkanen, responsible for full review of his Visual Perceptual Test Manual Textbook (originally created in 1988), including updating test critiques and current research, as well as general editing of manual.

- **Pacific University College of Optometry,** Forest Grove, Oregon

Teaching Assistant.....**Fall 2016 to Winter 2017**

Teaching assistant to Dr. James Kundart, helping to teach students in visual perception course for second year optometry students. Responsible for attending weekly TA meetings overviewing lab equipment, teaching weekly lab sessions, and conducting lab proficiency testing of students.

- **Pacific University College of Optometry, Downtown Portland Clinic,** Portland, Oregon

Front Desk Receptionist.....**May 2015 to August 2015**

Responsible for front office reception and administration duties, such as scheduling appointments, patient check-in/check-out, billing, filing, mailing, answering phone calls.

- **Portland State University Dining**, Portland, Oregon

Marketing Intern.....**Summer 2013 to March 2014**

Helped present innovative and engaging ways to market campus dining to students, worked as a representative at events, travelled throughout campus to check status of campus dining facilities and help correct problems.

Volunteer Experience

- **Tualatin Valley Gleaners**, Beaverton, Oregon

Garden Volunteer.....**Summer to Fall 2017**

TVG is a church organization maintaining a large community garden year round, and donating all produce to charity/food banks. Volunteers responsible for harvesting, cleaning, boxing, and loading of produce, as well as routine maintenance of the garden space.

- **Tom McCall Vision Therapy Program**, Forest Grove, Oregon

  Volunteer/student vision therapist……**Fall 2017 to Winter 2017**

  Volunteering skills as a student vision therapist at Tom McCall school in Forest Grove. As part of a pilot program to make vision therapy an afterschool program option at the local school, this program involved weekly one-on-one therapy sessions with students determined to have a binocular vision deficit. These children were previously diagnosed by doctors at Pacific via a comprehensive visual exam.

- **Pacific University College of Optometry**, Forest Grove, Oregon

  Student volunteer for conducting vision screenings……**Fall 2014 to Spring 2017**

  Volunteering skills learned throughout optometry school to conduct community vision screenings, of all ages of patients. Settings range from migrant worker camps, community health fairs, and public schools. Volunteer opportunities generally half day in length, four times a year.

- **Potluck in the Park**, Portland, Oregon

  Supervisor……**June-September 2013**

  Oversee smooth operation of weekly services, assist volunteers with troubleshooting and refilling serving stations, help organize and direct patron flow through event.

  General Volunteer……**June-September 2012**

  Serving hot food to the homeless, assisting disabled people with carrying food and seating, worked with volunteers to maintain smooth flow of weekly services. After consistent weekly commitment to the program, was promoted to supervisor title in 2013.

- **American Diabetes Association**, Portland, Oregon

  General Office Assistant……**Summer 2012**

  Organizing, printing, mailing, cleaning, operating office equipment, computing data.

- **Sunshine Pantry**, Beaverton, Oregon

  General Volunteer……**Summer 2012**

  Greeting and assisting customers of the food bank, working with customers to fill their boxes with requested foods, cleaning up area, worked with a team.

- **Paris Nights Fashion Show (Doernbecher Hospital Fundraiser)**……**March 2012-August 2012**

  Head of advertising for non-profit event to raise money for Doernbecher Children's Hospital. Obtained sponsorships and donations, helped develop social media strategy, worked effectively as part of a system.

- **Compassion Clinic: Downtown Portland**……**June 2012**

  Greeted and directed guests of the church clinic, served guests food, worked with a team of volunteers.

Extracurricular Activities

- Pacific University College of Optometry, Forest Grove, Oregon

  Vision Science Graduate (VSG) Student-Faculty Liaison……**February 2016 to January 2017**

  Responsible for representing the student vote at faculty meetings for Masters and PhD of Vision Science programs. Tasks include reviewing new student applications, curriculum changes, and program standards and expectations for growth.

- PSU Optometry Club, **Founder and President**……..**2012-2014**

  Initiated the creation of a new student organization, worked collaboratively with advisors to follow university procedures and fill out protocol paperwork, recruit members, set up and facilitate meetings, monitor and allocate budget to club event expenditures, perform pre and post event evaluations, send and respond to organization newsletters.

- PSU Leadership Fellows Program, **Student Leader**……..**2012-2014**

  Selected to serve in a one-on-one program working with multiple advisors to better develop role and skills as a student leader as the president of a PSU organization, through participation in weekly meetings and through educational trips.

- *Current Organization Affiliations:*

  - *Pacific Practice Management Group (**PPMG**), Pacific Neuro-Optometric Rehabilitation Association (**NORA**), College of Optometrists in Vision Development (**COVD**), Optometric Extension Program Foundation (**OEPF**), National Optometric Student Association (**NOSA**), American Optometric Student Association (**AOSA**), Oregon Optometric Physicians Association (**OOPA**), Optometric Physicians of Washington (**OPW**)*
    Member**……..**2014-current

- *Past Organization Affiliations:*

  - *PSU Environmental Club, LSAMP (Louis Stokes Alliance for Minority Participation), Indian Students Association,*
    Member**……..**2012-2014

Skills and Strengths

- Bilingual: English/Hindi.
- Basic optometric Spanish skills (**Basic Spanish for Optometry Course, Pacific University College of Optometry**…**May-July 2016**)