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# Psychometric validation of Arabic attention control scale: reliability, correlation, PCA, and CFA analyses

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**ABSTRACT**

The scarcity of reliable tools to measure attention control among Arabic speaking learners represents a key research problem. To address this gap, this study aimed to develop and evaluate the Arabic version of the attention control scale (ACS). The research was conducted on a sample of (N=210) Moroccan students in their second year of middle school (2023/2024), using precise translation methods, including "forward and backward translation". The reliability of the scale was confirmed through Cronbach's alpha (α=0.832), McDonald's omega (ʊ=0.820), and split-half reliability (ρ=0.870). The factor structure of the scale was verified using principal component analysis (PCA), while confirmatory factor analysis (CFA) confirmed the model's goodness of fit ($\chi^2$=1689.398, df=66, *p<.001; Kaiser-Meyer-Olkin (KMO)=0.672). The results showed statistically significant correlations between the scale's dimensions: general attention control (GA), attention focusing (AF), and attention shifting (AS) (*p<.001). The findings confirmed that the 12 item Arabic version of the ACS (short version) has strong psychometric properties with factor loadings ranging from 0.311 to 0.825. This study is considered an important step in developing attention assessment tools for learners in the Arab educational context. It provides a standardized scale to measure the attention process, which helps enable teachers to accurately diagnose attention difficulties and provide targeted educational interventions. These interventions contribute to improving learners' focus and engagement, thereby enhancing the overall effectiveness of the educational process.



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## 1. INTRODUCTION

In the beginning, the attention control scale (ACS) was developed as a general measure to assess overall differences in voluntary attentional control. The scale was used to study the role of voluntary control efforts in the attentional process as a cognitive psychological process [1]. Despite its widespread use, little is known about its psychometric properties. The goal of the current study was to investigate the psychometric properties of the scale. The ACS consists of 20 items that initially appeared as two measures, attention focusing (AF) and attention shifting (AS). In the study by Derryberry and Rothbart [2], they defined attention focusing as "The ability to maintain attentional focusing on specific channels and resist involuntary shifting to irrelevant or distracting channels," and attention shifting as "The ability to deliberately shift attentional

focusing to specific channels, thus avoiding involuntary focusing on certain channels." In recent years, the two measures have been combined under the title of the ACS using the total score as a measure of individuals' ability to control attention, which we refer to in this study as general attention (GA=AF+AS).

According to Derryberry [3], factor analyses of the ACS indicate that it consists of "Interrelated sub factors related to AF (Item 1=it is very hard for me to concentrate on a difficult task when there are noises around) and others related to AS between tasks (Item 14=it is easy for me to read or write while I'm also talking on the phone)." To our knowledge, no studies have been published on the factor structure of the ACS among middle school learners in Morocco or neighboring regions, making this study particularly important as it is the first of its kind to translate the ACS from English to Arabic following strict procedures "backward and forward" translation procedure, and then to verify the content validity and reliability of the scale using a range of advanced statistical techniques to develop the structural model of the scale and discover its short version. The factor structure of the ACS was evaluated in this study on a sample of learners aged 13 to 18 years (N=210). We note in this regard that the researchers, in addition to establishing the face validity of the scale, demonstrated the internal validity related to consistency and reliability by assessing the internal consistency, which reflects the scale's ability to interact with the two sub dimensions, namely AF and AS. The Cronbach's alpha coefficient was (α=0.88), (the Spearman-Brown coefficient=0.82), and the same value was achieved by the researchers after subjecting the scale to the Guttman Split-Half coefficient test.

To further support the previous findings, it appears that the ACS enjoys a high and reassuring degree of validity and reliability. Furthermore, the uses of the scale are not limited to measuring attentional efficiency alone but extend to measuring the relationship of attention to emotional, motivational aspects, and behavioral disorders, among other variables. Over the years, information has accumulated about its validity. The ACS has been used in several laboratory experiments focusing on the interaction between voluntary control and automatic processes in adults [4]. Overall, the main objective of this study was to examine and evaluate the psychometric properties of the Arabic version of the ACS after following strict translation standards and relying on validity and reliability tests such as Cronbach's alpha, McDonald's omega, and split-half reliability. Additionally, the study aimed to develop the scale's structure using AF and CFA and confirm the findings using principal component analysis (PCA), which is rarely used in social sciences, with the goal of developing and diversifying measurement and evaluation mechanisms to provide diverse options for comparison and analysis, ultimately achieving the most effective and optimal version of the scale (short version).

This study is the first of its kind to translate the ACS into Arabic and rigorously validate its validity and reliability using advanced statistical procedures, such as PCA, which are rarely employed in social sciences. The study also adopted a precise translation technique, utilizing the forward and backward translation method to ensure accuracy and fidelity to the original version. Additionally, expert and reviewer evaluations were incorporated into the validation process, which has become increasingly rare in contemporary research that typically prioritizes quantitative analysis over qualitative verification of measurement tools. This study uniquely combines both quantitative and qualitative methods to ensure a comprehensive and robust evaluation. This scale helps enable teachers to accurately diagnose attention difficulties and provide targeted educational interventions, thereby improving learners' focus and engagement and enhancing the overall effectiveness of the educational process.

## 2. METHOD

### 2.1. Participants

The sample comprised 210 learners (N=210), including ($n_{(F)}$=80) females and ($n_{(M)}$=130) males, from three preparatory education levels (first, second, and third preparatory levels), with ages ranging from 13 to 18 years. It is a sufficient sample size considering the rule that states the need for 5 to 10 learners per item, which we have precisely adhered to, in addition, the sample was purposively selected based on specific criteria (age, level) to ensure an accurate representation of the target population [5]. They were distributed across Abdelkhaleq Al-Touriss school on the outskirts of Tetouan city, Morocco. It is important to note that the sample was intentionally selected to target the preparatory education level.

### 2.2. Procedure

#### 2.2.1. Phase 1: obtaining authorization and approval for the study and ethics

Participants were assured that their personal information would remain confidential and not be disclosed to third parties. Additionally, they were informed that they could withdraw from the study at any time without needing to provide a justification [6]. All procedures were conducted in accordance with the ethical principles outlined in the Helsinki declaration [7], first published in 1975 and revised in 2000. Additionally, the study obtained approval from the administrative committee of the Higher School of Teachers (ENS), Moulay Ismail University, Meknes, Morocco.

### 2.2.2. Phase 2: translation of ACS "backward and forward" translation procedure

The ACS, was translated from English into Arabic using the classical three-stage "backward and forward" translation procedure. In the first step, two bilingual translators, whose native language was Arabic, independently translated the ACS from English to Arabic (forward translation). In the second stage, the two translators, along with a third individual who served as a recording observer, compared and unified their translations to produce a single Arabic version (interim Arabic version). In the third and final stage, this interim Arabic version was translated back into English by two additional translators (backward translation) [8]. It is important to note that all translators involved in this process were not aware of the original English version and did not possess specific expertise in educational psychology.

### 2.2.3. Phase 3: content validity

In the subsequent step, specialists in psychology (BZ, HC, MB) and educational measurement (AR, SZ, AR) participated in the validation process of the scale and its content. They provided feedback based on their expertise in the field. Following their judgments and recommendations, the researchers revised and modified the initial Arabic version of the scale. Some items were adjusted for meaning and relevance, as well as for structural and linguistic accuracy. After these adjustments, the scale retained its full set of 20 items, distributed across three dimensions: AF, AS, and GA, as agreed upon by the expert reviewers.

To support the aforementioned, the researchers assessed the validity of the ACS based on evaluations from an expert panel, using percentage and Chi-square ($\chi^2$) methods [9]. To further elaborate on the agreement percentage among the judges and experts regarding the scale items, we present Table 1. From Table 1, it is evident that the critical Chi-square value ($\chi^2$=3.84) at a significance level of ≤0.05 with 1 degree of freedom is used for comparison. All scale items were statistically significant at the ≤0.05 significance level, as the computed Chi-square values exceeded the critical value (6≥3.84) [10]. Additionally, the researchers calculated the percentage agreement as a secondary measure to assess the apparent validity and reliability of the scale based on the feedback from the expert panel and judges. An agreement rate of 80% was adopted as the criterion for accepting an item. All items achieved a full agreement percentage of 100%, regardless of whether modifications were made. Consequently, the researchers decided to retain all the scale items, as they received unanimous agreement from both judges and experts. This reflects both the superficial and content validity of the scale.

Table 1. The experts' decision regarding the validity of the scale in the Moroccan context using percentage and Chi-square ($\chi^2$)

| Items | Agreeing | | Disagreeing | | $x^2$ | |
|---|---|---|---|---|---|---|
| | F | % | F | % | CV | TV |
| 1, 2, 3, 4, 5, 6, 7, 8 | 6 | 100 | 0 | 0 | 6 | 3.84 |
| 9, 10, 11, 12, 13, 14 | 6 | 100 | 0 | 0 | 6 | 3.84 |
| 15, 16, 17, 18, 19, 20 | 6 | 100 | 0 | 0 | 6 | 3.84 |

p≤0.05, F=frequency, CV=computed value, TV=tabular value

### 2.2.4. Phase 4: first round of pilot testing

At the outset, consent was obtained from both the study participants and the administrative staff of Abdel Khalek Al-Tariess School [11]. Before proceeding to verify the validity and reliability of the scale, we undertook several preparatory steps to ensure the accuracy of the subsequent analyses. These steps included examining the normal distribution of each dimension of the scale individually using the Shapiro-Wilk test and ensuring that the sample size was representative. Additionally, we conducted basic descriptive analyses, which involved calculating means, standard deviations, and correlation coefficients between the items and their respective dimensions. Subsequently, the validity and reliability of the scale were assessed using various validity tests, including Cronbach's alpha coefficient (α), McDonald's omega coefficient (ʊ), and the split-half (ρ) technique. Advanced statistical methods, such as factor analysis (FA), confirmatory factor analysis (CFA), and PCA, were also employed, as detailed later. The purpose of these procedures was to evaluate the scale and propose a final, stable structure that accounts for the specificity of the sample in the Moroccan context, including language, content, and psychometric properties.

### 2.2.5. Phase 5: first round of pilot testing

After analyzing and discussing the results, only the statistically significant items were retained. The remaining items, which validity and reliability tests and CFA indicated were non-significant or negatively related to the scale, were removed. Consequently, the final version developed comprises 12 items (AF=items 1, 2, 4, 5, 7, 8, 9), (AS=items 10, 13, 14, 19, 20).

### 2.3. Measures

The scale consists of 20 items that are answered using four response choices (1=almost never, 2=sometimes, 3=often, 4=always) with higher scores indicating better attentional control. There were 11 items (1, 2, 3, 6, 7, 8, 11, 12, 15, 16, 20) have to be reverse-coded before scoring. Also, the scale is distributed across two dimensions, the first is AF (AF=items 1-9), while the second dimension is AS (AS=items 10-20).

### 2.4. Statistics analyses

The study data were analyzed using IBM SPSS Statistics version 27 for Windows (IBM Corp., Armonk, NY, USA). CFA and statistics descriptive were conducted using JASP software version 0.18.3, while PCA was computed using R software. Reliability tests were calculated using Minitab version 21.

## 3. RESULTS AND DISCUSSION

### 3.1. Assessment of the normality assumption

After performing a descriptive statistical analysis on the nine items that make up the AF dimension in the scale, we obtained the following results. These results are presented in Tables 2 and 3. The analysis provides a detailed overview of the data for each item. The findings reflect key insights into the attention dimensions as measured by the scale.

Referring to Table 2, it becomes evident that the average responses range from 2.429 to 3.076, with SD ranging from 0.754 to 1.171. Furthermore, the results indicate that the data are normally distributed [12], as evidenced by the Shapiro-Wilk test values ranging from 0.796 to 0.877, significant at the <.001 level. As for the second dimension regarding AS, its descriptive characteristics can be expressed as in Table 3.

Table 2. Normality test (Shapiro-Wilk) for dimension AF of ACS

| No. | Items | SD | Shapiro-Wilk | P-value | Min | Max |
|---|---|---|---|---|---|---|
| 1 | It's very hard for me to concentrate on a difficult task when there are noises around* | 0.916 | 0.876 | <.001* | 1 | 4 |
| 2 | When I need to concentrate and solve a problem, I have trouble focusing my attention* | 0.754 | 0.806 | <.001* | 2 | 4 |
| 3 | When I am working hard on something, I still get distracted by events around me | 0.860 | 0.864 | <.001* | 1 | 4 |
| 4 | My concentration is good even if there is music in the room around me* | 1.171 | 0.815 | <.001* | 1 | 4 |
| 5 | When concentrating, I can focus my attention so that I become unaware of what's going on in the room around me* | 0.953 | 0.873 | <.001* | 1 | 4 |
| 6 | When I am reading or studying, I am easily distracted if there are people talking in the same room | 1.042 | 0.796 | <.001* | 1 | 4 |
| 7 | When trying to focus my attention on something, I have difficulty blocking out distracting thoughts* | 0.810 | 0.837 | <.001* | 1 | 4 |
| 8 | I have a hard time concentrating when, I am excited about something* | 1.028 | 0.860 | <.001* | 1 | 4 |
| 9 | When concentrating I ignore feelings of hunger or thirst* | 1.099 | 0.856 | <.001* | 1 | 4 |

*p≤0.05; Note: The items that end with an asterisk (*) are the items that belong to the final (short) version, this translation is not a literal translation, it is a scientific translation that reflects the meaning and significance of each item individually.

Table 3. Normality test (Shapiro-Wilk) for dimension AS of ACS

| No. | Items N | SD | Shapiro-Wilk | P-value | Min | Max |
|---|---|---|---|---|---|---|
| 10 | I can quickly switch from one task to another* | 2.790 | 0.788 | <.001* | 1 | 4 |
| 11 | It takes me a while to get really involved in a new task | 2.381 | 0.863 | <.001* | 1 | 4 |
| 12 | It is difficult for me to coordinate my attention between the listening and writing required when taking notes during lectures | 2.867 | 0.858 | <.001* | 1 | 4 |
| 13 | I can become interested in a new topic very quickly when I need to* | 3.476 | 0.708 | <.001* | 2 | 4 |
| 14 | It is easy for me to read or write while I'm also talking on the phone* | 1.933 | 0.781 | <.001* | 1 | 4 |
| 15 | I have trouble carrying on two conversations at once | 2.819 | 0.839 | <.001* | 1 | 4 |
| 16 | I have a hard time coming up with new ideas quickly | 3.086 | 0.824 | <.001* | 1 | 4 |
| 17 | After being interrupted or distracted, I can easily shift my attention back to what I was doing before | 2.600 | 0.859 | <.001* | 1 | 4 |
| 18 | When a distracting thought comes to mind, it is easy for me to shift my attention away from it | 2.600 | 0.877 | <.001* | 1 | 4 |
| 19 | It is easy for me to alternate between two different tasks* | 2.724 | 0.853 | <.001* | 1 | 4 |
| 20 | It is hard for me to break from one way of thinking about something and look at it from another point of view* | 3.114 | 0.789 | <.001* | 1 | 4 |

*p≤0.05; Note: The items that end with an asterisk (*) are the items that belong to the final (short) version, this translation is not a literal translation, it's a scientific translation that reflects the meaning and significance of each item individually.

Similarly, referring to Table 3, the results of the first dimension concerning ACS, the findings for the second dimension regarding (AS) can be interpreted as: it becomes evident that the average responses range from 1.933 to 3.476, with standard deviations ranging from 0.728 to 1.171. Furthermore, the results indicate that the data are normally distributed [13], as evidenced by the Shapiro-Wilk test values ranging from 0.708 to 0.877, significant at the <.001* level [14].

### 3.2. Reliability

To evaluate the reliability of the scale, the researchers applied multiple statistical measures, including Cronbach's alpha (α), McDonald's omega (ʊ), and the split-half (ρ) coefficient. These methods were chosen to ensure the scale's stability and internal consistency, providing a comprehensive assessment of its reliability. The results obtained through these analyses are summarized in Table 4, highlighting the robustness of the scale across different metrics.

Table 4 indicates that the overall reliability coefficient for the scale items, after applying it to the study sample, reached a value of (α=0.832). This was after removing item 3 and item 11, as the Cronbach's alpha coefficient showed they were negatively correlated with the scale. Therefore, the obtained value of 0.832 in the final stage indicates that the scale enjoys a high level of stability [15], and can be relied upon to measure attention, especially in the Moroccan context.

Following the same interpretation approach as with Cronbach's alpha, the results in Table 4 indicate that the scale exhibits a high level of reliability, with a coefficient of (ʊ=0.820) after excluding item 3 and item 11 because they, according to the omega coefficient, are also negatively correlated with the internal consistency of the scale. Therefore, a value of (ʊ=0.820) suggests high reliability and indicates a high stability of the scale [16] within the local context in Morocco. The split-half coefficient is a statistical technique used to estimate the reliability of measurements and tests by dividing the data into two equal parts. This is done by dividing the items or samples into two equivalent groups, then calculating the test results or measurements for each group separately. Subsequently, the correlation coefficient between the results of the two groups is calculated to assess the stability and reliability of the measurements [17]. Table 4 indicates that the split-half coefficient before correction reached a value of (0.770), whereas after correction using the Spearman-Brown coefficient, it reached (ρ=0.870). This indicates that the scale enjoys a high level of stability and reliability [18].

Table 4. Reliability tests for each item of ACS

| Coefficient | Point estimate |
|---|---|
| Cronbach's alpha (α) | 0.820 |
| McDonald's omega (ʊ) | 0.832 |
| Split-half (ρ) | 0.870 |

### 3.3. Correlation

To explore the nature of the relationship between each item and its corresponding dimension, the researchers employed the Pearson correlation coefficient. This statistical method was selected for its ability to measure the strength and direction of linear relationships within the data. The results of this analysis are presented in Tables 5 and 6, offering detailed insights into the alignment of individual items with their respective dimensions.

It is evident from Table 5 that the Pearson correlation coefficients between the items after AF concentration and the cumulative mean indicate a strong relationship, with the highest value reaching (r=0.778) for item number 5, and the lowest value for item number 6 being (r=0.345). Therefore, it can be affirmed that all coefficients are statistically significant at ***p<.001 [19] level except for item number 3, which showed a negative correlation with the cumulative mean. This led us to exclude it, a decision that will be confirmed by Cronbach's alpha reliability test in the following section regarding validity and reliability.

As for the second dimension related to AS, Table 6 illustrates that the Pearson correlation coefficients between the items belonging to the second dimension concerning AS and the cumulative mean were strong. The highest value reached (0.636) for item number 16, while the lowest value was around (r=0.257) for item number 13. Based on the foregoing, we infer that all correlation coefficients are statistically significant at a level of ***p<.001 [20], except for item number 11, which showed a negative correlation with the cumulative mean. This led us to exclude it, a decision that was previously confirmed by Cronbach's alpha and McDonald's omega reliability tests in the previous section regarding reliability. To confirm the previously obtained data, Pearson correlation coefficients were calculated between the sum of scores for each dimension and the total score of the scale. The results can be seen in Table 7.

Table 5. Pearson's correlations between the nine items and the underlying dimension (AF)

| Variable | Item | Pearson's r | p-value |
|---|---|---|---|
| AF | 1. It's very hard for me to concentrate on a difficult task when there are noises around | 0.442*** | <.001 |
| | 2. When I need to concentrate and solve a problem, I have trouble focusing my attention | 0.638*** | <.001 |
| | 3. When I am working hard on something, I still get distracted by events around me | 0.099 | <.001 |
| | 4. My concentration is good even if there is music in the room around me | 0.595*** | <.001 |
| | 5. When concentrating, I can focus my attention so that I become unaware of what's going on in the room around me | 0.778*** | <.001 |
| | 6. When I am reading or studying, I am easily distracted if there are people talking in the same room | 0.345*** | <.001 |
| | 7. When trying to focus my attention on something, I have difficulty blocking out distracting thoughts | 0.654*** | <.001 |
| | 8. I have a hard time concentrating when, I am excited about something | 0.463*** | <.001 |
| | 9. When concentrating I ignore feelings of hunger or thirst | 0.761*** | <.001 |

*** p<.001

Table 6. Pearson's correlations between the nine items and the underlying dimension (AS)

| Variable | Item N | Pearson's r | p-value |
|---|---|---|---|
| AS | 10. I can quickly switch from one task to another | 0.505*** | <.001 |
| | 11. It takes me a while to get really involved in a new task | 0.111 | <.001 |
| | 12. It is difficult for me to coordinate my attention between the listening and writing required when taking notes during lectures | 0.543*** | <.001 |
| | 13. I can become interested in a new topic very quickly when I need to | 0.257*** | <.001 |
| | 14. It is easy for me to read or write while I'm also talking on the phone | 0.609*** | <.001 |
| | 15. I have trouble carrying on two conversations at once | 0.573*** | <.001 |
| | 16. I have a hard time coming up with new ideas quickly | 0.636*** | <.001 |
| | 17. After being interrupted or distracted, I can easily shift my attention back to what I was doing before | 0.311*** | <.001 |
| | 18. When a distracting thought comes to mind, it is easy for me to shift my attention away from it | 0.473*** | <.001 |
| | 19. It is easy for me to alternate between two different tasks* | 0.530*** | <.001 |
| | 20. It is hard for me to break from one way of thinking about something and look at it from another point of view* | 0.595*** | <.001 |

***p<.001

Table 7 indicates that the Pearson correlation coefficient suggests a high level of correlation between both GA and AF, with a value of (r=0.906). Similarly, the correlation coefficient between GA and AS is approximately (r=0.903). Meanwhile, the Pearson correlation coefficient between the first dimension related to AF and the other dimension concerning AS is (r=0.635). From this, we can infer that all correlation coefficients are statistically significant at a level of *p<.001 [21], as shown in Figure 1.

Table 7. Pearson correlation coefficient between the score of each dimension and the total score of the scale

| Dimensions | Pearson's r | p | Lower 95% CI |
|---|---|---|---|
| GA↔AF | 0.906* | <.001* | 0.878 |
| GA↔AS | 0.903* | <.001* | 0.874 |
| AF↔AS | 0.635* | <.001* | 0.546 |

*p<.001

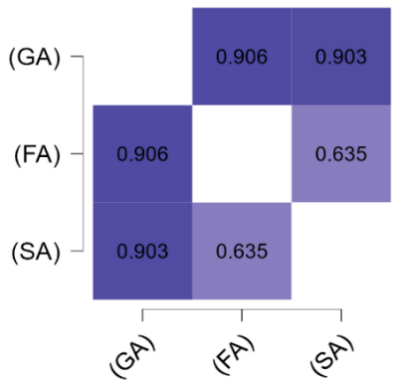


Figure 1. Correlation plot between all dimensions of ACS (AF+AS+GA)

### 3.4. Principal component analysis

To confirm the correlation results obtained, we employed PCA as a complementary method. This approach validates the findings derived from Pearson's correlation, providing a more comprehensive understanding of the data relationships. The consistency between these methods reinforces the robustness of the observed patterns, as illustrated in Figure 2.

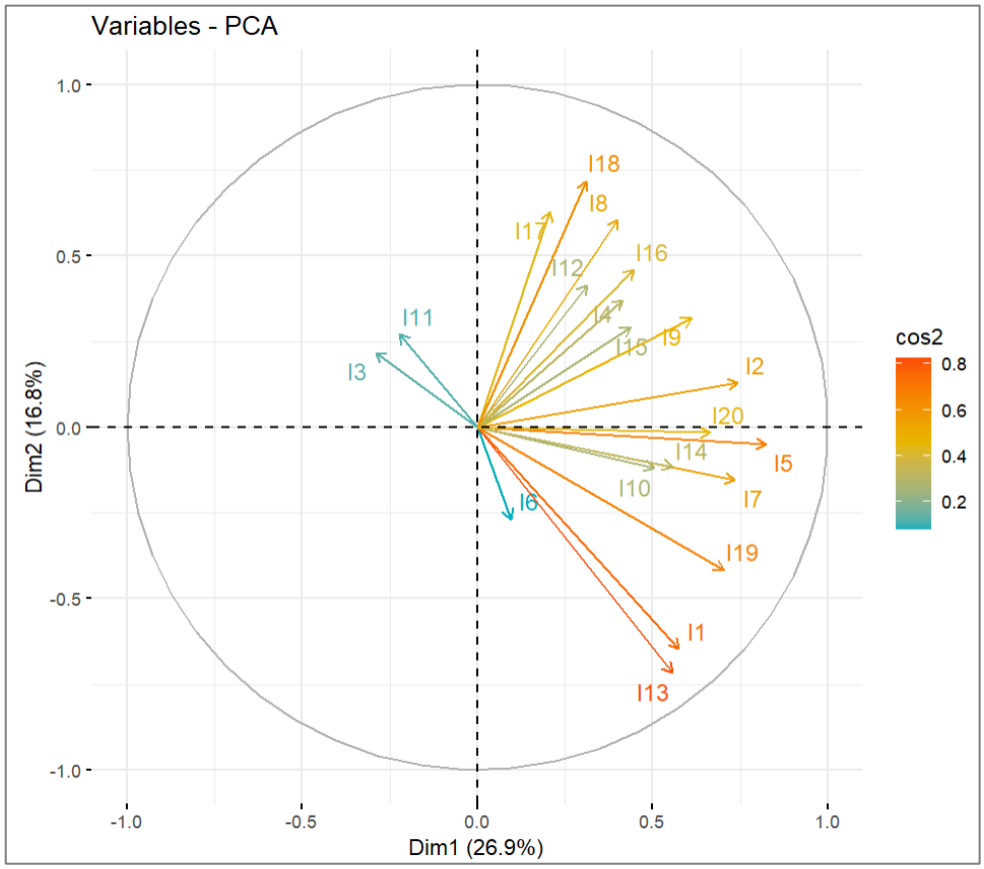


Figure 2. (PCA) plot for all items of (ACS)

Based on Figure 2, we notice a strong correlation between item 1 and 13, with a correlation coefficient greater than (Cos2=0.8). This indicates that these two items are positively correlated and have a similar impact on the learner's attention. Additionally, there is a correlation between items 8, 16, 9, and 20, with a correlation coefficient of (Cos2=0.6), meaning these items have a comparable impact. Similarly, items 19, 7, and 18 have a correlation coefficient of (Cos2=0.7), indicating a similar impact. In contrast, the last three questions (6, 3, and 11) have a weak impact on the learner's attention [22], as also shown by the Pearson correlation (Tables 5 and 6) and reliability section [23], [24].

### 3.5. Confirmatory factor analysis

The goal of CFA is to assess how well the collected data fit the pre-defined theoretical model. This method is particularly useful in validating measurement scales and evaluating the structural relationships between variables based on a priori hypotheses [25]. The structural equation model Figure 3 shows that the items load on their respective factor (all above 0.30). Additionally, the results of the CFA indicate that the following indicators are significant and fit well [26], largely conforming to the established criteria (Kaiser-Meyer-Olkin (KMO)=0.672) [27], as shown in Table 8, and ($\chi^2$=1689.398, df=66: *p<.001), as seen in Table 9. The results showed a strong relationship between the AF and AS dimensions factor covariance's (FC), with an estimate value of 0.806 and a standard error of 0.052. The z-value was 15.441, indicating that the relationship between the dimensions is highly statistically significant (*p<.001), (FL: min=0.311, max=0.825), as shown in Table 10. Despite this [28], we acknowledge that the Tucker-Lewis index (TLI) and comparative fit index (CFI) values were slightly below the recommended threshold at 0.92 and 0.93 [29].

However, it is important to note that although these values did not meet the stringent criteria of >0.95, they are still close and generally considered to indicate a reasonable fit in many social science applications, especially given that the correlation and variance coefficients between the dimensions of the scale were very high.

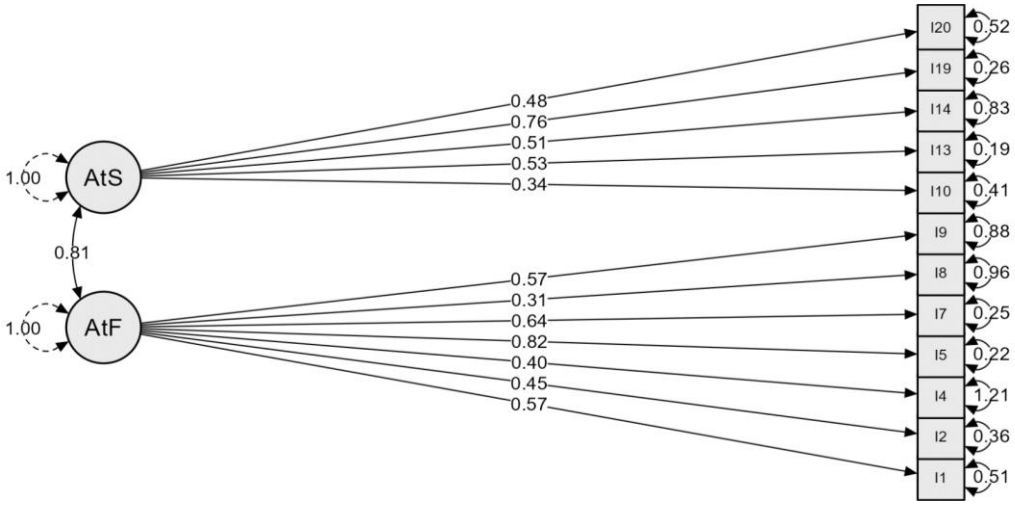


Figure 3. Results of the CFA

Table 8. Results of KMO test

| | KMO test | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Indicator | Item1 | Item2 | Item4 | Item5 | Item7 | Item8 | Item9 | Item10 | Item13 | Item14 | Item19 | Item20 | Total |
| MSA | 0.758 | 0.832 | 0.450 | 0.786 | 0.842 | 0.523 | 0.630 | 0.431 | 0.643 | 0.498 | 0.772 | 0.755 | 0.672 |

Table 9. Chi-square $\chi^2$ test of ACS

| Model | $x^2$ | df | p |
|---|---|---|---|
| Baseline model | 1689.398 | 66 | |
| Factor model | 923.993 | 53 | <.001 |

Note: The estimator is ML

Table 10. Factor loading of ACS for short version

| | | Factor | | | | 95% confidence interval | | |
|---|---|---|---|---|---|---|---|---|
| | Items | Estimate | SE | z-value | P | Lower | Upper | Std. Est. (lv) |
| AF | Item1 | 0.571 | 0.062 | 9.162 | <.001* | 0.449 | 0.693 | 0.571 |
| | Item2 | 0.448 | 0.051 | 8.819 | <.001* | 0.349 | 0.548 | 0.448 |
| | Item4 | 0.399 | 0.084 | 4.746 | <.001* | 0.234 | 0.564 | 0.399 |
| | Item5 | 0.825 | 0.056 | 14.756 | <.001* | 0.715 | 0.934 | 0.825 |
| | Item7 | 0.635 | 0.049 | 12.932 | <.001* | 0.539 | 0.732 | 0.635 |
| | Item8 | 0.311 | 0.078 | 3.993 | <.001* | 0.158 | 0.464 | 0.311 |
| | Item9 | 0.569 | 0.077 | 7.407 | <.001* | 0.418 | 0.720 | 0.569 |
| AS | Item10 | 0.338 | 0.051 | 6.576 | <.001* | 0.237 | 0.438 | 0.338 |
| | Item13 | 0.533 | 0.043 | 12.262 | <.001* | 0.448 | 0.618 | 0.533 |
| | Item14 | 0.513 | 0.076 | 6.744 | <.001* | 0.364 | 0.662 | 0.513 |
| | Item19 | 0.764 | 0.060 | 12.769 | <.001* | 0.646 | 0.881 | 0.764 |
| | Item20 | 0.476 | 0.065 | 7.273 | <.001* | 0.348 | 0.605 | 0.476 |

*p<.001, Note. FL=factor loading, SE=standard error

To provide an accurate discussion and comparison between the results of this study and other studies on the same topic, we look at key points of similarity and difference. Many studies evaluating attention control measurement tools show similar levels of validity and reliability. For example, studies such as those by Lengua *et al*. [30] used tools with high validity and reliability in different cultural contexts and found these tools effectively assessed attention control. The current study confirmed that the ACS shows high validity and reliability in the Moroccan context, with strong results in statistical analysis, supporting its

alignment with previous studies in this field [31]. Factor analyses are crucial in assessing the structural integrity of measurement tools. Study by Quigley *et al.* [32] demonstrated how FA can confirm the structural model of tools used to measure attention control. The current study showed good agreement in FA [33], although TLI and CFI results were less than ideal [34], which may suggest that sample-specific conditions could affect these results, consistent with some studies that encountered similar difficulties [35]. we observe both similarities and differences in the evaluation of attention control measurement tools. For instance, study by Ólafsson *et al.* [36] used a similar scale for measuring attention control in the Icelandic context and found that the scale demonstrated high validity and reliability, which aligns with the findings of the current study.

Studies that modified their measurement tools by reducing the number of items often showed positive results in improving scale efficiency. For instance, study by Atalay *et al*. [37] reduced the number of items from 20 to 17 items in their scale to enhance accuracy and reliability. The current study demonstrated that reducing the number of items from 20 to 12 in the final version improved the scale's effectiveness, aligning with findings from other studies that showed reducing items can enhance the quality of the tool.

Finally, Al-Balhan *et al*. [38] emphasize the importance of accurate translation and cultural standards in ensuring the validity of tools across cultures. The study's adherence to rigorous translation standards through "backward and forward" procedures enhances the accuracy of the results and aligns with previous studies emphasizing the importance of proper translation for translated tools like the scales. Overall, the current study shows alignment with results from other studies evaluating the validity and reliability of attention control measurement tools [39], with some differences potentially attributed to sample characteristics and cultural context. The results highlight the importance of using FA and statistical tests in evaluating tools and emphasize the benefits of reducing the number of items to improve scale efficiency [40]. This study contributes to understanding the effectiveness of attention control measurement tools in different cultural contexts, helping to develop more accurate and reliable measures in the future.

The results obtained in this study serve as an important starting point for guiding future research in this field. By understanding the dimensions of attention control and its effects in the field of education, researchers can explore further factors influencing these abilities in various contexts, such as the impact of culture, age, or psychological conditions. Additionally, precise and reliable measurement tools can be developed to track the development of attention control skills over time. From a practical standpoint, these results can be used to design another scale that combines attention with other cognitive processes, such as memory and perception, which also play a role in education and learning, contributing to enhancing learners' academic performance.

## 4. CONCLUSION

Based on the findings outlined, the study confirms that the ACS within the Moroccan context demonstrates a high degree of validity and reliability. Content validity was established with unanimous agreement by experts at a rate of 100% and ($\chi^2$=3.84: ≤0.05) with 1 df. The translation process adhered to rigorous standards through both "backward and forward translation procedures". Statistical analysis showed a strong correlation between scale items and their respective dimensions (AF↔AS), with a correlation coefficient of (r=0.635), significant at *p<.001, indicating a robust relationship between the dimensions of the ACS. Reliability tests confirmed that the scale remains consistent after removing items that negatively correlated with it. FA and PCA, this led to the development of evaluation techniques for the scale based on PCA rather than exploratory factor analysis (EFA), corroborated these findings, despite less than ideal TLI and CFI results, likely due to sample characteristics. CFA further validated the model, with all item loadings above 0.30, (KMO=0.672), and ($\chi^2$=1689.398, with 66 df at p<.001). The analysis showed significant correlation coefficients, with the final version of the scale comprising 12 (short version) items rather than 20 (AF=items 1, 2, 4, 5, 7, 8, 9), (AS=items 10, 13, 14, 19, 20), as the remaining items either negatively correlated with the scale or were not significant.

Although this study is characterized by some strong and positive points, including novelty, particularly in employing PCA instead of EFA, diversifying statistical techniques, and the findings, especially regarding correlation coefficients and reliability tests that complemented each other, it is, to our knowledge, the first study of its kind that focused on translating the ACS test into Arabic. Despite all this, it is not without some limitations that need to be pointed out. Perhaps the most notable is the sample size, which would have been more representative if it were larger.

Additionally, the study did not rely on the test-retest technique. To overcome these limitations and further improve this work, we recommend applying the scale to other age groups and developing additional dimensions to the scale besides AF and AS, such as evaluating attention, for instance. It is also recommended to employ some qualitative techniques to observe the behavior of the subjects during situations that require attention competencies. Furthermore, efforts should be made to develop the ACS scale in relation to other

cognitive processes like memory and perception, as they overlap and complement each other. By addressing these aspects, future studies can provide us with a more precise and deeper understanding of the attention process.

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| Name of Author | C | M | So | Va | Fo | I | R | D | O | E | Vi | Su | P | Fu |
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C : **C**onceptualization
M : **M**ethodology
So : **So**ftware
Va : **Va**lidation
Fo : **Fo**rmal analysis
I : **I**nvestigation
R : **R**esources
D : **D**ata Curation
O : Writing - **O**riginal Draft
E : Writing - Review & **E**diting
Vi : **Vi**sualization
Su : **Su**pervision
P : **P**roject administration
Fu : **Fu**nding acquisition

## CONFLICT OF INTEREST STATEMENT

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

## INFORMED CONSENT

We have obtained informed consent from all individuals included in this study.

## ETHICAL APPROVAL

All procedures followed in studies involving human participants were in accordance with the ethical standards of the Research Committee of the Higher School of Teachers (ENS), Moulay Ismail University, Meknes, Morocco, and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

## DATA AVAILABILITY

The data (Arabic version of ACS) that support the findings of this study are available from the corresponding author [AK], upon reasonable request.

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