

RELIABILITY AND FACTOR ANALYSIS OF THE TIME AWARENESS QUESTIONNAIRE (PORTUGUESE VERSION) ¹**A. A. Gomes, C. F. Silva, V. Clemente, A. M. Ferreira, I. Coelho, H. César, C. Pissarra, and M. H. P. de Azevedo**

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The aim of this study was to examine the reliability and factor structure of the Portuguese version of the Time Awareness Questionnaire (TAQ). In the context of individual differences in tolerance to shift work, the original British questionnaire was developed by Simon Folkard guided by the hypothesis of an association between time awareness and circadian rhythms amplitude. Based on the 17 item original questionnaire, a 26 item Portuguese preliminary version was developed and rated on a 5 point scale. This version was completed by 392 university students; a sub-group completed a retest with a 5-7 week gap. After several item analyses, an 18 item questionnaire was obtained. The reliability assessment of the 18 item version showed that Cronbach alpha was .803; Spearman-Brown coefficient was .775; Pearson correlations between each item and the total score ranged between .115 and .643. A principal component analysis with varimax rotation was performed and a 3 factor solution was selected explaining 43.70% of the total variance. In conclusion, the Portuguese version of the TAQ was found to be reliable and a multifactorial scale.

KEY WORDS: Time Awareness Questionnaire; reliability; factor structure.

RESUMEN

El objetivo de este estudio es analizar la fiabilidad y la estructura factorial de la versión portuguesa del Time Awareness Questionnaire (TAQ). En el ámbito de la problemática de la tolerancia al trabajo por turnos, el cuestionario británico original fue desarrollado por Simon Folkard a partir del supuesto de que la capacidad de una persona para orientarse en relación al tiempo, sin acceso a un reloj, estaría asociada a la amplitud de los ritmos circadianos. Basándose en la versión británica, se elaboró una versión preliminar del TAQ de 26 ítems, con 5 categorías de respuesta. Esta versión fue distribuida a 392 estudiantes universitarios. Pasadas 5-7 semanas, se aplicó un retest a 335 sujetos. Se realizaron diversos análisis estadísticos, obteniéndose un cuestionario de 18 ítems. El estudio de fiabilidad de la versión de 18 ítems dió los siguientes resultados: alfa de Cronbach de .803; coeficiente de Spearman-Brown de .775; correlaciones de Pearson entre cada ítem y el total entre .115 y .643. La correlación test-retest fue de .862. En el análisis factorial mediante componentes principales y rotación varimax se obtuvieron 3 factores, que explican el 43.70% de la varianza. En conclusión, la versión portuguesa del TAQ posee buenos índices de fiabilidad y es una escala multidimensional.

PALABRAS CLAVE: Time Awareness Questionnaire; fiabilidad; estructura factorial.

INTRODUCTION

One focus of attention by researchers on shift work has been the study of inter-individual circadian rhythms differences associated with tolerance to shift work. This knowledge may be of great value for counselling workers as how to cope best with their shift system, by taking account of known individual differences.

Several self-response questionnaires have been developed to measure and quantify individual circadian characteristics (e.g., 1). Recently, a Time Awareness Questionnaire (TAQ) was constructed by Simon Folkard (2) based on the hypothesis of an association between the ability to keep track of time without a watch or a clock and the circadian rhythms amplitude. The evidence about the association between time sense and internal rhythms comes from subjects who lived in isolation units for weeks. When asked to estimate the passage of time hourly, they produced intervals longer than one hour that were positively correlated with both the duration of wakefulness and the duration of the circadian cycle (3). The hypothesis behind the TAQ development is that a better time

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sense might be associated with higher amplitudes of the circadian rhythms.

Several studies carried out by the Reinberg group (4-8) using measures of physiological variables, have found an association between tolerance to shift work and circadian rhythms amplitudes. At least in rapid rotation shift systems, tolerant shift workers exhibited larger amplitudes, associated with smaller shifts of circadian acrophases, for a set of circadian rhythms. These relationships have been observed consistently for oral temperature, and, in some studies, for right- and left-grip strength and heart rate circadian rhythms.

We consider that the development of a paper and pencil questionnaire aiming at inferring inter-individual differences in the amplitude of circadian rhythms, would be important, because of its low cost, minimal completion time and easy administration.

Our purpose here is to describe the development of an experimental Portuguese version of the Time Awareness Questionnaire (TAQ), and to present the results concerning its reliability and factorial structure.

METHODS

Subjects

The subjects consisted of 392 undergraduate students (medicine and psychology). There were 292 (74%) females and 100 (26%) males, with ages between 18 and 45 years ($M = 21.81$, $S.D. = 4.00$). A subgroup of students (335 subjects) was asked to complete the TAQ on a second occasion, after a 5-7 week-gap.

Procedures

Time Awareness Questionnaire (TAQ) Translation

The British version of the TAQ was developed by Simon Folkard (2), and is a 17 item questionnaire rated on a 5 point Likert scale.

The object of the translation was to produce a Portuguese instrument that would be easily understood by individuals from a variety of social, economic, and cultural backgrounds, while remaining semantically equivalent to the original British version. The translation and adaptation of the TAQ into Portuguese was carried out in the following steps.

Preliminary version

An initial translation draft was carried out by the members of our Sleep Disorders Clinic (psychiatrists and psychologists), all native Portuguese speaking with varying degrees of English language. For each

item, several translations were generated (2-5 questions), which resulted on a total of 71 questions.

Compared to the original version, some modifications were introduced. The comparison component was eliminated from the instructions given to respondents ("Compared to most people...") and response modalities adapted accordingly. One item ("how much does it affect you if you have to wake up much earlier or later than usual?") was subdivided in two separated items: "Do you feel disturbed if you have to wake up much earlier than usual?" and "Are you upset when you wake up later than usual?". In the heading, the following instructions are given: "For each of the following situations, please mark with an X the answer which best describes you".

The resulting translation was then administered to 87 subjects, ages 18-60 years ($M=38.08$; $S.D. =11.03$), male and female (53% females), covering varying levels of education (basic to higher education) and socioeconomic status. We asked each subject individually to choose, among the several options presented for each item, the question they would find easier to be understood by the majority of Portuguese people.

After examining the subjects choices and comments, repeated questions were maintained for four items ("is it easy for you to wake up at a desired time (without an alarm clock)?"; "how often do you need to check the time?"; "does your alertness vary throughout the day?"; "can you work out the time by how awake you feel?"), and one additional question was included ("when you wake up on the middle of the night, do you normally know how many hours of sleep you have had?"). Thus, the preliminary version of the TAQ was composed by a total of 26 items rated on a 5 point Likert scale. A linguist without previous knowledge of the questionnaire performed a back translation. Professor Folkard then reviewed the back translation and agreed that the items were appropriate and accurate.

This preliminary version was then administered to 392 university students. The aim of the study was explained at each class session to the students, who then agreed to participate. Then the questionnaire was completed by all group of students attending the class session.

Several item analyses were carried out (item correlation with total score; Cronbach alpha excluding the item). We first excluded the repeated items added, and further analysis of the remaining 19 items led us to remove item 20 ("does your alertness vary throughout the day?"), which performed poorly in all item analysis done.

TAQ experimental version

The experimental version of the TAQ is an 18 item questionnaire, where fourteen questions (1, 2, 4, 5, 6, 7, 9, 10, 11, 13, 14, 16, 17 and 18) are scored 5-1 (from left to right) and the remaining four are scored 1-5. TAQ scores may range between a minimum of 18 to a maximum of 90 points, with higher scores representing a better time awareness.

RESULTS

The reliability and factorial structure of the 18 item Portuguese version of the TAQ is described here. The TAQ items are reproduced in table I. Descriptive statistics indicated that scores on each item and the total TAQ score were close to the requirements for the use of parametric tests.

RELIABILITY

Internal consistency

Cronbach alpha coefficient was calculated to assess internal consistency of the total scale, and a value of .803 was found. The value for the Spearman-Brown coefficient was .775.

To evaluate the ability of individual items to measure the attribute supposed to be measured by the

scale, items remainder and totals were examined. Pearson's product-moment correlation coefficients between each item and total score (excluding the item) ranged between .115 ($p < .05$) and .643 ($p < .001$ for 17 items) (Table I: 2nd and 3rd columns). Cronbach's alpha excluding each item were computed and compared with the coefficient alpha for the total scale (Table I: 4th column). The results indicated that, for all but three items (items 3, 13 and 16), the exclusion of one item decreases the Cronbach alpha coefficient, as compared to the alpha for the total scale.

Test-retest stability

The test-retest stability study was based in the answers of 335 subjects.

Pearson product-moment correlation coefficients of individual items ranged from .389 (item 13) to .805 (item 4). The levels of significance gave values of $p < .001$ for all items. The value of "r" for the total score test-retest was .862. The plot of test-retest for the total score is given in Figure 1.

No significant differences were found in mean total scores between first ($M = 50.585 \pm 7.408$) and second ($M = 50.558 \pm 7.569$) administrations, with an interval of 5-7 weeks (paired t test: $t = -0.125$, d. f. = 334, $p > .05$).

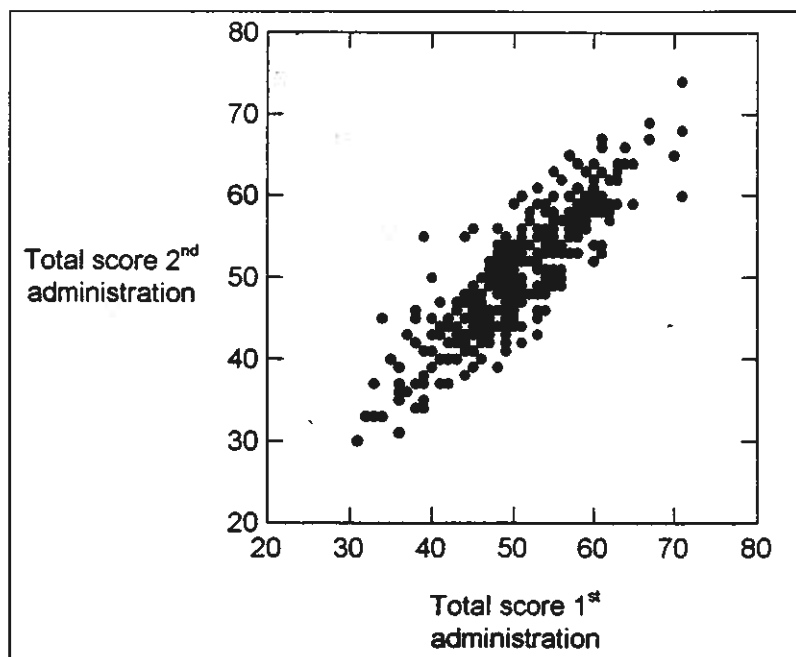


Figure 1. Scatterplot of total scores between first and second administrations of the TAQ.

Table I: Correlations between each item and the total score (excluding the item), and Cronbach alpha coefficients excluding the item

Item	Item-total correlation	p	Alphap excluding the item
1. Is it easy for you to know the time without a watch?	.446	.000	.790
2. When you wake up, do you know exactly what the time is, without looking at a clock?	.590	.000	.780
3. Is it easy for you to eat at any time?	.198	.000	.805
4. Is it easy for you to wake up at a desired time (without an alarm clock)?	.564	.000	.779
5. When you are relaxing, do you know the right time without looking at a watch?	.460	.000	.789
6. When you wake up in the middle of the night do you know the right time, without looking at a clock?	.559	.000	.783
7. Do you find it easy to return punctually to a job without looking at the time, after a half hour break?	.397	.000	.792
8. Would you feel "completely lost" without a watch?	.369	.000	.795
9. Are you normally "surprised" when you discover the time?	.437	.000	.792
10. Do you think you are capable of knowing what the time is, when you wake up?	.643	.000	.778
11. If you had a week's holiday would you always wake up at the same time?	.334	.000	.797
12. How often do you need to check the time?	.273	.000	.800
13. Do you prefer doing things at certain times of the day?	.115	.023	.808
14. Do you prefer to eat at set times?	.275	.000	.799
15. Do you feel "disturbed" if you have to wake up much earlier than usual?	.286	.000	.802
16. Are you upset when you wake up later than usual?	.202	.000	.806
17. Can you work out the time by how awake you feel?	.484	.000	.788
18. When you wake up in the middle of the night, do you normally know how many hours sleep you have had?	.439	.000	.790

FACTOR ANALYSIS

The 18 items of the TAQ were factor analyzed for the sample of 392 subjects. Three factors were extracted explaining 43.700% of the total variance; the number of factors derived was determined by the scree test described by Cattell (9).

A varimax rotation was performed and the items with factor loadings greater than .30 were assumed to be associated with that factor (10). The rotating loa-

dings of the items ranged from -.338 to .792, as shown in Table II. The variance explained by the respective factors was 20.479% (factor 1), 12.298% (factor 2), and 10.923% (factor 3).

Each of the three factors was capable of a sensible interpretation. It would appear that Factor 1 labeled "Internal time" contained items that best reflects the ability to keep track of time. Items loading on Factor 2, labeled "Independence from a clock", appear to be

Table II: Varimax-rotated three-factor solution of the TAQ

Item	Factor loading
<i>Factor 1 – "Internal time"</i>	
1. Is it easy for you to know the time without a watch?	.506
2. When you wake up, do you know exactly what the time is, without looking at a clock?	.701
4. Is it easy for you to wake up at a desired time (without an alarm clock)?	.450
5. When you are relaxing, do you know the right time without looking at a watch?	.655
6. When you wake up in the middle of the night do you know the right time, without looking at a clock?	.740
7. Do you find it easy to return punctually to a job without looking at the time, after a half hour break?	.402
10. Do you think you are capable of knowing what the time is, when you wake up?	.737
17. Can you work out the time by how awake you feel?	.686
18. When you wake up in the middle of the night, do you normally know how many hours sleep you have had?	.577
<i>Factor 2 – "Independence from a clock"</i>	
8. Would you feel "completely lost" without a watch?	.774
9. Are you normally "surprised" when you discover the time?	.553
12. How often do you need to check the time?	.774
13. Do you prefer doing things at certain times of the day?	-.338
<i>Factor 3 – "Flexibility/rigidity of habits"</i>	
3. Is it easy for you to eat at any time?	.609
11. If you had a week's holiday would you always wake up at the same time?	.498
14. Do you prefer to eat at set times?	.614
15. Do you feel "disturbed" if you have to wake up much earlier than usual?	.507
16. Are you upset when you wake up later than usual?	.447
Note: Only rotated loadings greater than .30 are shown	

related to independence from a watch or a clock. The third factor, "Flexibility/rigidity of habits", consists of items reflecting regularity of eating-sleeping habits.

Cronbach alpha coefficients for each factor were computed and the following values were obtained:

$\alpha_{(9 \text{ items})} = .823$ for Factor 1;

$\alpha_{(4 \text{ items})} = .589$ for Factor 2;

$\alpha_{(5 \text{ items})} = .452$ for Factor 3.

CONCLUSIONS

The self-report TAQ was found to be simple to administer and easy to complete within a short period of

time. The reliability assessment results have shown the TAQ Portuguese version to have high internal consistency and to be stable over time.

An alpha coefficient of .802 indicated a good internal consistency (11, 12), and the Spearman-Brown coefficient was higher than a minimum of .7 usually required for reliability coefficients in general (13). In addition, the individual items were related to the concept supposed to be measured by the scale; the majority of the items correlated to the total score higher than .2 (14) or .3 (13). All, but three items, contributed to global TAQ internal consistency, as indicated by the decrease of alpha coefficients when excluding each

item. These analyses highlighted the homogeneity of TAQ items, and the ability of each individual item to adequately measure the concept supposed to be measured by the total TAQ. Item 13, however, although within the limits of acceptable criterion, performed poorly in all analyses. The test-retest coefficient of .862 for the total score indicates stability of the TAQ scores across time.

In relation to the exploratory factor analysis, the results suggested several dimensions for the 18 item TAQ. Factor 1, labelled "Internal time", seems to be the factor that best describes the ability of a person to keep track of time, possibly provided by internal signals associated to circadian rhythms. Nine of the 18 items loaded on this first factor. In addition, the internal consistency (Cronbach alpha coefficient) for this factor was found to be higher (.823) than for the others (.589 for factor 2; .452 for factor 3). Factor 3 consists of items reflecting regularity of eating-sleeping habits. It is interesting to note the similarities in the structure of this factor and some questions of the factor "rigidity/flexibility of sleeping habits" of the Circadian Type Questionnaire (15).

As far as we know, this is the first report on the reliability and factor structure of the Time Awareness Questionnaire, consequently no comparison is possible. Further research, including validity analyses and using shift work samples are needed, in particular to examine the relationship of the Time Awareness Questionnaire with tolerance to shift work and circadian rhythms amplitude.

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