The behavioral domains of attention, memory, and language processing have been studied extensively in individuals with and without neuropathology, but models for understanding the role or precise effects of sensory competition and distraction are few. Events in daily life occur in context and are perceived in context, but the precise effects of attended and unattended auditory events on language are unclear. In a study of non-aphasic individuals, LeCompte, Neely, & Wilson (1997) reported that linguistically discernible words were more disruptive than pure tones or nonsense syllables. This suggests that semantic interference is more disruptive than nonlinguistic background noise; but little research has followed up to clarify the relative degradation capacity or potential of auditory backgrounds or of linguistic and nonlinguistic consequences.

Recent research has directed our attention to the effects of contextual priming for both a more fine-grained understanding of semantic organization as well as of possible treatment paradigms (Crutch & Warrington, 2003; Renvall, K., Laine, M., Laakso, & Martin, 2003). Effects of semantic context on naming and picture identification have been characterized as both facilitating and inhibiting during studies of language processing. Many researchers have reported the facilitating effects of semantic priming in individuals with and without aphasia (Baum, 1997; Bates, Marangolo, Pizzamiglio, & Dick, 2001). Damian and Bowers (2003), and Damian, Vigliocco, and Levelt (2003) have commented on the locus of semantic interference during a picture-word interference task and studied an array of variables thought to influence semantic access and realization. Models of cognitive resource allocation have drawn attention to the effects of dual task paradigms and cognitive distribution and sharing during linguistic processing in aphasia (Tseng, McNeil, & Milenkovic et al, 1993; LaPointe & Erickson, 1991; Murray, Holland, & Beeson, 1997), but at this time few studies of the effects of semantic distraction on linguistic processing in aphasia or for that matter, in people without aphasia have been conducted. Whether an ambient background of semantic auditory distraction would facilitate or interfere with ongoing linguistic processing is uncertain at this time. Further, either auditory or visual semantic relatedness of the background distraction may dictate whether picture identification is helped or hindered. The purpose of this study was to measure the effect of semantic relatedness of both visual and auditory distractions during a picture identification task.

Methods

Seventeen adults with no history of neurological impairment, mean age 20.1 years, completed an informed consent form and passed a hearing screening at 25dB. Participants sat directly in front of a 17-inch computer monitor and a four-button keypad. While staring at a central fixation cross, participants heard a simple direction, for example, “point to *corn*.” Immediately following the direction, four pictures, including the target, appeared on the screen in a quadrant array. Participants were instructed to press the button on the keypad that corresponded to the position of the target picture. For example, if the target picture (corn) was in the upper-left quadrant of the screen, the correct button was the upper-left button on the button array. Forty targets in each of three semantic categories (birds, sports, vegetables) were presented. Auditory distractions were presented at 60 dB HL during the picture displays. Participants were informed that both speed and accuracy of keypad response would be recorded.

The primary task (i.e., “point to _____”) remained constant but the semantic relatedness of the visual foils and auditory distractions were manipulated. In half of the trials (20 targets from each semantic category), the three foil pictures were semantically related to the target (e.g., target picture of corn shown with pictures of lettuce, tomato, and eggplant). The other half of the

trials incorporated semantically unrelated foil pictures (e.g., pictures of table, bucket, shoes with the target picture of corn). Participants repeated the task (order of targets was randomized) in four conditions of auditory distraction: words semantically related to the target, words semantically unrelated to the target, bursts of white noise, and quiet. The unrelated pictures and words were not related to birds, sports or vegetables (see Table 1).

Analysis

Effects of Semantic Relatedness in Visual Distraction

The degree of semantic relatedness of the ambient visual distraction does appear to affect participant's speed of identifying pictures. The visual factor had a main effect significant beyond the 1% level: $F(1,16)=237.1$; $p<.000$. A post-hoc Tukey analysis revealed that RT is always longer when visual distraction is semantically related to the target. For example, identifying a picture of corn takes longer when foils are vegetables, compared to when foils are semantically unrelated (see Figure 1).

Effects of Semantic Relatedness in Auditory Distraction

The auditory factor also had a main effect significant beyond the 1% level: $F(3,48)=4.74$; $p=.006$. Pairwise comparisons revealed significant differences between related auditory distraction and bursts white noise, and also between unrelated distraction and bursts of white noise with white noise resulting in shorter RTs. The auditory distraction of hearing words- regardless of semantic relatedness- resulted in a slower mean RT than in a quiet condition, but this difference did not reach statistical significance (see Figure 2).

Effects of category (birds, sports, vegetables)

An item analysis was performed by pooling the two visual conditions and four auditory conditions (n=136 for each item) to obtain the mean, standard deviation, and coefficient of variation (a ratio of standard deviation to the mean). Results for swallow and wren were quite deviant from the other items for each descriptive statistic (cv = .98 and .95, respectively, with all other items between .31 and .74). Furthermore, RTs for the bird targets generally were longest. Reaction times for the vegetable targets were always shortest, regardless of visual or auditory distraction condition.

Discussion

The effect of semantic relatedness of distraction varied according to the modality of distraction. In this computerized picture identification task, visual distraction semantically related to the target did hinder performance more than semantically unrelated visual distraction. Effects of semantic relatedness were less clear for the auditory modality. The bursts of white noise were included to provide an interruption without a linguistic load. It is possible that the participants found the static-like white noise sound annoying and it actually became an incentive to hurry and make a selection so that the noise would stop. Resource allocation theory would suggest that the participants decided the ambient words were not important and therefore did not allocate any cognitive resource or processing to the words, diminishing their distracting effect. Our data supports this hypothesis because neither related nor unrelated word conditions were different than the quiet condition. Participants were required, however, to look at the pictures when making a selection and therefore could not choose avoid semantic relatedness effects by ignoring the visual distraction.

Performance in the presence of distraction is determined by many factors, including the linguistic context or semantic relatedness of the distraction and the modality of the distraction. Further investigation is necessary to identify more conditions that facilitate or hinder processing speed during ambient distraction. It remains to be investigated whether or not participants with aphasia are affected in a similar fashion.

References

Bates E., Marangolo P., Pizzamiglio L., & Dick F. Linguistic and nonlinguistic priming in aphasia. *Brain and Language*, 76 (1), 62-69.

Baum, S.R. (1997). Phonological, semantic, and mediated priming in aphasia. *Brain and Language*, 60(3), 347-59.

Crutch, S.J. & Warrington, E.K. (2003). The organization of semantic memory: Evidence from semantic refractory access dysphasia. *Brain and Language*, 87, 81-82.

Damian, M.F., & Bowers, J.S. (2003). Locus of semantic interference in picture-word interference tasks. *Psychonomic Bulletin Review*, 10 (1), 111-117.

Damian, M.F., Vigliocco, G., & Levelt, W.J. (2001) Effects of semantic context in the naming of pictures and words. Cognition, 81 (3), 77-86.

LaPointe, L. L. & Erickson, R.J., (1991). Auditory vigilance during divided task attention in aphasic individuals. Aphasiology, 5 (6), 511-520.

LeCompte, Neely, & Wilson (1997). Irrelevant speech and irrelevant tones: the relative importance of speech to the irrelevant speech effect. *J Exp Psychol Learn Mem Cogn*. 23(2), 472-83.

Murray, L. L. , Holland, A.L., & Beeson, P.M. (1997). Auditory processing in indivisuals with mild aphasia: A study of resource allocation. *Journal of Speech, Language, Hearing Research*, 40 (4), 792-808.

Renvall, K., Laine, M., Laakso, M. & Martin, N. (2003). Anomia rehabilitation with contextual priming: A case study. *Aphasiology*, 17, 305-308.

Tseng C.H., McNeil M.R., & Milenkovic P. (1993). An investigation of attention allocation deficits in aphasia. *Brain and Language*, 45 (2), 276-296.

Table 1.

2 Visual Distraction Cond.	**Target Category**	4 Auditory Distraction Conditions			
		Quiet	***Related* Auditory distraction**	***Unrelated* Auditory distraction**	**Bursts of white noise**
Semantically *related* (visual *Target* with 3 RELATED foils)	*1. Birds*				
	2. Sports				
	3. Veggies				
Semantically *unrelated* (visual *Target* with 3 UNRELATED foils)	*1. Birds*				
	2. Sports				
	3. Veggies				

Note: Each participant performed the picture identification task in every combination of visual and auditory distraction and category.

Figure 1. Mean Reaction Time (ms) in Two Conditions of VISUAL Distraction, Pooled Across Auditory Distraction Conditions and Semantic Categories

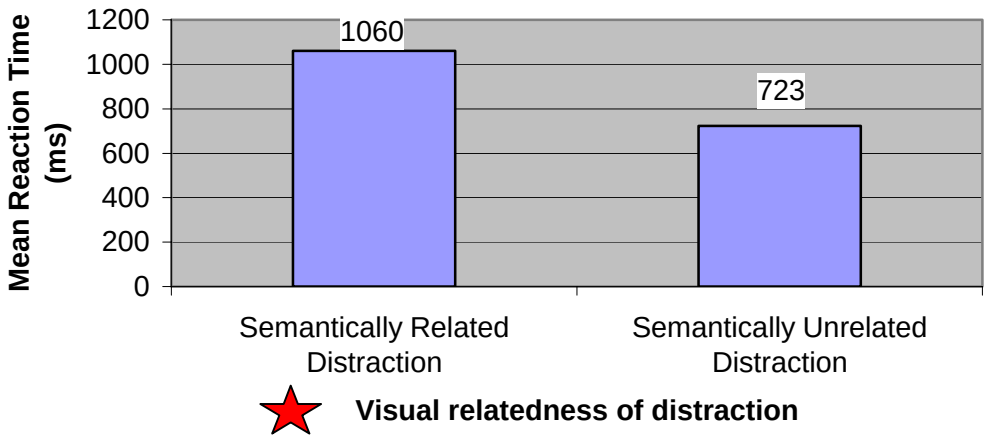

Figure 2. Mean Reaction Time (ms) in Four Conditions of AUDITORY distraction, pooled across visual distraction conditions and semantic categories