Rapid Automatized Naming and Adult Reading Abilities: Review

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Predictive Ability of Rapid Automatized Naming Tasks

ABSTRACT

Rapid automatized naming (RAN) tasks have been used to investigate underlying reading skills, understand reading impairment, and evaluate how to improve literacy instruction for typical and atypical readers. The two main areas of study have focused on the phonological and orthographic knowledge of children. In this review adult reading is investigated alongside the predictive qualities of the RAN task, expanding the focus of RAN tasks beyond the initial developmental stages of reading. The reviewed articles and information provide a strong argument that RAN tasks are predictive of adult reading ability, however further research is needed in order to provide additional detail about, and support for the relationship between RAN tasks and adult reading.

Communication today often consists of more than a face-to-face conversation or a phone call. Each person engaging in current literacy-based methods (e.g., texting or emailing) of communication is challenged to create, and express their messages through a written modality. Whether this be an email, a text message, a Facebook post, a comment on a Youtube video, or a message sent through different chat functions of many App games; people are communicating through written language at one point or another throughout each day. With this relatively recent increase of literacy-based communication, it is important to have well-developed and refined models of reading ability.

HYPOTHESIS

The aim of this review is to investigate the variability throughout the literature with regards to the RAN (rapid automatized naming)-reading relationship in adults. The intent is to clarify whether RAN tasks are able to predict and describe reading abilities when the tasks are administered to adults.

CURRENT MODEL OF READING

The majority of the theories developed to describe the acquired ability to read, and what is involved in the reading skill, converge on the idea that there must be at least two types of processing systems to account for word recognition (Coltheart et al., 2001; Forster & Chambers, 1978; Wile & Borowsky, 2004). These two systems involve differentiating between sounding out novel words and memorizing well known or exception words. The first processing system involves the phonological component, encompassing the ability to sound out a word from print. The ability to decode a written

word into sounds is often considered the first step when learning to read (Norton & Wolf, 2012). Phonological awareness and the alphabetic principle are aspects of the phonological component of reading; connecting sounds to symbols. This relational ability has been considered one of the largest challenges children face when learning to read (Liberman, 1971).

The second system involves the orthographic component, which is the ability to recognize a written word and know the meaning of the word. This is different from the phonological aspect in that the word is not broken up into separate sound components, but rather recognized as a whole unit of meaning. Reading fluency is related to orthographic skills and is the ability to accurately process the letter units and words with sufficient automaticity in order for comprehension of the material to take place (Norton & Wolf, 2012).

Phonological Evidence The phonological component of reading is supported by two occurrences in literacy research, the regularity effect, and the incidence of phonological dyslexia. The regularity effect is the decreased latency with which words are read when the pronunciation can correctly be produced from a set of grapheme-phoneme correspondence rules (McCann & Besner, 1987; Rastle & Coltheart, 1999b). Phonological dyslexia is a difficulty reading nonwords as the ability to sound out the word is impaired. A person with phonological dyslexia is able to memorize what a word looks like and know its meaning (e.g., an orthographic component), but reading new words or nonwords is difficult because it is effortful to sound out words (Castles, Bates, & Coltheart, 2006).

Orthographic Evidence The orthographic component of reading is supported by research on the frequency effect and surface dyslexia. The frequency effect is the finding that the response time decreases as the number of times a word is encountered in print increases (Forster & Chambers, 1973). Surface dyslexia presents oppositely of phonological dyslexia, in that readers are able to read nonwords within typical limits, but their ability to read words with an atypical spelling-to-sound correspondence (e.g., "yacht") is poor (Castles et al., 2006) (see Figure 1a).

The two aspects of reading summarized above are the foundations of the double deficit theory of reading, which was proposed by Wolf and Bowers (1999) as a conceptualization for the developmental dyslexias. The double deficit hypothesis is the idea that one route for reading and reading development is memorization of orthographic features, and the other route is involved with the ability to sound out words using phonological skills. People with dyslexia have presented with difficulties that researchers have categorized into difficulty with phonological skills (i.e., sounding out words for nonword reading), or orthographic knowledge (reading irregular words where phonological skills cannot support the correct production of the word). An additional category is warranted when both skills are difficult for the participant as evidenced by poor reading performances in both domains. The double-deficit hypothesis has been applied to typical and atypical readers (e.g., Coltheart et al. 2001) to describe literacy development and advanced literacy skills. Currently, it is a highly accepted model of reading and reading impairment.

The theoretical model describing two pathways for reading is supported throughout the research of both the phonological and orthographic systems (Powell, Stainthrop, Stuart, Garwood, & Quinlan, 2007; Furnes & Samuelsson, 2011). Many different approaches have been investigated while studying the contribution of phonological and orthographic skills to the basic reading process (Stage, Abbot, Jenkins, & Berninger, 2003). One particularly influential activity has been the rapid automatized naming (RAN) task.

RAPID AUTOMATIZED NAMING

RAN-reading Relationship Rapid automatized naming (RAN) is a cognitive task that consists of naming familiar items as quickly as possible, which are presented in serial or individual fashion. Researchers have investigated the use of specific letters (p, o, d, a, s), numbers (2, 6, 9, 4, 7), colours (red, green, black, blue, yellow), and picture objects originally described in the early work of Denckla and Rudel (1976) to probe the underlying functions and components of reading that RAN presumably accesses. The presentation of items in each task has varied, but the most common form of presentation has been the 5 items by 10 rows array developed by Denleka and Rudel (1974) (Logan, Schatschneider, & Wagner, 2011) (see Appendix 1). Other presentations involve an item string, individual presentation of each item, or different array designs. For example, the Comprehensive Test of Phonological Processing uses 4 rows of 9 items.

Notably, RAN is useful in both basic and applied settings as it can differentiate between adults/children with reading difficulties and adults/children without reading difficulties. Decker (1989) found that RAN distinguished between adult readers with

reading disabilities (such as dyslexia, poor comprehension, or slow reading fluency) and adult readers without reading deficits. Specifically, adults with reading disabilities were not able to correctly name as many letters within 20 seconds compared to typical reading adults. The RAN task is also effective in contrasting people who had a history of reading disorders and those who did not. Felton, Naylor and Wood (1990) explain that tasks involving rapid and sequential naming (e.g., RAN) and phonological skills were the most accurate in contrasting the individuals. The adults with reading disorders were significantly slower in naming colours, letters, objects and numbers in comparison to control adults without reading disorders. These RAN tasks accurately and clearly distinguished between the two populations of adults with greater significance than other tasks used to evaluate the performance of the readers. Creating a holistic differential quality, RAN also appears to distinguish between children and families with and without a history of dyslexia (Raschle, Chang, & Gaab, 2011). Specifically, children with a family history of dyslexia were significantly different on standardized behavioural assessments of RAN from children without a family history of dyslexia in that they took longer to complete RAN tasks.

One of the major findings resulting from the literature on reading ability and disability is that phonological awareness (PA) skills are directly related to reading ability. Phonological awareness (PA) is the ability to identify and create individual sounds within a word. Phonological awareness skills are important in the reading literature because they are the skills explicitly taught in reading development, as well as the skills accessed and assessed in regular word (e.g., “hint”), nonword (e.g., “bint”), and

pseudohomophone (e.g., “pynt”) reading tasks. PA has been correlated with reading ability and reading level prediction in children (Ekins & Schneider, 2006). It is continually investigated alongside RAN to sort out the interaction and individual contributions of each skill to literacy and reading assessment (Powell et al., 2007; Bowers & Newby-Clark, 2002). While researchers once hypothesized that the RAN-reading relationship was a by-product of the PA-reading links, current research shows that RAN tends to contribute independently to different reading skills (de Jong, 2011), specifically reading fluency (Moll, Fussenegger, & Willburger, 2009), which involves the rate at which the individual participates in the reading task.

RAN-reading Relationship Over Time Part of the investigation of RAN and PA abilities discerning people with reading difficulties and people without reading difficulties has involved exploring the development of RAN and PA skills as reading competence improves. In one study focusing on RAN, Korhonen (1995) explored the development of RAN skills by asessing grade three children, then reassessing those children nine years later. It was reported that children diagnosed with reading disabilites in grade three continued to show difficulties on the RAN tasks in grade nine. This finding supports the relationship between RAN and reading skills, as well as the notion that children with reading difficulties will continue to express the difficulties as adults. Scarborough (1998) reported similar results when investigating children in second grade, and then again in eighth grade. However, she noted that the RAN relation to future reading skills was still unclear, stating that RAN provides the most, but not enough, predictive qualitites to rely on RAN as a sole predictor for future achievement in reading.

The specific changes in performance on RAN tasks over time were evaluated by van den Bos, Zijlstra, and Spelberg, (2002). They report results that support the prediction of Korhnen (1995), and the results of Scarborough (1998). They state that naming speed and reading score correlations identify a continual positive relationship between reading and alphanumeric RAN tasks (van den Bos et al. 2002).

Supporting the findings of van den Bos et al. (2002) that RAN deficits remain correlated with reading ability is the work of Vukovic, Wilson, and Nash (2004) with university student participants who demonstrated reading disabilites. They found that persistent RAN difficulties characterized the population, and therefore, concluded that adults with reading disorders will have lasting deficits in RAN skills. Arnell et al. (2009) also report a clear relationship between RAN and reading rate, and RAN and reading comprehension in college aged typical adult readers. Their relationship described a negative correlation between RAN and reading rate, and RAN and reading comprehension. When total RAN naming times are longer, there were lower reading comprehension scores and reading rates.

Variations on RAN Stimuli and Presentation Arnell et al. (2009) investigated an additional aspect of RAN using not just numbers and letters, but also colours and objects. They note that RAN of colours and objects predicted reading rate and reading comprehension as well as, or better than, letter and number RAN tasks in adult participants. They subsequently proposed that colours and objects are less automatized in adults, and therefore, allow identification of unique variability between subjects. This would indicate that the speeded naming of a category of vocabulary items is related to,

and predictive of reading skills. However, van den Bos et al. (2002) reported an opposite finding: naming speed for colours and objects decreased through adolescence and adulthood. They concluded that experience and interaction with alphanumeric characters in reading and arithmatic contributes to RAN tasks. These two contradicting studies indicate that subsequent research is needed within the focused area of the relationship between object and colour naming in adults.

A slightly different approach to the investigation of RAN and adult reading was taken by Howe et al. (2006), where the reliability of computerized RAN tasks was compared to the conventional paper-pencil format. They report that both the conventional and computerized RAN tasks predicted reading comprehension and reading rate in university students. In addition, they confirmed that both forms have equal predictive power. This was important information for the literacy research and literature as many of the investigative methods use computerized tasks, yet still refer to previous literature involved in paper and pencil methods for explanations and support. Confirmation that the two methods are equivalent allows conclusions and predictions to continue from both the historical and current literature.

An additional area of focused research within the RAN task is the interaction between phonological skills, RAN, and single word reading. Wile and Borowsky (2004) envisioned a task to access the PA skills within the RAN task context. The purpose of this research was to identify the individual and component processes of RAN and PA in the adult population, as well as, add to the available options for different types of RAN tasks. Their task combined PA and RAN by asking participants to produce the sound the

letter makes, as fast and as accurately as possible. In addition, pseudohomophone word reading was included in the group of experiments. This task was included because Wile and Borowsky (2004) predicted that the pseudohomophone reading would be related to the letter sound production RAN task. Their results also supported the relationship between adult reading and RAN tasks. The individual contribution specified that RAN of letter names had a stronger relationship with irregular word reading (e.g., orthographic component), and RAN of letter sounds correlated with the ability to produce pseudohomophones (e.g., phonological component) (see Figure 1b).

Finally, recent work by Miller, et al. (2006) pointed out a short coming in the majority of the adult RAN literature pertaining to the participant selection. They noted that the participants were university and college students, and that this population of people with reading difficulties also have high intellectual abilities, and may not be varied enough to generalize results to the broad adult population. The adult participants in their study were parents of children who were referred for reading difficulties. The majority of these adults reported not having reading issues throughout their childhood, therefore allowing a more varied population to investigate. The results of the Miller et al. (2006) study are consistent with previous research in that participants with better PA and faster RAN displayed superior reading skills. Deficits in both PA and RAN were associated with lower and more impaired reading skils than when only one deficit was displayed supporting the dual route hypothesis. Statistically, both components were also found to be an independent, robust predictor of reading achievement. Additional

studies have indicated that each aspect continues to be a siginificant component of reading achievement into adulthood (Bowers & Swanson 1991).

CONCLUSION

Numerous studies, such as the ones described, create a convincing picture that RAN and PA are related to, and can predict reading ability. However, in a meta-analysis by Swanson, Trainin, Necoechea, and Hammill (2003) it was found that as reading skills improve RAN and PA do not increase uniformly, and that the overall correlation of RAN and PA to reading is low to moderate. Specfically, they reported that RAN has a low correlation with orthographic processing, and that age does not appear to play a significant role in moderating correlations between RAN and PA. Overall, the contradicting data suggests that the relationship between RAN tasks and reading skills is still unclear. The majority of the research indicates that there likely is a positive relationship between RAN and reading, but the specifics of relationship are still unclear. Additional research and replication of studies is likely to contribute to the clarification of the RAN and reading relationship in adults.

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Figure 1a. Phonological and Orthographic Description of Dyselxia

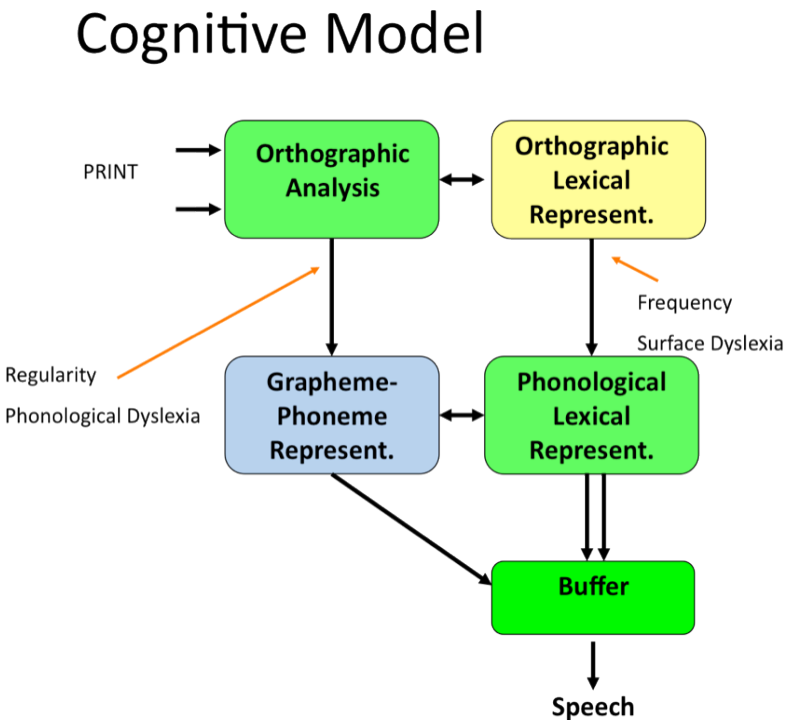
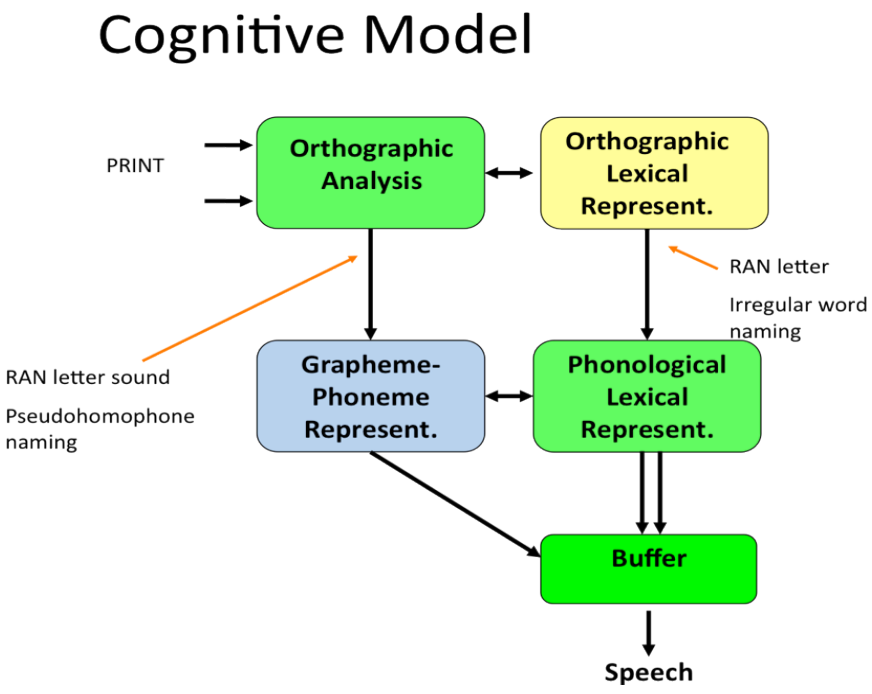


Figure 1b. Phonological and Orthographic Input for Rapid Automatized Reading



Appendix 1. Rapid Automatized Naming Displays

RAN 5 x 10 Array Presentation

A	P	D	O	S
P	D	A	S	D
O	P	S	A	S
S	O	D	A	P
P	A	P	D	O
D	S	P	D	O
A	S	P	D	A
O	D	P	S	P
P	A	O	S	P
D	O	S	A	P

RAN Item String Presentation

P	D	P	A	O

RAN Individual Presentation

S