LEARNING DOMAINS

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Dispensing opticians — CPD PROVIDER — General Optical Council

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21st century reading lenses. Time to ditch the term occupational?

By Eluned Creighton-Sims FBDO

From medieval mindset to millennium innovation — why we need to rethink dispensing in presbyopia.

The first recorded use of lenses for near work comes from the 12th century, when 'reading stones' were used by monks as a book accessory when illuminating manuscripts[1]. Interestingly, their use was not about vision correction but vision enhancement; visual defects were seen as part of the human condition and, therefore, correcting them would have been seen as blasphemy. One-hundred years later, the suggestion was made that the magnification provided by these lenses might be considered as a method of a correcting vision[1].

Reading stones have similarities to modern single vision lenses in that both offer clear vision at a fixed distance. In modern presbyopia solutions, we have seen the evolution from bifocals and trifocals to progressives, which have become a first-choice lens for many presbyopes – so why has the same evolution not happened for single vision near corrections?

Between 1911 and 1991, there was a significant increase in workers employed in roles classified as professional and managerial – along with a decrease in those employed in either partly skilled or unskilled work[2], demonstrating the move from industry and outdoor employment to a more office-based workforce (**Figure 1**). Alongside this, technology was also advancing and by the turn of the century, almost half of all UK households contained a computer[3] (**Figure 2**).

Occupational lenses entered the market to fill the gap created by these changes. Similar to progressives solving the intermediate problem faced with bifocals, they solved a similar issue for those workers who were moving to a more office-based style of working.

Early occupational lenses were pitched almost exclusively as solutions for computer users, with the question, "Do you use a computer?", providing the

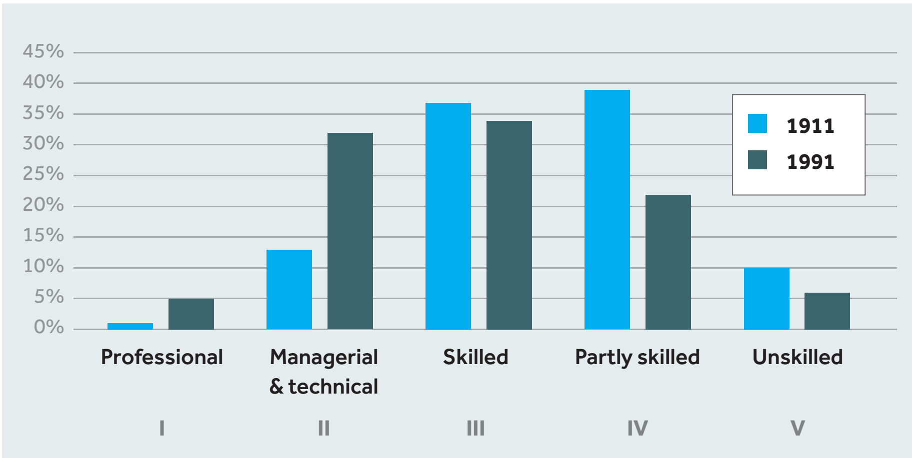

FIGURE 1. Changing occupation types 1911-1991

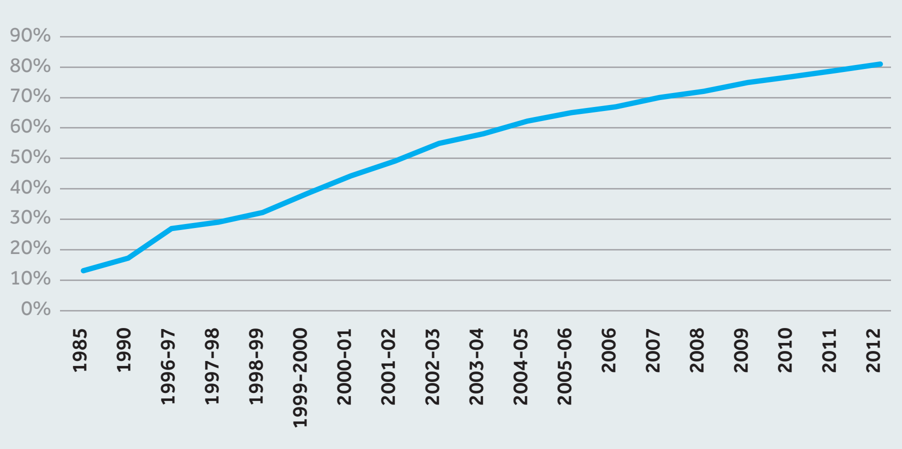

FIGURE 2. Changes in household ownership of computers 1985-2012

cue to recommending them. This was similar to how progressives were often recommended following the question, "Do you struggle to read the labels on the shelves in the supermarket?"

The world has moved on since then and mid-range distances are used for far more than home computers and reading price labels, but has our view of occupational lenses changed with it? Or is there simply one giant leap from fixed focus near lenses to progressives when there is a smaller, gentler step that could be taken?

WHAT ARE OCCUPATIONAL LENSES?

The term occupational suggests lenses which have a narrow scope for use in practice – only relevant to specific usage. However, this terminology may be a limiting factor to how we use them. According to BS EN ISO 21987[4], lenses that provide correction for multiple focal distances but lack any visible line are classed as power variation lenses (**Figure 3**). Although the standards do not use the term occupational, they do reference degressive-power lenses – those that are designed from the reading up, rather than from the distance power down.

Perhaps a more suitable term for them would be near variable focus lenses, which more accurately describes their function and helps to reinforce that they are not limited to visual demands stemming only from particular occupations.

As the term occupational is more familiar, this article will continue to use this terminology. However, it is worth considering how this term affects both our and our patients' perceptions of these lens types.

OCCUPATIONAL LENS TYPES

Aside from the terminology used to describe this category of lenses, there are additional barriers to dispensing them related to the range of options available and the various ways in which they are fitted and ordered.

BS EN ISO 21987:2017
Ophthalmic Optics - Mounted Spectacle Lenses

3.1 Power variation lenses
Spectacle lenses with a smooth variation of focal power over part or all of its areas, without discontinuity, designed to provide more than one focal power.

These are usually designed to provide increasing or decreasing spherical power, typically in a vertical meridian, so as to provide correction for different object distances.

Examples of power variation lenses are, but not limited to, progressive power lenses and degressive power lenses.

FIGURE 3. Definition of power variation lenses given in BS EN ISO 21987: 2017

Occupational lenses can be divided into two main types[5] – those which are suitable for a range of small distances, and those which offer an increased range of clear vision, both are degressive in nature. These are summarised in **Table 1** – although it should be noted that information does vary by supplier. A simple way to think of these two types of occupational are as the following:

ENHANCED READER STYLE

The first column in **Table 1** describes a kind of degressive that can be thought of as providing clear vision at one specific near distance and another specific mid-range distance – shown in **Figure 4** as the near and 'outer' mid-range areas. This type of degressive has a simpler design concept, typically with a linear change in power, and is generally more flexible to dispense for specific working distances.

MINI-PROGRESSIVE STYLE

The second column in **Table 1** describes lenses that can be thought of as 'mini progressives' in that they provide an extended intermediate area and sometimes include a small distance zone (**Figure 5**). As the degression in power is generally larger, the width of areas in this type of lens will be reduced slightly compared to an enhanced reader style design. However, the width will be wider than a full progressive.

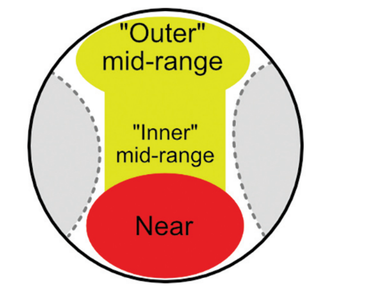

FIGURE 4. An enhanced reader style degressive

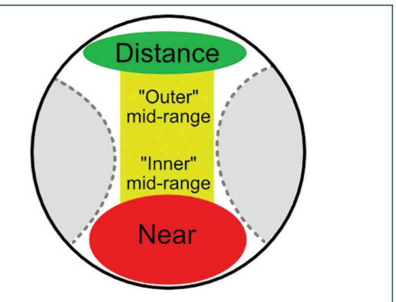

FIGURE 5. A mini progressive style of degressive

NAMES USED	'COMPUTER LENSES' 'ENHANCED READERS' 'TASK SPECIFIC'	'OFFICE', 'WORKSPACE' 'OCCUPATIONAL PROGRESSIVE'
Recommended for	Fixed position tasks - one main intermediate distance + near	Dynamic near-to-intermediate tasks, multiple working distances
Able to specify	Distances required/degression	Distances required /degression (in some cases), design profile eg. close, screen, room
Design	Short corridoor, blended transition, often linear	PAL-style corridoor, smoother progression, often non-linear
Ordering	Near Rx, mono PDs (distance, near and intermediate possible)	Distance Rx + Add
Heights	To pupil centre/lower limbus or degression calculated from HCL	To pupil centre
Width of areas	Widest areas	Wider areas than a full progressive, narrower than enhanced reader style

TABLE 1. Sub-categories of degressive lenses available

This type of lens may include information relating to its corridor or profile and will require a minimum fitting height similar to a progressive.

A key advantage of an occupational lens is in their versatility to offer clear vision at a range of distances with wider clear zones than a progressive can offer, due to the smaller change in power across the surface of the lens. As well as an ideal secondary pair for progressive lens wearers, they should also be considered for early presbyopes in place of single vision where there is no habitual distance correction.

ADDITION Vs AMPLITUDE

Wolffsohn *et al*[6] defined presbyopia as occurring: *"...when the physiological normal age-related reduction in the eyes' focusing range reaches a point, when optimally corrected for distance vision, that the clarity and comfort of vision at near is insufficient to satisfy an individual's requirements".*

If the reading addition is considered in isolation, it limits understanding of the patient's focusing range – and it is this knowledge which can be used to guide the ideal lens recommendation to fulfil near requirements for clear and comfortable vision. Therefore, it is the analysis of the amplitude of accommodation that provides insight about range of vision, both in terms of clarity and comfort.

A reading addition is determined using the patient's amplitude of accommodation and the distance at which they need clear vision. In early presbyopia (<50 years) there is usually enough amplitude of accommodation in reserve for a range of distances. For early presbyopia, the reading addition is prescribed for comfort rather than clarity, relaxing accommodation so closer object viewing may be sustained for longer periods, rather than to provide a larger retinal image[7].

A comfortable amount of accommodation is around two-thirds of the available amplitude and may be found from:

$$\text{Add} = |L_{sp,near}| - \tfrac{2}{3} A_{spMAX}$$

Here $L_{sp,near}$ is the vergence incident on the spectacle lens (trial lens or phoropter) from the near object and A_{spMAX} is the amplitude of accommodation (A_0A) measured in the plane of the correcting lens (the spectacle A_0A as opposed to the ocular which is measured without any lens in front of the eye).

In practical terms, if the addition is dispensed as a single vision lens, a new far point is created – the furthest distance at which the patient can see clearly without using accommodation – with some of the residual accommodation available in reserve for viewing objects at closer distances. Considering this relationship as part of the prescription analysis is key to understanding the needs of the patient.

Take a 50-year-old emmetrope who has been prescribed a +1.25D based on their near vision being tested at 40cm, we can rearrange the previous equation to calculate the amplitude:

$$\tfrac{2}{3} A_{spMAX} = |L_{sp,near}| - \text{Add}$$

Step 1: Calculate the dioptric demand at the test distance:

$$L_{sp,near} = \frac{100}{40} = 2.50\text{D}$$

Step 2: Subtract the addition:

$$\tfrac{2}{3} A_{spMAX} = |2.50| - (+1.25) = 1.25$$

Step 3: Multiply this by 1.5 to determine the full amplitude:

$$A_{spMAX} = 1.875\text{D}$$

With the full amplitude this patient has available, we can calculate the distances at which vision will be clear with a correction but also consider the comfort by looking at the percentage of the available accommodation they would need for various tasks.

Table 2 shows the range of vision this patient could achieve with a single vision near correction. For mid-range distances from 50cm to 1m, the patient is using either none or minimal accommodation so objects placed here will be clear, and where accommodative effort is required, it will be in the comfortable range. This is also true for tasks performed at 40cm, which is the limit for comfortable vision. For distances closer than 40cm, the patient will need to exert additional effort which reduces comfort, and for distances of 30cm there is not sufficient amplitude – in this case the patient could consider altering the working distance.

Overall, a single vision correction for this patient offers a reasonable range of distance at which clear and comfortable vision is possible – but may require advice on methods of improving comfort for certain activities. Of course, beyond 80cm, vision would start to blur and the patient would need to remove the correction, and this may be particularly inconvenient depending on their lifestyle activities.

For dual activities, like watching television and using a phone or tablet simultaneously, short periods of near focus would be manageable but with poor lighting they could begin to experience symptoms of asthenopia due to over-exertion of their accommodation. Instead of a fixed focus solution, we could consider a degressive lens that could be worn for distances beyond 1m (such as the television) and also tailor the addition for distances closer than 40cm if required.

IMPACT OF AMETROPIA ON AMPLITUDE

The previous example did not account for any ametropia, which will also impact the ability of the patient to achieve clear and comfortable vision at close distances. Uncorrected myopes effectively have too much plus – requiring a negative powered lens to correct for far distances. Wearing their distance correction for near means that more effort is required to bring these objects into focus as they need to overcome the minus power in their distance correction first. In practice, many myopes will simply remove their spectacles until they reach the point at which their amplitude has reduced beyond the limit of comfort.

Hyperopes have the opposite problem – they have too much minus for distant objects, so a positive correction avoids the need to accommodate to maintain a clear distance image. For near objects, hyperopes do not have the option of removing their spectacles; doing so would only increase the accommodative demand.

What this means in practice is that the amplitude of accommodation will have a different effect depending on the patient's ametropia. **Table 3** shows the effect on the range of clear vision for a myope and a hyperope when either corrected or uncorrected where they have the same amplitude of accommodation. Although corrected, they have the same range of vision; the myope is able to remove their correction to see objects 13cm closer whereas the hyperope is limited to clear vision at a maximum distance of 33cm.

Using this information in the context of what activities the patient is involved in day-to-day helps us to understand not only the range of clear vision but also the demand that is being placed on the accommodative system. This should be used to determine when issues may arise with either clarity or comfort to guide lens selection.

Object distance (cm)	Dioptic demand ($L_{sp,near}$)	Lens power	Residual demand (Demand - Add)	% of Amplitude required
100	1.00D	1.25D	-0.25D	0
80	1.25D		0.00D	0
50	2.00D		0.75D	40%
40	2.50D		1.25D	67%
30	3.33D		2.08D	111%

TABLE 2. Range of vision and demand on accommodation for a 50-year-old emmetrope with a +1.25D addition with 1.875D amplitude

CHOOSING THE RIGHT OCCUPATIONAL: CASE STUDY

Knowledge of the visual demands and the patient's accommodative ability should be used alongside information about how the degressive works – both relating to the change in power and how that change occurs.

The following real-world case demonstrates how this can lead to a better solution for the patient.

- **Age:** 46 years old
- **Rx:** R. +0.25DS/-0.25DC x 40 and L. +0.50DS/-0.25DC x 55
- **Addition:** +1.25D
- **Notes:** First reading addition, no specs previously. Type 1 diabetic
- **Visual task analysis:** Mobile health and safety consultant in the construction industry, driver, uses a laptop and mobile phone regularly, conducts site visits three-four days per week where he needs to see his paperwork as he moves around and his laptop for completing daily reports, laptop used at eye level ~60cm away while working from home for around six to seven hours. Enjoys watching TV at ~2m and often uses mobile to play games or browse social media at the same time

	Uncorrected myope -2.00D	Uncorrected hyperope +2.00D
Range of clear vision (up to 100% AoA)	20 - 50cm	∞ - 100cm
Range of clear vision (2/3 AoA)	25 - 50cm	∞ only

	Corrected myope -2.00D	Corrected hyperope +2.00D
Range of clear vision (up to 100% AoA)	∞ - 33cm	∞ - 33cm
Range of clear vision (up to 100% AoA)	∞ - 50cm	∞ - 50cm

TABLE 3. The effect of ametropia on range of clear vision

Although the amplitude of accommodation is not specified, it can be estimated by using Hoffsteter's formulae which are based on the data gathered by Duane (1912)[8]. Hoffsteter provides formulae for minimum, normal and maximum values by age, and as the patient is diabetic it is worth using the lower of these to reflect the possible reduced amplitude associated with this condition[9].

The minimum value is found from:

$$\text{Minimum AoA} = 15.0 - (0.25 \times \text{Age})$$

Therefore, the expected amplitude is 3.50D with two-thirds being 2.33D equating to a distance of ~43cm.

With the near correction and the comfortable value for his amplitude, he will be able to view objects at a distance of:

$$\text{Total plus power at near} = \text{Add} + \tfrac{2}{3}\,\text{AoA} = 1.25 + 2.33 = 3.58\text{D}$$

$$\text{Comfortable viewing distance for near} = \frac{100}{3.58} = \sim 28\text{cm}$$

This clear range would extend to 80cm, which is the new far point resulting from a single vision correction.

At 60cm, his laptop creates a dioptric demand of 1.67D – as 1.25D is accounted for by the correction, he would only need to exert 0.42D which is far below the comfortable limit and therefore easily sustainable for long periods.

Single vision in this case offers a degree of versatility for different working distances, however for site visits and being able to view his phone while watching television, it is a more limiting option where clear vision at further distances is required.

AN ENHANCED READER OPTION

Imagine we have access to a lens which is described as an 'office' lens and is available on options that give clear vision to 1.3m, 2m or 4m.

Given the detailed information we already have, it would be more useful to know the degression. A call to the supplier results in the following formula being used for this particular lens:

$$\text{Degression (D)} = \frac{1}{\text{Working Distance (m)}} - \text{Add}$$

The calculated degression values for this lens are shown in **Table 4**.

If we take the figures at face value, then we may consider the 2m option as suitable to meet his needs when

Distance (m)	Degression
1.3	-0.48D
2	-0.75D
4	-1.00D

TABLE 4. Degression values calculated from the working distances for a +1.25D addition

watching the television, alternatively we may recommend the 4m option to give more flexibility for when he is at a site visit.

However, if we consider the powers of the lens in the different areas and how they relate to the furthest point of clear vision (**Figures 6a and 6b**) we can see that the 4m degression has a power in the top of the lens, which is only slightly

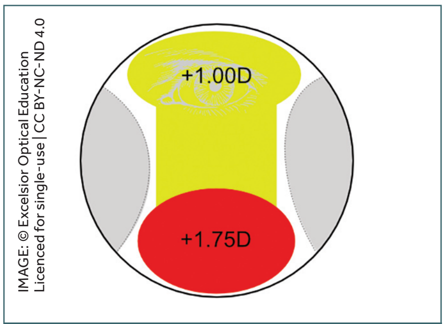

FIGURE 6 a: Calculated powers for a 2m degression with a +1.25D addition for the left eye

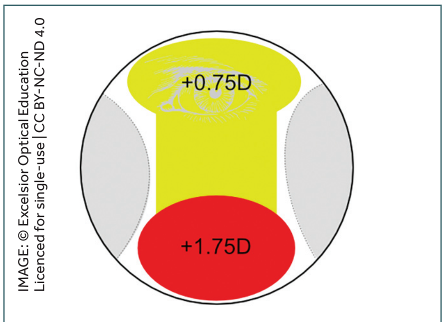

FIGURE 6 b: Calculated powers for a 4m degression with a +1.25D addition for the left eye

higher than his distance correction. This suggests that he would be able to wear them when walking around, only removing them for driving which may be a more convenient solution.

This patient was supplied with a 4m degressive, which he was able to wear full-time for work, at home and even when out socialising. As his presbyopia advanced, different degressions were

Distance (m)	Degression
1.3	-1.48D
2	-1.75D
4	-2.00D

TABLE 5. Degression values calculated from the working distances for a +2.25D addition

used to suit the change in near requirements. Once his hyperopia had increased, requiring a full-time distance correction, he was fitted with progressives, retaining a pair of degressives for use indoors.

This case highlights how a considered approach to the right degression can deliver lenses that are functional for all distances.

POSITIONING OF THE LENS

For lenses that provide information on both the degression amount and profile — the rate at which the power changes - it is also possible to consider amending the fitting position to place the power in the most suitable position. This is particularly useful where the amplitude has reduced significantly and where a non-standard fitting may be more beneficial.

AMENDING LENS POSITION: CASE STUDY

- **Age:** 68 years old
- **RX:** R. -1.75DS/-2.25DC x 87 and L. -1.50DS/-2.00DC x 102
- **Addition:** +2.25D
- **Notes:** Progressive wearer
- **Visual task analysis:** Semi-retired company director works from home two days per week, multi-screen computer user positioned slightly below eye level at ~70cm, paperwork and tablet positioned at ~35cm at desk height

Hoffsteter formulae prove less useful for older presbyopes (60 years+) as they assume a linear rate of decline. In this case, we can treat the amplitude as negligible, based on the knowledge that a 60-year-old is likely to have between 0.75D and 1.25D depending on the testing method[7].

This patient, therefore, is fully reliant on the addition for near. The complication of the significant astigmatic correction means that removing their spectacles is not a suitable option and as a progressive wearer using multiple screens the width of the clear field at mid-range will be severely limited.

This patient needs a correction that gives the full reading prescription in the lower lens (R. +0.50DS L. +0.75DS) and just below the pupil they need 1.43D less — the uncorrected dioptric demand at 70cm — (R. -0.93DS L. -0.68DS).

If we were to consider the same lens type used in the previous case, then the degressions for each will be as shown in **Table 5**.

The 1.3m option has a degression well suited to the dioptric demand from the computer at 70cm, and with a low rate of power change will provide the widest areas – ideal for multiple screen use.

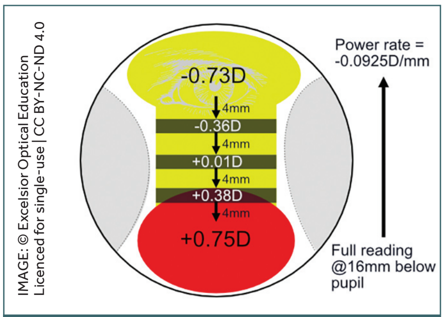

FIGURE 7. Calculated power zones for a 1.3m degression with a +2.25D addition with 16mm minimum fitting heights

However, the patient is viewing the screens slightly below eye level – and so using a standard fitting may mean that they are over-plussed for this distance. If the lens stated that the full addition was achieved at a point 16mm below the pupil with a linear rate of degression, it can be seen from **Figure 7** that it is possible to divide the lens into zones of differing power.

In this case, the heights could be measured from the gaze rather than pupil position to ensure that the patient is able to maintain comfortable vision for computer work.

An alternative option is to source a degressive that has a degression rate more suited for distances of 80-100cm. The power required for 70cm viewing will then automatically be in a lower position and the lower rate of power change will provide even wider clear areas.

PRACTICAL TIPS FOR DISPENSING OCCUPATIONALS

These examples show that the addition is only a part of the story in presbyopia. Rather than focusing solely on the add, a clearer picture is found when we consider a patient's amplitude and how its value is spent on everyday tasks. Without this, we risk under-serving patients and defaulting to medieval style fixed focus lenses or a single pair of progressives.

There are five practical steps to incorporating a more nuanced approach to dispensing in presbyopia:

1. **ASK ABOUT TASKS, IN DETAIL:** Ask about the patient's general tasks at closer distances – preparing food, fastening necklaces, glancing at their phone briefly, etc. Consider the information in terms of what range of distances clear and comfortable vision is needed for.

2. **CHECK USABLE AMPLITUDE:** If it is not noted on the record, measure or estimate it and consider what comfortable looks like. Dioptric demand at 35cm is 2.86D – what percentage of their amplitude is this?

3. **FACTOR IN THE AMETROPIA:** Myopes wearing a correction work harder for near, so is removing the correction the best solution? Corrected hyperopes with reduced amplitude have no wiggle room and may struggle with near earlier.

4. **CHOOSE THE RIGHT DESIGN TYPE:** For occupationals is that an enhanced reader or mini progressive option? Where there is higher amplitude, degressives can offer increased versatility with wider areas.

5. **FIT TO THE TASK:** Begin with the recommended fitting guidelines and consider what power is needed where on the lens – sometimes a workaround gives better results.

With so many occupational lenses to choose from, the right solution is out there. If you struggle to remember what measurements are required for a particular lens, note a variety of measurements on the patient's record so that you have the correct ones available to order. You may also wish to consider creating a crib sheet of the lenses you are able to order, listing the type of power change and ordering requirements to refer back to.

CONCLUSION

Occupational lenses may have begun as the computer lens of the late 1990s and early 2000s, but in today's world they deserve recognition for being the modern variable focus near lens that may deliver more benefits than a single vision or progressive lens option. We have seen the evolution of progressive lenses from a niche solution for presbyopia to the first-choice correction in ametropic presbyopia and for those who want convenience in their spectacles. After more than 25 years, is it not time we did the same with occupational lenses?

REFERENCES

References can be found when completing this CPD module. For a PDF of this article with references, email abdocpd@abdo.org.uk

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LEARNING OUTCOMES FOR THIS CPD ARTICLE

DOMAIN: Communication

1.1: *Recognise that sufficient time and attention should be given for consideration of working distances, range of vision and spectacle lens designs to deal properly with the visual requirements of presbyopic patients.*

2.1: *Communicate effectively the benefits of occupational lenses to correct intermediate and near distances to individual requirements for presbyopic patients using professional judgement to adapt communication approach accordingly.*

DOMAIN: Clinical practice

7.6: *Recognise the impact of reduced amplitude of accommodation on intermediate and near vision in presbyopia when considering a patient's visual needs and provide appropriate occupational lens options.*

COMMUNICATION

CLINICAL PRACTICE

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