Is the gain of visual acuity measured in binocular vision linked to modifications of the refractive errors measured in monocular vision for subjects suffering from myopia?

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PURPOSE:
Kobashi *et al.* [1] have demonstrated that subjective spherical refraction in monocular vision was significantly more myopic than that in binocular vision.
The aim of the present study is to bring additional outcomes through the comparison, in myopic healthy subjects, of the objective refractive error measured in binocular vision with the one measured successively for each eye in monocular vision.

METHODS:
Retrospective data from 136 myopic eyes (50% of female) over 0.25 diopter were analysed (Mean age = 28 years old). All refractive measurements were carried out using an automatic refractometer (Eye-Refract) featuring two Shack-Hartmann sensors and repeated at 10 minutes interval.
The protocol includes an objective measure of the refraction in both binocular and monocular conditions. The decimal visual acuity (VA) is noted at each refractive value.
Student's, Wilcoxon's and Spearman's tests have been applied to evaluate the repeatability of the measurements, and to compare the values of sphere, astigmatism and VA obtained under conditions of both binocular and monocular visions.

BINOCULAR/ MONOCULAR COMPARISON	Mean Différence Diopter	Standard Deviation	Student T-test p	Correlation Coefficient	Wilcoxon Test sig	Regression Slope
Sphere Bino/Mono	0.03	0.12	NA	0.99	**NA**	**0.98**
Cylinder Bino/Mono	-0.00	0.11	0.85	0.95	**no**	**1.00**

Tab. 2: Statistical results – Commparison of refractive erros in binocular Vs. monocular condition.

RESULTS:
A good repeatability of the measurements is obtained with the Eye-Refract device, as demonstrated by the Student's and the non-parametric Wilcoxon's tests (see Tab.1). The two series are then averaged for the following comparisons.
The high correlation coefficients (>0.98 for the sphere and >0.91 for the cylinder) show that binocular and monocular measurements are very similar (Fig. 1). However, the results show a difference in the VA measurements between the two conditions, with a better values of about one line (in the VA chart) observed in the binocular vision. This is in agreement with many studies and is related to the binocular summation effect. This study shows that the gain of binocular VA is not explained by a factor related to sphere and astigmatism corresponding to low order aberrations of the eye.

REPEATABILITY	Mean Difference Diopter	Standard Deviation	Student T-test p	Correlation coefficient	Wilcoxon Test sig	Regression Slope
Sphere Binocular	0,03	0,18	0,100	0,98	**no**	**0,98**
Sphere Monocular	0,00	0,19	0,58	0,99	**no**	**0,98**
Cylinder Binocular	0,02	0,17	0,20	0,91	**no**	**0,98**
Cylinder Monocular	-0,01	0,15	0,67	0,93	**no**	**0,97**

Tab. 1: Statistical results – Repeatability.

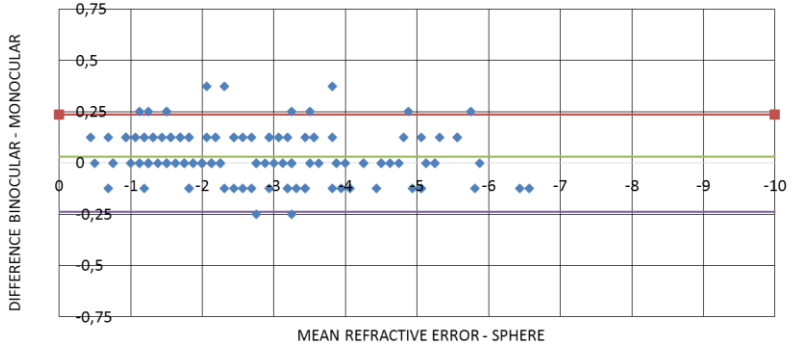

Fig. 1: Difference Bino-Mono in mean Sphere.

CONCLUSION:
As observed in [1], an increase of the visual acuity is obtained in binocular vision compared to the monocular one. However, in the present study, the measurements did not reveal a significant difference between the refractive errors (sphere and cylinder) in binocular and monocular conditions (Tab. 2 and Fig. 1).
This study shows that the observed gain in binocular subjective visual acuity is not linked to variations in the spherical and cylindrical refraction for myopic subjects. This difference is rather due to optical factors such as pupil diameter, luminance level, high level aberrations and to a possible effect of neurophysiological cortical summation.

[1] H. Kobashi *et al.* « Comparison of Subjective Refraction under Binocular and Monocular Conditions in Myopic Subjects », Sci. Rep., vol. 5, p. 12606, 2015.