The Contribution of Rapid Automatized Naming Skills and Phonological Awareness to Arabic Language Reading Fluency: A Path Analysis

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ABSTRACT

Purpose. The aim of this study was to investigate the contribution of rapid automatized naming skills (RAN) and phonological awareness (PA) to Arabic language reading fluency (RF).

Methods. A quantitative, cross-sectional and descriptive method was employed, with the main focus on the contribution of rapid automatized naming skills and phonological awareness to Arabic language reading fluency. A cross-sectional study was performed...
The Contribution of Rapid Automatized Naming Skills...

for all children in six prim art schools located in Makka. A convenience sampling method was used to recruit children. For children to be included in this study, there were some criteria: (a) to have no academic or developmental disabilities; (b) Both gender (males and females). Questionnaires were distributed to the children with the help of classroom teachers. All questions must be answered and responded to. A total of 360 participants aged 6–10 years took part in this study: 280 males (77.7%, age mean = 8.9, SD = 3.27), and 80 females (22.3%, age mean = 9.2, SD = 2.44).

Results. The first main finding of the current research is that the correlations between RAN, PA and reading fluency were significant. In the final model, PA was directly and positively predictive of RAN ($\beta = 0.664, p = 0.000$) and RAN was directly and strongly related to RF ($\beta = 0.623, p = 0.000$). PA explained 52.3% of variance of RF. RAN explained 51.8% of variance of RF. PA and RAN together explained 69.9% of variance of RF.

Conclusions. The findings of this study add to our knowledge of the contribution of PA and RAN to RF, as well as the complex intralingual relationship between PA and RAN.

Key words: rapid automatized naming skills, phonological awareness, Arabic language reading fluency, path analysis.

Introduction

Language appears in different forms such as speaking, listening, reading and writing, and listening is the most visible form of language, then conversation, after that, experiences accumulate to reach the written language (Altay, 2013). In this aspect, language is a basic foundation for the development of various other skills acquired by the individual in the various stages of his development, and all language skills are intertwined, and any skill acquired by the individual helps him/her to acquire other skills (Uysal & Habip, 2013).

Reading is regarded as a complex process that is likely to require the automatic integration of multiple cognitive and linguistic abilities (Abdul Kader & Eissa, 2016; Elhoweris, 2017; Esam, 2015; Fathalla, 2014). There are ample studies on the processes underlying reading acquisition (Eissa, 2013, 2014, 2017). Reading acquisition is strongly related to phonological awareness (PA), letter-sound knowledge, and reading fluency (Abdul, 2014).

Reading-related skills such as rapid automatized naming (RAN) and phonological awareness can be potential predictors or later reading ability and reading fluency (Al Sawi, 2013).

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**Phonological Awareness and Reading Fluency**

Phonological awareness is one of the linguistic levels most closely related to reading and writing skills (Eissa, 2017). Phonological awareness has been defined as the ability to recognize, discriminate, and manipulate speech sounds of spoken words. It is best understood as a complex construct composed of separate subskills (Eissa, 2013, 2014, 2017).

Phonemic dyslexia reflects a defect in the process of forming the alphabetic strategy for reading and writing, which impedes the emergence or development of an effective assembly process, and this defect, in turn, is reflected in the subsequent growth of recognition of written words and speed of naming them (Al Sawi, 2013).

Thus his/her language fluency is affected, and this is what was indicated by (Ramus et al., 2003), where they explained the three main factors responsible for learning to read, and then it became a basis for explaining dyslexia, which is the ability to name stimuli, and the ability to remember through the audio coding of stimuli Simple or complex visual as a reading text, for example, and the ability to employ phonemic awareness (the vocal ability represented in the ability to sense the components of the oral language and mentally analyze them according to different levels (Ramus et al., 2003).

According to the orthographical specifications of different languages, the correlation of phonemic operations with reading abilities may vary based on the nature of the relationship in terms of complexity or clarity between the letter and its sound. Dealing with different levels of phonemic awareness in languages with a complex orthographic character in which it is difficult to link the letter and its sound such as English is inevitable, as awareness of sounds is one of the strongest indicators of the accuracy and speed of reading in the English language, while its predictive ability is less Gradually in other languages with an easy spelling character such as German, Spanish, Greek or Finnish (Holopainen, Ahonen & Lyytinen, 2001; Seymour, Aro & Erskine, 2003; Wimmer, Mayringer & Landerl, 2000).

**Rapid Automatic Naming and Reading Fluency**

Rapid Automatic Naming emerges as an important predictor of reading in these easy-to-orthographic languages (Michalick-Triginelli & Cardoso-Martins, 2015). RAN consists of tasks that require naming
familiar items (objects, colors, letters, or digits). They visually presented as fast as possible (da Silva et al., 2020).

These simple tasks tap different cognitive skills including speed of processing, visual and integration skills, executive function, as well as access to phonological representations (Alves et al., 2016).

RAN correlates with reading accuracy and early reading fluency (Araújo et al., 2015). Araújo et al. (2015) in their study, found that RAN has been found to be a stronger correlate of reading in school-aged children who had started formal literacy instruction.

A large-scale longitudinal study including different European orthographies showed that both RAN and phonological awareness were reliable predictors of reading skills, with equal relative importance (Caravolas et al., 2012). Intervention studies have found that training RAN can have a positive effect on word-level reading skills (Stappen & Reybroeck, 2018).

Although RAN and PA have been extensively studied in children learning to read in English (da Silva et al., 2020), to my knowledge almost there is not on study has focused on Arabic language. To that end, there are three research questions posed to address the research gap.

RQ 1. Are there correlation between RAN, PA and reading fluency?

RQ 2. How do RAN and PA contribute to reading fluency?

RQ 3. What are the relative contributions of RAN and PA to reading fluency?

Based on the literature review, phonological awareness and rapid automatic naming might affect reading fluency. phonological awareness might mediate the relationship between rapid automatic naming and reading fluency.

**Methods**

A quantitative, cross-sectional and descriptive method was employed, with the main focus on the contribution of rapid automatized naming skills and phonological awareness to Arabic language reading fluency. The study was conducted in November, 2021.

**Participants**

A cross-sectional study was performed for all children in six primart schools located in Makka. A convenience sampling method was
used to recruit children. For children to be included in this study, there were some criteria:

(a) to have no academic or developmental disabilities;
(b) Both gender (males and females).

Questionnaires were distributed to the children with the help of classroom teachers. All questions must be answered and responded to. A total of 360 participants aged 6–10 years took part in this study: 280 males (77.7%, age mean = 8.9, SD = 3.27), and 80 females (22.3%, age mean = 9.2, SD = 2.44).

**Measures**

*RAN Scale.* This scale was developed particularly for this research study to measure numbers, letters, colors, and objects based on Denckla and Rudel’s scale (1974). Of the four tests of RAN consists of a chart containing 3 different items. The items used in RAN digit were 6, 7, 8, 9, 10 which are pronounced in Arabic (ستة، سبعة، ثمانية، تسع، عشرة). The items used in RAN letter were /s/, /n/, /g/ /f/, /o/ which are pronounced in Arabic (سين، نون، جيم، فاء، واو). The items used in RAN color were blue, red, yellow, brown, black which are pronounced in Arabic (أزرق، احمر، أصفر، بني، أسود). The items used in RAN object were the pictures of “bus”, “plane”, “lion”, “house”, “school”.

The internal consistency of the survey was measured through Cronbach’s alpha estimated at 0.84, 0.86, 0.85, 0.83 for RAN digit, RAN letter, RAN color, and RAN object respectively. A group of 6 experts examined the content validity. They indicated whether questions were, irrelevant, or highly relevant. All items were highly relevant. A content validity index at the item level (I-CVI) = 0.90.

**Phonological Awareness Test.** This test was developed particularly for this research study. Four aspects of phonological processing (Stampoltzis, Plakida & Peristeri, 2020): sentence awareness, syllabic awareness (analysis and synthesis), phonemic awareness (analysis and synthesis) and rhyme awareness (recognition and production) were developed. Correct answers were scored with 1 while wrong answers with 0. A total PA score was calculated per child by adding the subscores.

The internal consistency of the survey was measured through Cronbach’s alpha estimated at 0.87, 0.88, 0.84, 0.81 for sentence
awareness, syllabic awareness (analysis and synthesis), phonemic awareness (analysis and synthesis) and rhyme awareness (recognition and production) respectively. A group of 6 experts examined the content validity. They indicated whether questions were, irrelevant, or highly relevant. All items were highly relevant. A content validity index at the item level (I-CVI) = 0.90.

**The Arabic Test of Reading Fluency.** This test was developed particularly for this research study. It consists of one text which is based on “My Language” Arabic book. The text is accompanied by 10 questions that are used to assess reading comprehension. The child was asked to read aloud the text and his/her reading was tape-recorded so that his/her errors could be analysed through miscue analysis. The total reading time the child needed to read the text from the first to the last word was recorded. The child’s oral answers to the ten comprehension questions were also evaluated and counted. A composite score of reading fluency based on the child’s reading accuracy, speed and reading comprehension was calculated. The internal consistency of the test was measured through Cronbach’s alpha estimated at 0.87. A group of 6 experts examined the content validity. They indicated whether questions were, irrelevant, or highly relevant. All items were highly relevant. A content validity index at the item level (I-CVI) = 0.90.

**Procedure**

Scales were piloted twice. For the pilot study one, four teachers of Arabic were asked to check whether the test instructions were clear. The second pilot study were for checking how long it took each child to answer the scale items and for checking psychometric properties. All the tests were of paper-and-pencil type. After obtaining written consents from parents and the school principals, children were asked to answer the scale items.

**Data screening and Data Analysis**

The data was analyzed using path analysis and hierarchical regression analyses. Two theoretical models were hypothesized and tested. In Model 1, PA was hypothesized to be predictive of RAN and RAN was hypothesized to contribute to reading fluency. PA was also hypothesized to predict reading fluency directly.

In Model 2, with other paths being the same, PA, instead of predicting reading fluency directly, contributes to reading fluency...
indirectly through the mediation of RAN. Model 1 is a partial mediation model while Model 2 is a complete mediation model (see Figs. 1 and 2).

**Figure 1**
The Hypothesized Partial Mediation Model (Model 1)

![Diagram of Partial Mediation Model](image1)

**Figure 2**
The Hypothesized Complete Mediation Model (Model 2)

![Diagram of Complete Mediation Model](image2)

Model fits were evaluated using multiple indices: chi-square statistics, comparative fit index (CFI), the Tucker-Lewis index (TLI), root mean square error of approximation (RMSEA) and standard root mean square residuals (SRMR). Hierarchical regression analysis was adopted to examine the relative contribution of PA to RAN and reading fluency.

**Results**

*Descriptive Statistics and Correlations*

Table 1 shows the descriptive statistics of the three scales and Table 2 shows the bivariable correlations between the three scales.
All correlations were positive and significant. The correlations between RAN, PA and reading fluency were significant.

Table 1
Descriptive Statistics

<table>
<thead>
<tr>
<th>Variable</th>
<th>M</th>
<th>SD</th>
<th>Min–Max</th>
<th>Skew</th>
<th>Kurtosis</th>
</tr>
</thead>
<tbody>
<tr>
<td>RAN</td>
<td>14.61</td>
<td>2.13</td>
<td>2–15</td>
<td>−0.25</td>
<td>−0.73</td>
</tr>
<tr>
<td>PA</td>
<td>63.27</td>
<td>2.41</td>
<td>28–64</td>
<td>−0.28</td>
<td>−0.79</td>
</tr>
<tr>
<td>Reading fluency</td>
<td>3.00</td>
<td>2–7</td>
<td>−0.30</td>
<td>−0.68</td>
<td></td>
</tr>
</tbody>
</table>

Table 2
Correlation Among the Three Scales

<table>
<thead>
<tr>
<th>Variable</th>
<th>1</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. RAN</td>
<td></td>
<td>.558**</td>
<td>.712**</td>
</tr>
<tr>
<td>2. PA</td>
<td>.558**</td>
<td></td>
<td>.623**</td>
</tr>
<tr>
<td>3. Reading fluency</td>
<td>.712**</td>
<td>.623**</td>
<td></td>
</tr>
</tbody>
</table>

Path Analysis
Both Model 1 and Model 2 had a satisfactory fitness for the sample data. The model fit statistics for Model 1 (PMM) are $X^2 = 0.885$ ($df = 1$, $N = 360$), $p = 0.27$, CFI = 0.98, TLI = 0.971, RMSEA = 0.05 (90% CI = 0.00-0.29), SRMR = 0.01. The model fit indices for Model 2 (CMM) are $X^2 = 2.317$ ($df = 2$, $N = 360$), $p = 0.31$, CFI = 0.98, TLI = 0.971, RMSEA = 0.031 (90% CI = 0.00 -0.16), SRMR = 0.02. Chi-square difference tests indicated that the partial mediated model (Model 1) and the complete mediation model (Model 2) were not statistically different ($\Delta X^2 = 0.987$ (1), $p = 0.421$). Therefore, CMM 2 was chosen to be the final model. Standardized path coefficients for the final model are shown in Fig. 3. In the final model, PA was directly and positively predictive of RAN ($\beta = 0.664$, $p = 0.000$) and RAN was directly and strongly related to RF ($\beta = 0.623$, $p = 0.000$).

Regression Analyses
Regression analysis were conducted to test the relative contributions of PA to RAN and RF. The findings show that PA explained 52.3% of variance of RF. RAN explained 51.8% of variance of RF. PA and RAN together explained 69.9% of variance of RF.
The aim of this study was to investigate the contribution of rapid automatized naming skills and phonological awareness to Arabic language reading fluency. In the line with research with children learning to read in English, this study showed the contribution of rapid automatized naming skills and phonological awareness to Arabic language reading fluency.

The first main finding of the current research is that the correlations between RAN, PA and reading fluency were significant. In the final model, PA was directly and positively predictive of RAN ($\beta = 0.664, p = 0.000$) and RAN was directly and strongly related to RF ($\beta = 0.623, p = 0.000$). PA explained 52.3% of variance of RF.
RAN explained 51.8% of variance of RF. PA and RAN together explained 69.9% of variance of RF.

Although there is still no consensus regarding the underlying processes of RAN, how they contribute to the development of reading, or whether intervention approaches targeting RAN might lead to improvements in reading (Clayton et al., 2020), in our study rapid automatized contributed well to reading fluency. PA and RAN also turned out to be constructs that were stable over time (Landerl et al., 2019).

We come to the role played by the processing of phonemic operations in Semitic languages such as Arabic and Hebrew, which are languages with a transparent and very clear orthographic system, meaning that the relationship between the shape of the word and its sound is clear and stable, and this feature would contribute to a rapid development and a high ability to read words on one hand, and in great effectiveness on the other hand, the strategy of phonemic structure in reading (Saiegh-Haddad & Geva, 2008).

As for the Arabic text, it has an additional difference, as the clarity varies depending on the readable text. The problematic texts, which usually share characteristics that help distinguish the sound of written symbols for the novice reader, are often lost from more advanced texts that children may encounter in the future. After the third grade of primary school, the spelling systems move from being superficial to being deep and vague (Abu-Rabia & Abu-Rahmoun, 2012; Abu-Rabia & Sammour, 2013; Layes et al., 2015), in addition to the effect of the dual-dialect phenomenon, in which some sounds in the spoken local dialect differ from the written Standard Arabic (Share, 2008).

Thinking about these transformations and phenomena that affect both Arabic and Hebrew, studies that demonstrate the relationship of phonemic awareness accurately know the word in Hebrew is present and significant, but is generally considered less than what has been observed in English (Geva & Siegel, 2000).

While studies on the Arabic language, such as the study of al-Mannai and Everatt (2005), found that phonological awareness is the only factor that explains the discrepancy in the accuracy of reading words in the formed Arabic language.

In the study of Abu-Rabia, Share and Mansour (2003) on fifth-grade students with reading difficulties who spoke Arabic, it was found that the deficiency in phonemic awareness was associated with
the deficiency in decoding skill (spelling), and in the study of Taibah and Haynes (2010) for the importance of Phonological awareness skills (Phonological awareness, rapid naming, and phonemic memory) and their contributions to reading skills (word reading, text reading speed, and speed reading false words) among a sample of Saudi students from kindergarten and first three grades. The results showed that the most significant association was between phonemic awareness and reading skills, and to a lesser extent was rapid naming.

**Conclusion**

The present study investigated the contribution of rapid automatized naming skills and phonological awareness to Arabic language reading fluency. Pedagogically, the significant effects of both of PA and RAN on RF highlighted a need of focused instruction on Arabic PA. Previous research has shown the effects of direct teaching of PA on reading (Abdul, 2014; Abu-Rabia & Abu-Rahmoun, 2012; al Mannai & Everatt, 2005; Araújo et al., 2015). The findings of this study add to our knowledge of the contribution of PA and RAN to RF, as well as the complex intralingual relationship between PA and RAN.

**Acknowledgements**
The author wishes to thank the children for their participation.

**ADHERENCE TO ETHICAL STANDARDS**

**Ethics Declarations.** All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards.

**Data availability statement.** All the necessary materials pertaining to this research paper can be found Mendeley Data (Alshahrani, 2022), https://doi.org/10.17632/gnk9j83v5m.1

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**Author contribution statement.** The author is the only person that contributed to all parts of this paper.

**Consent for publication.** The authors approve of this submission and, conditional upon the decision made by the editorial board from the peer-review
process, consent to the publication of the current work. The work has not been submitted to other journals in consideration for publication.

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**АНОТАЦІЯ**

**Мета.** Метою цього дослідження було дослідити внесок навичок швидкого автоматизованого називання (RAN) та фонологічної обізнаності (PA) у вільне читання арабською мовою (RF).

**Методи.** У дослідженні були використані кількісний, перехресний та описовий методи, з основним акцентом на внесок навичок швидкого автоматизованого називання та фонологічної обізнаності у вільне читання арабською мовою.
Перехресне дослідження було проведено для всіх дітей у шести початкових школах мистецтв, розташованих у місті Макка. Для відбору дітей використовувався метод випадкової вибірки. Для включення дітей у це дослідження існували певні критерії: (а) не мати академічних порушень або порушень розвитку; (б) бути обох статей (хлопці й дівчата). Дітям були запропоновані анкети. Необхідно було дати відповідь на всі запитання. Загалом у дослідженні взяли участь 360 учасників віком 6–10 років: 280 хлопців (77.7%, середній вік = 8;9, SD = 3,27) та 80 дівчат (22.3%, середній вік = 9;2, SD = 2,44).

Результати. Перший основний висновок цього дослідження полягає в тому, що кореляції між RAN, PA й швидкістю читання були значними. В остаточній моделі PA прямо й позитивно прогнозовано RAN (β = 0.664, p = 0.000), а RAN був прямо й сильно пов’язаний з RF (β = 0.623, p = 0.000). PA пояснював 52.3% дисперсії RF. RAN пояснює 51.8% дисперсії RF. PA і RAN разом пояснюють 69.9% дисперсії RF.

Висновки. Результати цього дослідження доповнюють наші знання про внесок PA і RAN в RF, а також про складні внутрішньомовні зв’язки між PA і RAN.

Ключові слова: навички швидкого автоматизованого називання, фонологічна обізнаність, швидкість читання арабською мовою, аналіз шляху.