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Quantity and structure of word knowledge across adulthood

Timothy A. Salthouse [1]

Department of Psychology, University of Virginia, Charlottesville, VA 22904-4400, United States

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ABSTRACT

Cross-sectional and longitudinal data from moderately large samples of healthy adults confirmed prior findings of age-related declines in measures of the quantity of word knowledge beginning around age 65. Additional analyses were carried out to investigate the interrelations of different types of vocabulary knowledge at various periods in adulthood. Although the organizational structures were similar in adults of different ages, scores on tests with different formats had weaker relations to a higher-order vocabulary construct beginning when adults were in their 60s. The within-person dispersion among different vocabulary test scores was also greater after about 65 years of age. The discovery of quantitative decreases in amount of knowledge occurring at about the same age as qualitative shifts in the structure of knowledge raises the possibility that the two types of changes may be causally linked.

1. Introduction

As one would expect if knowledge accumulates over time, performance on tests of knowledge has often been reported to be greater at older ages. However, late-life declines in measures of vocabulary have been reported in cross-sectional data based on nationally representative samples (see figures in Salthouse, 1988a,b, 1991, 2003, 2010a), and also in several studies with longitudinal comparisons (e.g., Albert, Heller, & Milberg, 1988; Alder, Adam, & Arenberg, 1990; Anstey, Hofer, & Luszcz, 2003; Christensen et al., 1999; De Frias, Lovden, Lindenberger, & Nilsson, 2007; Ghisletta, McArdle, & Lindenberger, 2006; Schaie, 2005; Sliwinski & Buschke, 1999; Zelinski & Burnight, 1997). Because lack of access to previously available information may be a unique indicator of age-related decline in cognitive functioning, understanding the relations of age to word knowledge could provide valuable insights into the nature of late-life cognitive decline.

Many prior studies have examined only a single measure of vocabulary knowledge, but if multiple vocabulary measures are available relations among the measures can be examined to investigate the structure of a vocabulary construct at different ages. That is, not only can the amount of knowledge be assessed, in terms of the level of each measure, but also the cohesiveness of the vocabulary knowledge construct can be examined by the relations among the different measures.

A popular conceptualization of knowledge representation is a network in which the nodes correspond to semantic, phonological, or orthographic information (e.g., Burke, MacKay, & James, 2000; Burke, MacKay, Worthley, & Wade, 1991; Salthouse, 1988a,b). Because vocabulary tests in different formats vary in terms of the information that is provided and the information that is requested (e.g., Bowles & Salthouse, 2008; Rabaglia & Salthouse, 2011; Verhaeghen, 2003), different test formats can be postulated to involve different access routes to semantic information. That is, naming pictured objects requires that meaning is accessed and the phonological representation is activated, providing a definition of a target word requires that meaning be accessed from the phonological representation, and tests of synonyms and antonyms involve comparison of meanings with either the same or opposite connotations (cf. Rabaglia & Salthouse, 2011). If different types of vocabulary tests can be assumed to vary with respect to the

E-mail address: Salthouse@virginia.edu.

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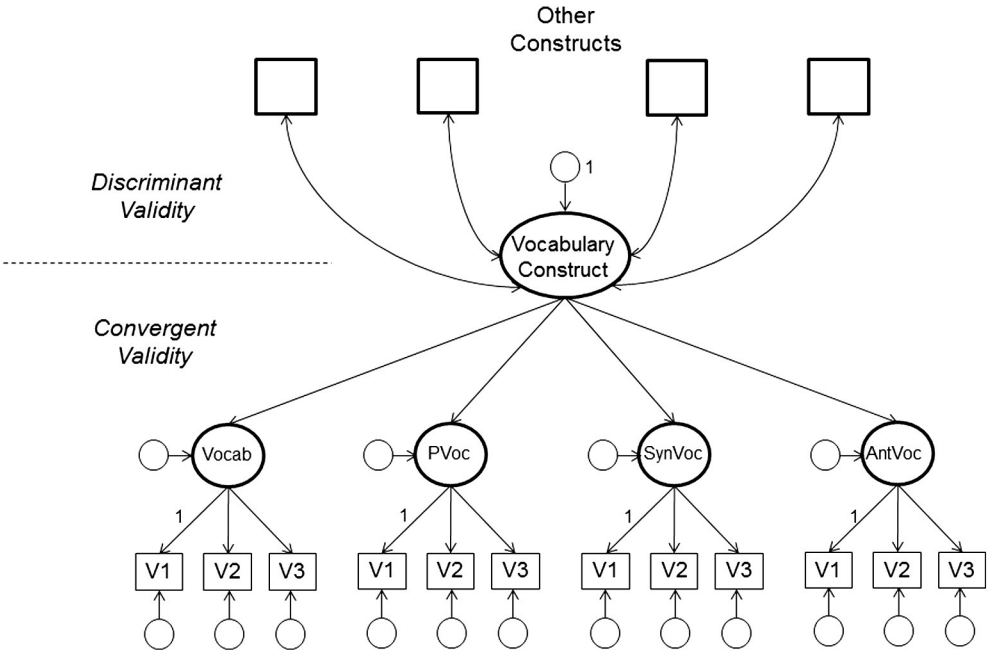

Fig. 1. Schematic representation of a vocabulary construct defined by three versions in each of four tests. Vocab refers to WAIS Vocabulary, PVoc to Picture Vocabulary, Synvoc to synonym vocabulary, and Antvoc to antonym vocabulary. V1, V2, and V3 refer to different versions of tests with the same format but involving different items. Relations with ability constructs in the top panel are relevant to discriminant validity and relations of the vocabulary construct to the vocabulary test constructs, and of the test constructs to the test versions in the bottom panel are relevant to convergent validity.

aspects of the semantic network that are involved, the cohesiveness of a vocabulary construct can be investigated by examining the strength of the relations among scores in tests involving different formats. That is, a more cohesive or tightly organized construct should have smaller variability across scores from different types of tests, and stronger relations among the scores in those tests.

There were therefore two primary goals of the present study: (1) further investigate the relations of age to vocabulary knowledge in both cross-sectional and longitudinal comparisons, and (2) investigate possible qualitative differences in word knowledge by determining whether increased age was associated with a shift in the structural organization of measures of vocabulary knowledge obtained from different test formats.

The first goal was pursued by examining the age trends on individual and composite measures of vocabulary from four different tests, each with three versions comprised of different items. The sample of participants consisted of over 4700 adults with cross-sectional data, and over 2200 adults with two-occasion longitudinal data. Because the age trends suggested the existence of two segments, spline regression analyses were conducted to determine the age corresponding to the transition between the two segments.

The second goal was investigated by examining relations among different vocabulary measures at both within-individual and between-individual levels of analysis. Within-individual comparisons were based on assessments of across-test variability. The rationale was that if the construct is becoming less cohesive with increased age, one might expect greater divergence, in the form of increased across-test variability, among the scores on different types of tests at older ages.

Between-individual comparisons were examined in the context of a hierarchical structure of word knowledge, as portrayed in the bottom of Fig. 1.[2] Note that the lowest level in the hierarchy consists of scores in the different test versions, the next level consists of constructs corresponding to the four different tests, and the highest level corresponds to a broad vocabulary construct. Relations from the first to the second levels, and from the second to the third levels, are relevant to whether the tests are all assessing the same construct, and hence serve to evaluate convergent validity of the vocabulary construct. When assessing construct validity it is also important to evaluate discriminant validity by determining whether the vocabulary construct is distinct from other constructs. Information relevant to this question is available in the magnitude of the relations of the vocabulary construct with measures of constructs representing different cognitive abilities because the correlations with cognitive abilities should be weak if the vocabulary construct represents something distinct from the other constructs.

Possible age differences in the structure of vocabulary knowledge were investigated by examining the fit of the model in different age groups, and comparing the magnitude of each parameter to determine where differences might exist in the structure. For example, differences could be evident at the lowest level, in the form of weaker relations of the test constructs to the test versions. Alternatively, if processes associated with aging have differential impact on the modes

[2] Although some (e.g., Kan et al., 2011) have advocated that a formative approach be used to model vocabulary measures, a reflective approach was used in this study because a latent variable of vocabulary knowledge was assumed to contribute to the scores on different types of tests.