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What educators need to know about Rapid Automatized Naming (RAN)

In this article, **Elizabeth Norton** defines the intriguing Rapid Automatized Naming (RAN) task, explains why it is related to reading, and argues that RAN can be a very useful component of literacy assessment.

Abstract

Rapid automatized naming (RAN) tasks require children to name an array of familiar items as quickly as possible, thus revealing the automaticity of many of the same cognitive and linguistic skills central to reading. RAN ability robustly correlates with reading ability, across different grade levels, reading measures, and languages. Despite all that is known about RAN, many teachers and practitioners are unsure about how or why to employ RAN tasks as part of literacy screening and assessment. Here, the RAN task is explained in terms of what it is and why it relates to reading. Next, the research on the RAN-reading relationship is reviewed. Finally, best practices for implementing RAN in literacy screening and assessment are presented.

What is RAN?

The rapid automatized naming (RAN) task may be one of the simplest assessments that a child can perform. A RAN task consists of an array of familiar items (such as objects, colors, letters, or numbers) each repeated several times, which the child is asked to name as quickly as possible. However, the simplicity of the RAN task is elegant in light of its strong association with reading and its predictive power to presage reading ability years into the future (Norton & Wolf, 2012).

There are three key aspects to a RAN task that differentiate it from other tasks and help explain its relationship with reading. Each is important for understanding RAN and its role in reading assessment. First, the items to be named are presented in an **array** (i.e., a grid) and the child names the items across each row from left to right. Most tasks have 8-10 items per row and 4-5 rows, for somewhere around 40-50 total items. This mirrors the process of reading connected text, as it requires similar sustained attention, eye movements, monitoring, and cognitive processing. Tasks that require naming single items quickly (also called discrete trial naming) are not nearly as strongly related to reading ability as RAN is (Logan et al., 2011), likely because the demand of consistent, sustained processing is absent. Researchers who have used slightly different arrangements of the grid or different numbers of items generally find similar results (Compton et al., 2002).

The second key facet of the RAN task is that the child names **familiar items**. Often for young children these are colors or familiar objects. For children who know their letter names and numbers with automaticity, those alphanumeric stimuli can be used, and they show a stronger relation with reading (e.g., Araújo et al., 2015). The stronger relation for alphanumeric than non-alphanumeric stimuli may be because the alphanumeric stimuli are more closely related to reading and are a smaller, closed set (that is, there is a limited set of items and no new items can be created within that set via small variations, as could be the case with colors or objects). The small set, typically 5-6 different items, is likely to be based on the history of RAN tasks, which were developed to be used for adults with aphasia who had lost some ability to name familiar items (see Cutting & Denckla, 1999). Note that a variant task called the rapid alternating stimulus (RAS) task includes multiple item types such as colors and letters in one array. Because traditional RAN is used more broadly, that is the focus here.

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The third feature that defines a RAN task is that the items are named as quickly as possible and that the **naming time** is used as the indicator of ability. Most standardized RAN measures take

the total time to name the array. Some research measures calculate the time per item, items per second, or time to name a certain number of items (e.g., Compton et al., 2002); however, these generally show similar patterns in their relationship with reading. Qualitative analyses can examine the types of errors children make (for example, are the errors self-corrected? Are they substitutions of similar visual or phonological forms?), but because the stimuli should be highly familiar and able to be named automatically, there are typically few errors. Errors also typically contribute to the total time it takes a child to name the array and thus can be considered to factor into the total time.

Because RAN ability depends on a large number of perceptual and cognitive factors, one can think of RAN as the "check engine light" that indicates a problem, but doesn't reveal the exact cause.

Overall, RAN is an important indicator because it shares many processes with reading. Wolf and Bowers (2000) proposed a model of the RAN-reading relationship that highlights how RAN shares attention, visual recognition, integration, and access processes with reading. One way to think of RAN is as a microcosm of reading because of their many shared processes (Norton & Wolf, 2012). Importantly, RAN is not just a subcomponent of phonological awareness (PA), as RAN improves prediction of reading ability beyond PA measures alone (e.g., Kirby et al., 2010).

What does the research on RAN and reading show?

RAN as a correlate of reading ability

Hundreds of studies with readers of many different abilities, ages, and languages have found significant relations between faster RAN and stronger reading ability. Meta-analyses (that is, studies that examine and aggregate the results of other studies) have been conducted about the relation between RAN and reading across languages; these provide the best big-picture view of how RAN relates concurrently to reading because they analyze very large numbers of children and allow a more consensus view across studies. Two large meta-analyses found that the correlation between RAN and single word reading was r=0.41 (Swanson et al., 2003, with 2,991 individuals included across studies) and 0.45 (Araújo et al., 2015, n=26,491). (Note that these correlations are absolute values; in all cases, better RAN is associated with better reading.) The correlation with text (sentence or paragraph) reading was also 0.45 (Araújo et al., n=2,798). The relation with reading comprehension ranged from 0.45 (Swanson et al., n=1,550) to 0.39 (Araújo et al., n=4,965). Restricting analyses to just orthographically opaque languages like English, Araújo and colleagues found that the association of RAN with reading accuracy was 0.44 (n=8,913) and with reading fluency was 0.55 (n=6,565). Together, these results show that RAN is robustly related to reading, and in English, the strongest relations tend to be with speeded or fluency measures.

RAN as a predictor of reading ability

In terms of RAN serving as a predictor of future reading ability, one meta-analysis examined early predictors focused on reading comprehension (Hjetland et al., 2017). This analysis included 3,746 individuals who completed RAN assessment at around age 5 and then a reading comprehension assessment later, at around age 8. The correlation was found to be r=0.34. Similarly, of those studies included that also looked at word identification (n=3,285), the correlation with earlier RAN scores was 0.37. Importantly there was one outlier included in these analyses that was listed as having the opposite RAN-reading relation, so these are likely to under-estimate the strength of the RAN-reading relation. Our group is currently conducting a comprehensive meta-analysis of how early RAN measures in preschool or kindergarten relate to later reading, measured around the end of grade 2 (McWeeny et al., in prep). Our analyses reveal that the overall correlation between early RAN and later reading in English is 0.38, and that RAN relates similarly to timed vs. untimed measures, as well as similarly to single word reading and comprehension measures at this young age. These longitudinal data show that RAN is not only a correlate, but a powerful predictor of reading ability.

RAN as a deficit in dyslexia

Given the strong association between RAN and reading, it makes sense that a child with poor RAN could have dyslexia (an unexpected difficulty with reading that is biologically based and not caused by primary sensory or perceptual problems, nor lack of effort or opportunity to learn to read; Peterson, & Pennington, 2012). In 1999, Wolf and Bowers introduced the double-deficit hypothesis (DDH), suggesting that dyslexia could be caused by deficits in phonological awareness and/or RAN, and that children with both (double) deficit would be the most severely affected. At that time, the field was dominated by the core phonological deficit view of dyslexia. Over the past two decades, dozens – if not hundreds – of studies have found that RAN deficits are common in children with dyslexia and can exist on their own or in tandem with other deficits like PA. Thus, the view in the field has begun to shift toward a multi-componential understanding of reading ability and dyslexia, recognizing that a weakness in RAN can cause poor reading, but that RAN, phonological, and other deficits can co-occur and that profiles of children with dyslexia are highly heterogeneous (Norton & Wolf, 2012).

The brain basis of RAN

Many of the patterns about RAN and reading observed in behavior are bolstered by the findings of neuroimaging research. When adults complete RAN tasks and reading tasks during fMRI scanning, their brains show highly similar patterns of activation, involving a host of regions that support visual, semantic, motor, articulatory, and sound-symbol correspondence processing (Cummine et al., 2015). In turn, research on deficits in dyslexia shows that RAN and PA are distinct; children with PA and RAN deficits showed different patterns of brain activation during a reading and rhyming task with fMRI (Norton et al., 2014). Thus, these brain data further our understanding of the fact that RAN and reading relate because of shared processing demands, and that RAN deficits are a unique and important biological cause of poor reading.

Best practices for using RAN in screening and assessment

Why and when should I assess RAN?

Consider RAN as an aspect of reading screening as well as assessment. Because RAN is such a strong predictor of later reading, it is a key component of an early literacy screening battery and a diagnostic reading assessment. We know that children's RAN gets faster with age, but that children tend to be relatively stable in their RAN ability compared to peers (e.g., Ozernov-Palchik et al., 2017). This means that a valid assessment of RAN in kindergarten is a good indicator of later RAN ability, and thus later reading. Screening is crucial for early identification of children at risk for dyslexia, as intervention is more effective earlier (Lovett et al., 2017). For evidence-based recommendations on screening, see Petscher et al. (2019).

For children who are already identified with dyslexia or are in the process of being assessed, RAN can provide insight into the nature of their difficulties. An interdisciplinary approach that bring together the child's teacher with speech-language pathologists, school psychologists, neuropsychologists and other relevant experts is ideal for gaining the clearest picture of the child's profile of strengths and areas for development (Berninger, 2001).

How should I assess RAN?

Many standardized test batteries include RAN tasks. Using a standardized and normed assessment is the easiest way to understand where a child's RAN ability falls compared to their peers of the same age or grade. It is possible to create a "homemade" RAN grid and use this, but without other children to compare performance against, the data are harder to interpret.

It is also crucial to get a valid administration of the RAN task. As for any assessment, this means making sure that the child is able to give their best performance. It is crucial to follow the directions for any standardized assessment and to ensure that the child is familiar with the items in the RAN task and can name them accurately. Thus, for kindergarten children who do not know their letters and or numbers automatically, using objects or colors is a better option. Once children know their letters, alphanumeric RAN is a stronger predictor (Araújo et al., 2015).

What RAN score indicates a problem?

A major challenge of all research on reading screening is determining which children are at risk (and thus need further assessment, monitoring, and/or intervention) and which children are on track. Despite extensive research, there is no single test or single cutoff score that indicates that RAN is a problem. This is in part because RAN ability is a continuum, not a cliff; a child who scores in the 9th percentile is not all that different from a child who scores in the 10th percentile. However, if a cutoff of below the 10th percentile is chosen, one child would be identified while the other would not. Thus, RAN should be considered as a continuum and a piece of the puzzle with other assessments of language, reading, and cognition.

What does a low RAN score mean?

Because RAN ability depends on a large number of perceptual and cognitive factors, one can think of RAN as the "check engine light" that indicates a problem, but doesn't reveal the exact cause. Even still, knowing the exact cause doesn't mean that there is an easy fix, as detailed in the next section. However, it is important to keep in mind that because of the overlap in processes with RAN and efficient or fluent reading, a low RAN score in a child could indicate that they may have particular weaknesses in fluency.

If a child is identified with low RAN at screening, they may be monitored more closely, especially for difficulties with reading fluency.

What should we do for children with weak RAN?

A question I am often asked is "How can we improve that child's RAN score?" The answer is frustrating to hear, I'm afraid – we know of no way to simply bolster a child's RAN ability. Though some studies have tried to improve RAN via practice with naming (see Kirby et al., 2010 for review), the results do not show that training RAN leads to better outcomes than providing equal hours of reading intervention. It seems that RAN ability is a relatively intrinsic or set characteristic of an individual. Similarly, training processing speed and other executive function skills may lead to better performance on the training task, but rarely leads to meaningful, generalizable improvements (e.g., Melby-Lervåg & Hulme, 2013).

If a child is identified with low RAN at screening, they may be monitored more closely, especially for difficulties with reading fluency. Given the lack of evidence-based practices that currently exist that are specific to children with RAN difficulties, one course of action is to work on building accuracy and then automaticity in all the other areas of language and literacy. We know that good readers not only use certain areas of their brains when reading, but that skilled reading depends on robust structural connections that allow

Figure 1: Dr Norton administers a literacy screener, including RAN. Photo: Justin Barbin

fast association of orthography with phonology and other levels of language (Norton et al., 2015). Thus, instruction and practice using evidence-based curricula is crucial.

In summary, RAN is a powerful tool for identifying children at risk for reading problems and understanding the causes of reading difficulties and dyslexia.

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