Psychology and Aging
2010, Vol. 25, No. 3, 714–718

0882-7974/10/$12.00 DOI: 10.1037/a0019199

# Preview Benefit During Eye Fixations in Reading for Older and Younger Readers

Keith Rayner
University of California, San Diego

Monica S. Castelhano
Queen's University

Jinmian Yang
University of Massachusetts at Amherst

Older and younger readers read sentences as their eye movements were recorded, and the boundary paradigm (Rayner, 1975) was used to present either a valid or an invalid parafoveal preview of a target word. During the saccade to the target word, the preview word changed to the target word. For early measures of processing time (first fixation duration and single fixation duration), the standard preview benefit effect (shorter fixation times on the target word with a valid preview than an invalid preview) was obtained for both older and younger readers. However, for gaze duration and go-past time, the preview benefit was somewhat attenuated in the older readers in comparison to the younger readers, suggesting that on some fixations older readers obtain less preview benefit from the word to the right of fixation.

*Keywords:* preview benefit, eye movements, older and younger readers

A number of differences between older readers and younger readers have recently been demonstrated with respect to eye movements during reading. First, older readers tend to make more (Kemper, Crow, & Kemtes, 2004; Kemper & Liu, 2007; Kemper & McDowd, 2006; Kliegl, Grabner, Rolfs, & Engbert, 2004; Rayner, Reichle, Stroud, Williams, & Pollatsek, 2006) and longer (Kliegl et al., 2004; Rayner et al., 2006; Stine-Morrow et al., 2010) eye fixations during reading than younger readers do. Second, older readers make longer saccades and skip words more frequently (Laubrock, Kliegl, & Engbert, 2006; Rayner et al., 2006), which results in their making more regressions to skipped words than younger readers do. Third, older readers have a slightly smaller and less asymmetric perceptual span (Rayner, Castelhano, & Yang, 2009). All of these factors are associated with older adults reading more slowly than younger readers (Stine-Morrow, Miller, & Hertzog, 2006).

Given that older readers read more slowly than younger readers and also have a slightly smaller perceptual span than younger readers, do they obtain less information from the word to the right of fixation? In the experiment reported here, we used the boundary paradigm (Rayner, 1975), in which an invisible boundary is located just to the left of a target word (see Figure 1); before the reader's eyes cross the boundary, either a valid or an invalid preview (i.e., another word or nonword or random string of letters that initially occupied the target location) is provided. When the reader's eyes cross the boundary, the preview is replaced by the target word. Because the change takes place during a saccade (when vision is suppressed), readers are unaware of the identity of the preview and of the display change. Research using this paradigm has revealed that when readers have a valid preview of the word to the right of fixation, they spend less time fixating that word (following a saccade to it) than when they do not have a valid preview. The size of this preview benefit is typically on the order of 20–30 ms. Research using this technique has revealed a number of interesting findings (for summaries, see Rayner, 1998, 2009). Readers do not combine a literal representation of the visual information across saccades, and semantic information is not the source of preview benefit. Rather, information about the beginning and ending letters of words, orthographic and abstract letter codes, and phonological information is integrated across saccades.

In the experiment reported here, the boundary paradigm was used to determine if there are differences between older and younger readers in the amount of preview benefit obtained from the word to the right of fixation. This was accomplished by presenting either a valid preview (*abdomen* as a preview for *abdomen*) or an invalid preview (*abdcnor* or *ohbcnor* as a preview for *abdomen*) to older and younger readers. When the reader's eyes crossed the boundary, the preview was replaced by the target word. If older readers do not get as much preview benefit as younger readers do, there should be an interaction between reading group and preview.

Keith Rayner, Department of Psychology, University of California, San Diego; Monica S. Castelhano, Department of Psychology, Queen's University, Kingston, Ontario, Canada; Jinmian Yang, Department of Psychology, University of Massachusetts at Amherst.

This research was supported by National Institute of Health Grant HD26765 and a grant from the Microsoft Corporation to Keith Rayner. The research was conducted when all of the authors were at the University of Massachusetts. Thanks to Reinhold Kliegl, Elizabeth Stine-Morrow, and Mathew Shake for helpful comments on an earlier version of the paper; to Reinhold Kliegl and Bernhard Angele for statistical assistance; and to Mark Toczylowski for assistance with data collection.

Correspondence concerning this article should be addressed to Keith Rayner, Department of Psychology, University of California, San Diego, CA 92093. E-mail: krayner@ucsd.edu

```
Margaret's tender| ohbcnor impaired her ability
  *     *    *
Margaret's tender| abdomen impaired her ability
                           *       *     *     *
```

*Figure 1.* Example of the boundary paradigm. In the top line, the invalid preview (*ohbcnor*) is initially displayed in the target location. When the reader's eyes cross the invisible boundary location (|), the preview is replaced by the target word (*abdomen*). The asterisks represent the fixation locations. The full sentence was "Margaret's tender abdomen impaired her ability to win the race." The question following the sentence was "Did Margaret win the race?"

## Method

### Subjects

Thirty-six younger adults who were students at the University of Massachusetts at Amherst participated in the experiment; they averaged 20.8 years of age (range = 17–24 years). In addition, 18 older adults from the community participated in the experiment; they averaged 72.3 years of age (range = 65–89 years). The groups did not differ in number of years of schooling (15.5 years for the younger adults and 15.6 years for the older adults). The younger adults had either normal or corrected to normal vision. All of the older adults had corrected 20/20 vision for reading,[1] and they wore their glasses during the experiment. All of them reported that they spent quite a bit of time each day reading newspapers and books.

### Apparatus

Eighteen younger and eleven older readers' eye movements were recorded via an SR Research Ltd. EyeLink II eye-tracking system with high spatial resolution and a sampling rate of 500 Hz (2-ms sampling resolution). Another 18 younger and seven older readers' eye movements were recorded via an SR Research Ltd. EyeLink 1000 eye-tracking system, with high spatial resolution and a sampling rate of 1,000 Hz (1-ms sampling resolution).[2] Custom-designed software ensured that the display change was typically completed during the saccade, when vision is suppressed. The change occurred in 12 ms for the EyeLink II and 9 ms for the EyeLink 1000. For all subjects, viewing was binocular, but only the right eye was monitored. Sentences were presented on a 19-in. IIYAMA HM903DT B monitor with the refresh rate of 150 Hz, and the letters were black on a white background. Subjects were seated approximately 63 cm from the monitor, and 3.8 characters subtended 1 degree of visual angle.

### Design and Material

Seventy-two target words, which averaged 6.1 letters in length (range = 5–7), were embedded into sentences. Each of the target words was paired with an identical preview (*abdomen* as a preview for *abdomen*), a three-letter overlap preview (*abdcnor* as a preview for *abdomen*), and a different preview (*ohbcnor* as a preview for *abdomen*); in the different condition, each letter from the original target word was replaced by a visually similar letter; in the three-letter overlap condition, the first three letters overlapped with the target word and the other letters were replaced by a visually similar letter. An invisible boundary was located at the end of the word to the left of the target word. When readers moved their eyes across the boundary, the identical or invalid preview changed to the target word (see Figure 1). Three material sets were created for the experiment, so that each reader saw a third of the target words in the identical preview condition, a third in the three-letter overlap preview condition, and a third in the different preview condition.

### Procedure

When subjects arrived for the experiment, some background information was obtained. Then the eye movement system was calibrated; this typically took about five minutes. Calibration accuracy was determined by asking subjects to sequentially fixate on three fixation points where the sentence would subsequently appear. The validity of the calibration was checked prior to each sentence by asking the subject to fixate on a fixation marker. If the subject's eyes were on the fixation marker the next trial occurred; if they were not, the subject was recalibrated (this typically took less than a minute). Subjects read sentences that appeared one at a time on the video monitor. They were asked to read each sentence silently for comprehension. They were told that they would be asked questions about the sentences; following one half of the sentences they were asked questions (requiring yes/no responses) about the sentence's meaning.

## Results

All readers scored over 75% correct on the questions; the older readers' average percent correct was slightly higher (89%) than that of the younger readers (87%), but there was no significant difference (likewise, there was no difference due to experimental condition). Fixations less than 120 ms or greater than 800 ms were eliminated from the analyses. Trials in which (a) the display change occurred too late (either at the end of a saccade or during a fixation) or (b) the duration of a fixation on or adjacent to the target word was greater than 800 ms were excluded. Data loss, including track losses, totaled 16.4%. (The amount of data loss did not differ between the younger and older readers or between conditions, and no subject lost more than a third of the data.)

Three standard first-pass fixation time measures (Rayner, 1998, 2009) were computed: first fixation duration (the duration of the first forward fixation on the target word independent of the number of first-pass fixations), single fixation duration (the fixation duration for the subset of trials in which there was only one first-pass

[1] The older subjects were part of a large group of volunteers in the Amherst area who serve as a control group for comparison with patients with Alzheimer's in an ongoing study. Prior to the experiment, they completed the Shipley Institute of Living Scale test (Zachary, 2006) to evaluate their vocabulary and abstraction skills. They had an average score on the test of 68.2 (out of 80, with a range from 48 to 79). These scores demonstrate that the older readers have intact cognitive abilities. None of them reported any vision problems (other than needing glasses for reading).

[2] The data were analyzed according to which eye tracker was used, and exactly the same pattern of results was obtained independent of which tracker was used. Therefore, we collapsed the data across the two trackers.

fixation on the target word), and gaze duration (the sum of all the consecutive first-pass fixations on the target word prior to a saccade to another word). In addition, go-past time (the sum of all fixation durations from when the eyes first encounter a word to when they leave the word to the right, including time spent rereading earlier words and time spent rereading the word itself), which reflects integration processes, was computed. We also examined a number of other measures discussed below. Table 1 shows the means for the various measures for each condition; skipping probability is shown but will not be discussed further, as all differences across the conditions were quite small and unreliable.

Statistical analyses on the various eye movement measures were performed with linear mixed models for durations and generalized linear mixed models for binary dependent variables (skipping, refixations, and regressions), with subjects and items specified as crossed random effects. Age was specified as a fixed effect, as were two contrasts for preview type (contrast 1: identical vs. different; contrast 2: different vs. three letter). Therefore, the model provided statistics with respect to three main effects (age, contrast 1, and contrast 2) and two interactions (age and contrast 1; age and contrast 2). These analyses were carried out with the lmer program of the lme4 package (Bates & Maechler, 2009) in R, an open-source programming language and environment for statistical computation (R Development Core Team, 2009). We report regression coefficients (*b*s, effects relative to the intercept, which indicate effect size in milliseconds for durations and change in log odds for binary dependent variables), standard errors (*SE*s), *t* values (for durations), *z* values (for binary dependent variables), and *p* values. The *p* values corresponding to the *t* values were estimated with posterior distributions for model parameters obtained by Markov chain Monte Carlo sampling (Baayen, 2008; Baayen, Davidson, & Bates, 2008). Contrast 2 was not significant in any of the analyzed measures and will not be discussed below. When there was an interaction between age and contrast 1, we explored it using a posteriori contrasts.

## First Fixation and Single Fixation Duration

There was no significant effect of age ($p$s $> .2$) on either first fixation or single fixation duration.[3] However, target words were read faster in the identical preview condition than in the different preview condition: for first fixation duration ($b = 17$, $SE = 3.9$, $t = 4.38$, $p < .001$), and for single fixation duration ($b = 26$, $SE = 4.39$, $t = 5.95$, $p < .001$). There were no interactions between age and preview type, as the size of preview effect was comparable between the two groups ($p$s $> .6$).

## Gaze Duration

Readers' gaze durations on the target words were longer in the different preview condition than in the identical preview condition ($b = 24$, $SE = 5.4$, $t = 4.47$, $p < .001$). Although the main effect of age was not significant ($b = 2$, $SE = 7.4$, $t = 0.28$, $p > .7$), the interaction between age and the contrast between the identical and different preview types was significant ($b = 12$, $SE = 5.4$, $t = 2.12$, $p < .05$). In a posteriori contrasts we tested this effect for each group: For the older readers, the difference between the two preview conditions was not significant ($b = 13$, $SE = 8.9$, $t = 1.43$, $p > .1$); for the younger readers, however, the difference was significant ($b = 36$, $SE = 6.2$, $t = 5.75$, $p < .001$).

## Refixations

Given the differing patterns in gaze duration compared to first and single fixation duration, we examined refixations on the target word (as per Reingold, Yang, & Rayner, in press). Gaze duration is largely influenced by two factors: (a) the frequency of refixations on a target word and (b) the duration of initial fixations on a target word in conjunction with the duration of refixations on the word. With respect to refixations, older readers actually made fewer refixations (19%) on the target word than the younger readers did (24%), although this effect was not significant ($b = .18$, $SE = .11$, $z = 1.65$, $p = .1$). However, the contrast between the identical and the different condition was significant ($b = .24$, $SE = .12$, $z = 2.05$, $p < .05$). This effect differed between the two groups ($b = .25$, $SE = .12$, $z = 3.77$, $p < .001$), as the older readers refixated the target word 20% of the time in the identical condition and 19% of the time in the different condition (with no difference between conditions; $p > .9$), and the younger readers refixated the target 20% of the time in the identical condition and 28% of the time in the different condition,( $b = .50$, $SE = .13$, $z = 3.77$, $p < .001$).

With respect to fixation times, the duration of the first of multiple fixations was longer for older readers than for younger readers ($b = 13$, $SE = 5.9$, $t = 2.15$, $p < .05$). Although the contrast between the identical and the different preview conditions was not significant, a posteriori contrasts showed that this effect was marginally significant for the younger readers ($b = 15$, $SE = 8.5$, $t = 1.72$, $p = .086$) but was not significant for the older readers ($b = 4$, $SE = 13.4$, $t = 0.33$, $p > .7$). Finally, for the remainder fixations (the mean of all other fixations after the initial fixation on the target word), the interaction between age and the contrast between the identical and different preview types was marginally significant ($b = 20$, $SE = 11.4$, $t = 1.77$, $p = .077$). This was due to the fact that the remainder fixation was shorter in the different condition than in the identical condition for the older readers, with a reversed pattern for the younger readers.

## Go-Past Time and Regressions Out of the Target Word

As with the gaze duration pattern, the go-past time for the target word was longer in the different preview condition than in the identical condition ($b = 34$, $SE = 10.6$, $t = 3.19$, $p < .01$), and this effect marginally interacted with age ($b = 20$, $SE = 10.6$, $t = 1.86$, $p = .063$). A posteriori contrasts revealed that the difference between the identical and the different preview conditions for the older readers was not significant ($b = 14$, $SE = 17.4$, $t = 0.81$, $p > .4$), but the difference between these two conditions was significant for the younger readers ($b = 54$, $SE = 12.2$, $t = 4.41$, $p < .001$). Although older readers made slightly more regressions (15%) out of the target word than younger readers (13%; $b = .26$,

[3] Although there were no significant age differences in fixation times on the target word, the average fixation duration across the entire sentence was 23 ms longer for the older readers than the younger readers ($p < .05$). Also, the older readers had a higher skipping rate (.22 vs. .17) across the entire sentence than the younger readers ($p < .05$).

Table 1
*Temporal Measures of Processing and Probability Measures*

| Measure | Older adults ($N$ = 18) Identical | Older adults Different | Older adults Three letter | Younger adults ($N$ = 36) Identical | Younger adults Different | Younger adults Three letter |
|---|---|---|---|---|---|---|
| | | | Temporal measures | | | |
| First fixation | 277 (45) | 293 (44) | 301 (50) | 265 (40) | 282 (48) | 281 (39) |
| Single | 284 (53) | 313 (52) | 320 (58) | 277 (46) | 301 (57) | 301 (46) |
| Gaze | 324 (77) | 335 (53) | 338 (58) | 306 (49) | 343 (59) | 335 (46) |
| First of multiple | 258 (58) | 261 (65) | 257 (49) | 225 (41) | 245 (60) | 243 (46) |
| Remainder | 227 (62) | 218 (68) | 206 (57) | 211 (69) | 219 (53) | 216 (50) |
| Go-past | 413 (124) | 427 (120) | 407 (93) | 364 (72) | 417 (79) | 409 (87) |
| Last fixation | 248 (62) | 255 (53) | 251 (46) | 251 (43) | 249 (45) | 252 (33) |
| Spillover | 296 (45) | 289 (47) | 294 (40) | 264 (40) | 271 (43) | 270 (46) |
| | | | Probability measures | | | |
| Skipping | .03 (.05) | .02 (.04) | .03 (.04) | .04 (.06) | .03 (.06) | .03 (.05) |
| Refixations | .20 (.16) | .19 (.14) | .18 (.11) | .20 (.13) | .28 (.17) | .25 (.16) |
| Regress out | .15 (.11) | .16 (.13) | .13 (.12) | .11 (.09) | .15 (.11) | .13 (.10) |

*Note.* The table shows the following temporal measures (all in milliseconds): average first fixation duration, single fixation, gaze duration, first of multiple fixation durations, remainder duration, go-past time on the target word, the last fixation prior to crossing the boundary (last fixation), and the first fixation on the posttarget word (spillover fixation). It also shows the following probability measures: skipping, refixations, and regressions out of the target word. Standard deviations are shown in parentheses.

$SE$ = .14, $z$ = 1.86, $p$ = .063), there were no significant interactions ($p$s > .2) and no significant age difference. This suggests, as with the refixation data, that older readers made longer fixations than the younger readers did when they regressed from the target word and the durations of these regressive fixations were not different across conditions.

## Last Fixation and Spillover Fixation

We also examined the last fixation before the eyes crossed the boundary. This fixation was generally on the word immediately preceding the target word (but could also be on the second word before it) for evidence of parafoveal-on-foveal effects (which refers to the possibility that the word to the right of fixation can influence fixation time on the currently fixated word; for discussion, see Rayner, 2009). No effect of age or preview approached significance on the last fixation before crossing the boundary.[4] However, spillover fixations (the first fixation on the posttarget word) were longer for older readers than for younger readers ($b$ = 25, $SE$ = 11.8, $t$ = 2.11, $p$ < .05).

## Supplementary Analyses

Because differences between the different and the three-letter preview conditions were not significant on any of the measures,[5] we tested the difference between the identical condition and the average of the other two conditions and the interaction of this effect with age in a second model. These analyses revealed the same patterns as described above. The main difference was that for the go-past time and for the remainder fixations, the interaction between preview effect and age became significant: for go-past time ($b$ = 15, $SE$ = 6.2, $t$ = 2.42, $p$ < .05) and for the remainder fixations ($b$ = 15, $SE$ = 6.7, $t$ = 2.19, $p$ < .05).

# Discussion

The results of the present study demonstrate that the amount of preview benefit that older readers obtain from the word to the right of fixation is sometimes somewhat attenuated overall in comparison to the amount that younger readers obtain. For both first fixation duration and single fixation duration, the size of the preview benefit was quite comparable for the two groups of readers. However, for gaze duration and go-past time, there was an interaction between age and preview condition, with older readers showing less preview benefit. Given that older readers are generally slower in terms of lexical processing (Rayner et al., 2006), it would be expected that any differences between older and younger readers in preview benefit might show up in gaze duration (which consists not only of the initial fixation on a word but of any subsequent fixations on the word prior to moving to another word). Furthermore, because go-past time reflects integration processes, one might expect differences between older and younger readers on this measure as well. And, indeed, what we found was that the size of the preview benefit effect was attenuated in both of these measures for the older readers.

The fact that older and younger readers had comparable preview benefit via the first fixation and single fixation duration measures suggests that on many fixations (at least the roughly 80% of the

[4] The failure to find an orthographic parafoveal-on-foveal effect is a bit surprising. It is probably due to the fact that the original letters in the target word were replaced by visually similar letters (and hence the invalid preview did not look too strange).

[5] We had anticipated that the three-letter preview condition might yield more preview benefit than the different condition, but this did not happen. For the younger readers, there was an 8-ms effect in gaze, which did not approach significance ($p$ > .20).

time in the present experiment that they made only a single fixation on the target word) older readers obtain the same amount of preview benefit from the word to the right of fixation that younger readers do. But the fact that preview benefit was largely attenuated in the gaze duration measure for older readers, as well as largely eliminated in go-past, seems to indicate that on roughly a third of the trials older readers obtained less preview benefit from the word to the right of fixation than younger readers did.

Another factor to consider is that for the older readers there was no difference across the conditions in terms of either refixations on the target word or the duration of the first of multiple fixations and remainder fixations. The younger readers, in contrast, refixated on the target word less frequently in the valid preview (identical) condition than when there was an invalid preview, and the first of multiple fixations was shorter for the identical condition than for the invalid preview condition. The lack of difference in refixations and the two fixation measures for the older readers appears to be consistent with the notion, previously suggested by Rayner et al. (2006), that older readers are more likely to guess at upcoming words (though not consciously) than younger readers are.

In summary, with respect to the question that we raised at the outset, the results of the present study indicate that older readers do differ overall from younger readers in the amount of preview information that they obtain from the word to the right of fixation. Thus, older readers apparently have a slightly smaller (and less asymmetric) perceptual span than younger readers (Rayner et al., 2009), and the amount of preview benefit that they obtain from the word to the right of fixation is attenuated overall in comparison to that of younger readers.

## References


Baayen, R. H. (2008). *Analyzing linguistic data: A practical introduction to statistics.* Cambridge, England: Cambridge University Press.

Baayen, R. H., Davidson, D. H., & Bates, D. M. (2008). Mixed-effects modeling with crossed random effects for subjects and items. *Journal of Memory and Language, 59,* 390–412. doi:10.1016/j.jml.2007.12.005

Bates, D. M., & Maechler, M. (2009). lme4: Linear mixed-effect models using S4 classes (R package version 0.999375-1) [Computer software]. Retrieved from http://cran.r-project.org/web/packages/lme4/index.html

Kemper, S., Crow, A., & Kemtes, K. (2004). Eye fixation patterns of high- and low-span young and older adults: Down the garden path and back again, *Psychology and Aging, 19,* 157–170. doi:10.1037/0882-7974.19.1.157

Kemper, S., & Liu, C.-J. (2007). Eye movements of young and older adults during reading. *Psychology and Aging, 22,* 84–93. doi:10.1037/0882-7974.22.1.84

Kemper, S., & McDowd, J. (2006). Eye movements of young and older adults while reading with distraction. *Psychology and Aging, 21,* 32–39. doi:10.1037/0882-7974.21.1.32

Kliegl, R., Grabner, E., Rolfs, M., & Engbert, R. (2004). Length, frequency, and predictability effects of words on eye movements in reading. *European Journal of Cognitive Psychology, 16,* 262–284. doi:10.1080/09541440340000213

Laubrock, J., Kliegl, R., & Engbert, R. (2006). SWIFT explorations of age differences in eye movements during reading. *Neuroscience & Biobehavioral Reviews, 30,* 872–884. doi:10.1016/j.neubiorev.2006.06.013

Rayner, K. (1975). The perceptual span and peripheral cues in reading. *Cognitive Psychology, 7,* 65–81. doi:10.1016/0010-0285(75)90005-5

Rayner, K. (1998). Eye movements in reading and information processing: 20 years of research. *Psychological Bulletin, 124,* 372–422. doi:10.1037/0033-2909.124.3.372

Rayner, K. (2009). The Thirty-Fifth Sir Frederick Bartlett Lecture: Eye movements and attention during reading, scene perception, and visual search. *Quarterly Journal of Experimental Psychology, 62,* 1457–1506. doi:10.1080/17470210902816461

Rayner, K., Castelhano, M. S., & Yang, J. (2009). Eye movements and the perceptual span in older and younger readers. *Psychology and Aging, 24,* 755–760. doi:10.1037/a0014300

Rayner, K., Reichle, E. D., Stroud, M. J., Williams, C. C., & Pollatsek, A. (2006). The effect of word frequency, word predictability, and font difficulty on the eye movements of young and older readers. *Psychology and Aging, 21,* 448–465. doi:10.1037/0882-7974.21.3.448

R Development Core Team. (2009). R: A language and environment for statistical computing [Computer software]. Retrieved from http://www.R-project.org

Reingold, E., Yang, J., & Rayner, K. (in press). The time course of word frequency and case alternation effects on fixation times in reading: Evidence for lexical control of eye movements. *Journal of Experimental Psychology: Human Perception and Performance*.

Stine-Morrow, E. A. L., Miller, L. M. S., & Hertzog, C. (2006). Aging and self-regulated language processing. *Psychological Bulletin, 132,* 582–606. doi:10.1037/0033-2909.132.4.582

Stine-Morrow, E. A. L., Shake, M. C., Miles, J. R., Lee, K., Gao, X., & McConkie, G. (2010). Pay now or pay later: Aging and the role of boundary salience in self-regulation of conceptual integration in sentence processing. *Psychology and Aging, 25,* 168–176. doi:10.1037/a0018127

Zachary, R. A. (2006). *Shipley Insitute of Living Scale.* Los Angeles, CA: Western Psychological Services.


Received June 30, 2009
Revision received February 2, 2010
Accepted February 15, 2010 ■