Perception & Psychophysics
1982, 32 (2), 192-194

Notes and Comment

Persisting problems in persistence: A response to Bowling and Lovegrove

GERALD M. LONG
Villanova University, Villanova, Pennsylvania

In a recent note, Bowling and Lovegrove (1982) have questioned several of the conclusions I reached in a recent methodological critique of the field of iconic memory (Long, 1980) as well as in subsequent published work. In the present paper, I wish to respond to several of their points.

First, it should be emphasized that there may be more agreement between our positions than Bowling and Lovegrove are aware of. For example, they place considerable emphasis on *definitional problems* that have plagued the field of persistence. This was also a major contention of my review: Investigators have used very different experimental tasks and yet have been willing, for the most part, to call the process(es) evaluated simply "persistence" or "iconic memory." However, in the last few years there has been a growing realization that at least two distinct forms of persistence are assessed by currently popular tasks of persistence (e.g., Hawkins & Shulman, 1979; Long, 1979; Sakitt & Long, 1979a). So-called "Type I persistence" is an inverse-energy phenomenon apparently related to perceived offset of a target; "Type II persistence" is a positive-energy phenomenon related to the end of the fading trace of the target. Several recent empirical studies have supported this distinction (e.g., Long & Gildea, 1981; Long & McCarthy, 1982; Long & Sakitt, 1981). Moreover, these different types of persistence undoubtedly underlie much of the past confusion in the field of persistence. As I have noted elsewhere: "Regardless of terminology, however, most important is that the distinction [between the different types of persistence] be recognized in future research. The results of the present study and related investigations (cf. Long, 1980) would seem to indicate that very different processes underlie these task differences. Hence, subsequent research should attempt to determine and specify which 'type' of persistence is involved in the particular tasks employed" (Long & Gildea, 1981, p. 1399). On this point, then, we are in complete agreement.

Bowling and Lovegrove also question the representativeness of several of my colleagues' and my research efforts for the general persistence literature. They essentially conclude in the negative, primarily because they view these data as "usually collected under a specific combination of somewhat extreme experimental conditions" (p. 194). I would like to address this argument because it has been raised elsewhere as well (cf. Adelson, 1978; Banks & Barber, 1977; Coltheart, 1980).

In several original studies, Sakitt and Long (1978, 1979b; Long & Sakitt, 1980a, 1980b; Sakitt, 1976) departed from more typical iconic memory procedures and employed dark background fields and dark-adapted observers in their persistence research. The logic for this was quite simple. If there were a retinal component to visual persistence (as they hypothesized), it would be most clearly demonstrated under such conditions. If no support for the retinal model were forthcoming under these "optimal" conditions, this peripheral interpretation of the locus of persistence would have to be rejected out of hand. The fact that, on several very different persistence tasks, results supportive of a role of early receptor processes were obtained raised the possibility that these same processes *could* contribute to performance under other conditions as well. Subsequent research then attempted to extend these findings to more typical photopic background conditions. And, on the partial-report task (Long & Beaton, in press; Long & McCarthy, in press), the successive-field task (Sakitt & Long, 1979b), and the duration-of-stimulus task (Long & Beaton, 1980a, 1980b, 1981; Long & McCarthy, 1982; Long & Sakitt, 1981), the same basic pattern of results was obtained. This has resulted in our current position that a significant component to iconic memory, as assessed by several of the standard tasks of persistence, is of peripheral locus. In the current terminology, this form of persistence would be referred to as Type II persistence.

Given the above clarifications, I believe that the greatest remaining difference between the positions of Bowling and Lovegrove and myself may be more a matter of emphasis than substance. My primary concern at the time of the review was in the phenomenal persistence underlying the famous iconic memory tasks of Eriksen and Collins (1967, 1968) and Sperling (1960). It was the persistence assessed by these now-famous studies (and subsequent replications and extensions) that had resulted in the dominant conceptualization in cognitive psychology of a "sensory register" or "short-term visual store" as the first stage in information processing by the visual system. This persistence was depicted as a gradually fading image, or "icon," of the target that outlasted target offset by hundreds of milliseconds (cf. Neisser, 1967; Sperling, 1960). Following Sakitt's work (1976), my colleagues and I attempted to

The author's mailing address is: Department of Psychology, Villanova University, Villanova, Pennsylvania 19085.

0031-5117/82/080192-03$00.55/0

examine the properties of this persistence and thereby infer its likely function and locus in the system. Based upon this work, we have proposed that a positive-energy persistence consistent with extended photoreceptor activity provides a critical component for performance on these iconic memory tasks (cf. Long & Beaton, 1982). I equate this "traditional" persistence with Type II persistence.

Bowling and Lovegrove, on the other hand, appear to wish to emphasize Type I persistence. Their own extensive work, which uses the persistence-of-form procedure with flickering target stimuli (e.g., Bowling & Lovegrove, 1980, 1981; Bowling, Lovegrove, & Mapperson, 1979), does appear to involve an inverse-energy phenomenon similar to that reported under specific conditions with the duration-of-stimulus task, which involves asynchrony judgments (e.g., Bowen, 1981; Bowen, Pola, & Matin, 1974; Long & Gildea, 1981; Sakitt & Long, 1979a). However, this persistence would seem to be related to perceived *offset* of the stimulus and not to the fading trace of the target that may, in fact, continue for several hundred milliseconds. Such a characterization fits well with subjective reports of observers (e.g., Bowen et al., 1974; Long & McCarthy, 1982; Sakitt & Long, 1979a). Hence, as Bowling and Lovegrove agree, Type I persistence would seem to contribute little to the persistence of traditional interest: iconic memory. This distinction is not meant to deny the possible importance of Type I persistence. Recent work, for example, suggests its theoretical value in assessing response properties of transient and sustained channels in the visual system (e.g., Bowling & Lovegrove, 1981; Long & Gildea, 1981; Parker, 1980), as well as in identifying a potentially interesting difference between normal and disabled readers (Badcock & Lovegrove, 1981) and providing a likely explanation for a new visual illusion (Walker, 1981). The point being made here is simply that its role in traditional iconic memory is probably limited.

Some points of more serious disagreement do remain. For example, Bowling and Lovegrove base many of their conclusions concerning the nature of Type I persistence on the results obtained with the persistence-of-form procedure. With this procedure, a target (usually a target grating) is alternated with a blank field, the duration of which is adjusted by the observer so that the target (grating) never completely disappears. The adjusted duration of the blank field is then taken as a direct measure of persistence. However, in a recent article, Long and Sakitt (1981) have demonstrated that this "quasi-flicker" procedure is especially sensitive to the effects of probability summation (across space). That is, spatial frequency effects obtained with this procedure may, in fact, reflect simply the changing number of elements (i.e., cycles) in a constant area target as spatial frequency is altered. Hence, conclusions about the underlying persistence that are based on this procedure must be viewed with caution.

And, finally, I wish to question the logic of one of Bowling and Lovegrove's arguments. To make their point, they have replotted the results from a single figure in Long and Sakitt (1980b) for the purpose of offering an alternative interpretation of the data. This is neither very impressive nor very objective. Not only are there several other studies to support the original interpretation of increasing (Type II) persistence with increasing luminance, but, as Bowling and Lovegrove admit, other data *in the same study* cannot be similarly treated.

Conclusions

In agreement with Bowling and Lovegrove's basic premise, there is little doubt that various procedures used to measure visual persistence are not equivalent. Several current techniques appear to assess an inverse-energy persistence (Type I persistence) that is related to perceived offset of a brief target and which "contributes only minimally to iconic memory" (Bowling & Lovegrove, 1982, p. 197). Hence, the use of such procedures to establish the nature or locus of iconic memory per se, although common, has been of limited value. This was the major contention of my previous extensive critique (Long, 1980).

Iconic memory, which historically has been of major interest, is traditionally assessed by such techniques as the partial-report task and the successive-field task, and it appears to be based upon processes in the visual system that are very different from those upon which Type I persistence is based. I personally believe that iconic memory can be equated with positive afterimages and Type II persistence (e.g., Long, 1979; Long & Beaton, 1982), but this position is much more controversial (cf. Coltheart, 1980).

REFERENCES

ADELSON, E. H. Iconic storage: The role of rods. *Science*, 1978, **201**, 544-546.

BADCOCK, D., & LOVEGROVE, W. The effects of contrast, stimulus duration, and spatial frequency on visible persistence in normal and specifically disabled readers. *Journal of Experimental Psychology: Human Perception and Perfomance*, 1981, **7**, 495-505.

BANKS, W. P., & BARBER, G. Color information in iconic memory. *Psychological Review*, 1977, **84**, 536-546.

BOWEN, R. W. Latencies for chromatic and achromatic visual mechanisms. *Vision Research*, 1981, **21**, 1457-1466.

BOWEN, R. W., POLA, J., & MATIN, L. Visual persistence: Effects of flash luminance, duration and energy. *Vision Research*, 1974, **14**, 295-303.

BOWLING, A., & LOVEGROVE, W. The effect of stimulus duration on the persistence of gratings. *Perception & Psychophysics*, 1980, **27**, 574-578.

BOWLING, A., & LOVEGROVE, W. Two components to visible persistence: Effects of orientation and contrast. *Vision Research*, 1981, **21**, 1241-1251.

BOWLING, A., & LOVEGROVE, W. Iconic memory: Fallacies persist(?). *Perception & Psychophysics*, 1982, **31**, 194-198.

BOWLING, A., LOVEGROVE, W., & MAPPERSON, B. The effect of spatial frequency and contrast on visual persistence. *Perception*, 1979, **8**, 529-539.

COLTHEART, M. Iconic memory and visible persistence. *Perception & Psychophysics*, 1980, **27**, 183-228.

ERIKSEN, C. W., & COLLINS, J. F. Some temporal characteristics of visual pattern perception. *Journal of Experimental Psychology*, 1967, **74**, 476-484.

ERIKSEN, C. W., & COLLINS, J. F. Sensory traces versus the psychological moment in the temporal organization of form. *Journal of Experimental Psychology*, 1968, **77**, 376-382.

HAWKINS, H. L., & SHULMAN, G. L. Two definitions of persistence in visual perception. *Perception & Psychophysics*, 1979, **25**, 348-350.

LONG, G. M. Comment on Hawkins and Shulman's Type I and Type II visual persistence. *Perception & Psychophysics*, 1979, **26**, 412-414.

LONG, G. M. Iconic memory: A review and critique of the study of short-term visual storage. *Psychological Bulletin*, 1980, **88**, 785-820.

LONG, G. M., & BEATON, R. J. The effects of spatial frequency and target type on perceived duration. *Perception & Psychophysics*, 1980, **28**, 413-421. (a)

LONG, G. M., & BEATON, R. J. The contribution of visual persistence to the perceived duration of brief targets. *Perception & Psychophysics*, 1980, **28**, 422-430. (b)

LONG, G. M., & BEATON, R. J. The effects of stimulus numerosity, retinal location, and rod contrast on perceived duration of brief visual stimuli. *Perception & Psychophysics*, 1981, **29**, 389-394.

LONG, G. M., & BEATON, R. J. The case for peripheral persistence: Effects of target and background luminance on a partial-report task. *Journal of Experimental Psychology: Human Perception and Performance*, 1982, **8**, 383-391.

LONG, G. M., & GILDEA, T. J. Latency for the perceived offset of brief target gratings. *Vision Research*, 1981, **21**, 1395-1399.

LONG, G. M., & MCCARTHY, P. R. Target energy effects on Type 1 and Type 2 visual persistence. *Bulletin of the Psychonomic Society*, 1982, **19**, 219-221.

LONG, G. M., & MCCARTHY, P. R. Rod persistence on a partial-report task with scotopic and photopic backgrounds. *American Journal of Psychology*, in press. (b)

LONG, G. M., & SAKITT, B. Target duration effects on iconic memory: The confounding role of changing stimulus dimensions. *Quarterly Journal of Experimental Psychology*, 1980, **32**, 269-285. (a)

LONG, G. M., & SAKITT, B. The retinal basis of iconic memory: Eriksen and Collins revisited. *American Journal of Psychology*, 1980, **93**, 195-206. (b)

LONG, G. M., & SAKITT, B. Differences between flicker and nonflicker persistence tasks: The effects of luminance and the number of cycles in a grating target. *Vision Research*, 1981, **21**, 1387-1393.

NEISSER, U. *Cognitive psychology*. Englewood Cliffs, N.J: Prentice-Hall, 1967.

PARKER, D. M. Simple reaction times to the onset, offset, and contrast reversal of sinusoidal grating stimuli. *Perception & Psychophysics*, 1980, **28**, 365-368.

SAKITT, B. Iconic memory. *Psychological Review*, 1976, **83**, 257-276.

SAKITT, B., & LONG, G. M. Relative rod and cone contribution in iconic storage. *Perception & Psychophysics*, 1978, **23**, 527-536.

SAKITT, B., & LONG, G. M. Cones determine subjective offset of a stimulus, but rods determine total persistence. *Vision Research*, 1979, **19**, 1439-1441. (a)

SAKITT, B., & LONG, G. M. Spare the rod and spoil the icon. *Journal of Experimental Psychology: Human Perception and Performance*, 1979, **5**, 19-30. (b)

SPERLING, G. The information available in brief visual presentations. *Psychological Monographs*, 1960, **74**(11, Whole No. 498).

WALKER, J. T. A new dynamic visual illusion: The bending hourglass. *Perception & Psychophysics*, 1981, **30**, 455-458.

(Manuscript received May 19, 1982;
accepted for publication June 7, 1982.)