Re: Lutein supplementation improves visual performance in Chinese drivers: 1-year randomized, double-blind, placebo-controlled study: The importance of supplementing with all three macular carotenoids

To the Editor:

We congratulate Yao et al [1] on their valuable contribution to the area of nutritional supplementation to maximize visual performance. In brief, Yao et al conducted a randomized, double-blind, placebo-controlled trial of patients supplemented with 20 mg of lutein daily versus placebo, and found that supplementation with 20 mg of lutein per day resulted in improvements in terms of contrast sensitivity and glare disability, especially under mesopic conditions.

Indeed, the findings of Yao et al are consistent with the growing evidence base in this area, which indicates that high levels of macular pigment are required for visual excellence in normal individuals [2].

Macular pigment is made up of three carotenoids, lutein (L), zeaxanthin (Z), and *meso*-zeaxanthin (MZ), MZ being the dominant carotenoid at the visual center, where visual performance and sensitivity is maximal [3]. A recent randomized, placebo-controlled trial of differing carotenoid formulations versus placebo (also in normal participants), revealed that a formulation containing MZ resulted in the greatest improvements in visual performance (contrast sensitivity, under mesopic and photopic conditions, under and not under conditions of glare), whereas only minimal benefits were noted with the supplementation lacking the centrally dominant carotenoid (MZ); no visual improvements were noted in participants who were supplemented with placebos [4].

The finding that MZ is required in a formulation to maximally improve visual performance is unsurprising, given that 12% of the population has a central dip in the spatial profile of their macular pigment [5], and that in these individuals the normal, centrally peaked spatial profile of macular pigment can only be realized following supplementation with a formulation that contains all three of macular pigment's constituent carotenoids (MZ, L, and Z in a ratio of 10:10:2) [6]. Also, the necessity of MZ in a formulation to maximally enhance visual performance is consistent with a recent serum study, where it was shown that a preparation containing all three macular carotenoids was required if serum bioavailability of macular pigment's constituent carotenoids was to be maximized, and therefore enhance capture by the target tissue (macula) of these circulating compounds [7].

In summary, and again, we congratulate Yao et al for their excellent piece of work and contribution to this growing area of research. However, we believe that a formulation designed to optimize visual performance should include all three of macular pigment's constituent carotenoids in a MZ:L:Z ratio of 10:10:2.

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Higher dose lutein and a longer supplementation period would be good for visual performance

To the Editor:

We appreciate the comments by Drs. John Nolan, Stephen Beatty, and Jessica Dennison about our article [1]. They suggest that a formulation designed to optimize visual performance should include all three of macular pigment's (MP) constituent carotenoids in a *meso*-zeaxanthin (MZ) to lutein (L) to zeaxanthin (Z) ratio of 10:10:2 [2]. We agree that MP is made up of the three carotenoids, L, Z, and MZ, and that MZ does play an important role in improving visual performance [3].

Very recently, Ma et al. [4] conducted a randomized, double-masked, placebo-controlled trial that revealed that macular pigment optical density (MPOD) increased significantly both in the 20-mg L group (without MZ) and the L and Z group (without MZ), and there was a significant between-group difference in contrast sensitivity (CS) at three and six cycles per degree between the 20-mg L group and the placebo group. Huang et al [5] found that serum lutein levels in the HL (20-mg lutein) group increased significantly in the first 4 wk, and MPOD increased significantly at 24 and 48 wk. Based on the previous study, retinal MZ is primarily generated from isomerization of retinal L (but not Z) [6]. Participants who are unable to convert L to MZ at this location led to a central dip MPOD spatial profile are in the minority [7]. So we believe, L supplementation can improve human visual performance, even without MZ. Indeed, it may take higher doses and a longer supplementation period.

We choose 20-mg L as the intervention factor also for consumption psychological factors [8]. We conducted an unpublished survey of 200 L consumers in different age groups in Shanghai. The options included L, Z, MZ and the combination, but the Z or MZ formulations were more expensive. The survey indicated that 90% of respondents tended to buy the higher-