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Normative study of 500 general-knowledge for true-false questions in Russian

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Open practices statement. The materials of this experiment can be found in the Supplemental material, as well as the data. Raw data available by contacting the first author.

Ethics statement: This study was reviewed and approved by the HSE University Ethics Committee. The participants provided their written informed consent to participate in this study.

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General knowledge questions are a valuable experimental stimulus that can be used to measure semantic memory processes (Kelley, & Parihar, 2018; Yee, Chrysikou, & Thompson-Schill, 2014). General knowledge questions can also be used in other multiple strands of research such as tip-of-tongue studies (Schwartz, 2010), errors in adults (Metcalf & Finn, 2011) and errors in children (Metcalf & Finn, 2012), false memory research (Luna & Martín-Luengo, 2012) among others. This type of valuable stimuli requires of normative studies to assure the cultural alignment of the content of the questions with the target sample since the mere translation from one language to another is insufficient (Buades-Sitjar, et al 2021a, 2021b; Duñabeitia et al 2016; Martín-Luengo, Zinchenko, Alekseeva, & Shtyrov, 2020; Nelson & Narens, 1980; Tauber, Dunlosky, Rawson, Rhodes, & Sitzman, 2013). It is also required to up-date the databases from time to time to adjust the questions to the continuing cultural changes (Tauber, et al, 2013), and to the different capacities of the population as for example the cognitive decline because of age (Coane & Umanath, 2021). In this study we aimed to create the first data base of general knowledge questions with a true-false format in Russian language.

There are different types of format for closed questions (Enders, Gaschler, & Kubik, 2021; Haladyna, Downing, & Rodríguez, 2002). For example, in multiple choice questions the participant is presented with one question and several alternatives and more often need to choose which of those alternatives is the correct one (for other formats of multiple-choice questions see Couch, Hubbard, & Brassil, 2018). In two-alternative force choice format participants are presented with a question and alternatives as with the multiple-choice format but in this case the number of alternatives is only two. Finally, in true-false questions the alternative provided are also two but, in this case, they are: true, false. That is, participants task is to decide whether the question, or statement, presented is true or not.

The format of the questions influences both, the memory and metamemory performance. True-false questions have been found to be more difficult and result in worse performance when compared with two alternative forced-choice (2AFC) tests (Jang, Wixted, & Huber, 2009). In a true-false test participant have less information at hand to decide which of the alternatives is the correct answer. For example, if someone has no clue about what is the capital city of Malawi, their choice between true and false for this sentence: "Lilongwe is the capital city of Malawi" will be random. However, if as option for the question: "What is the capital of Malawi?" are presented "Lilingwe" and "Pretoria", someone might discard Pretoria for knowing that is one of the three capital cities of South Africa, nor from Malawi. That is, the alternatives presented in a 2AFC test might aid the decision over which alternative to choose because they provide additional information.

The type of memory test also influences the metamemory performance. Several studies have shown that confidence judgments allow the participants to make finer grained distinctions between answers (Gonzalez & Nelson, 1996), even improving metacognitive monitoring (Huff & Nietfeld, 2009). For example, previous studies have reported that retrospective confidence is a better predictor of accuracy when associated to multiple-choice questions than when associated to other types of questions (Miesner & Maki, 2007; Maki, Willmon & Pietan, 2009). Also, other studies found that by comparing metamemory performance from multiple-choice questions with two-alternative and true-false questions, participants adopted a more conservative criterion of answering for the true-false questions most likely for lower access of information that these types of format the question provides (Arnold, et al, 2013).

True-false questions are widely used to asses student's learning (Burton, 2001; Enders, Gaschler, & Kubik, 2021). As a tool in research they have been used to study the boundaries of the calibration of subjective probability (Smith & Ferrell, 1983) the effect of feedback (Arnold,

Higham, & Martín-Luengo, 2013), and to test its retention benefits for its use as learning tool (Uner, Tekin, & Roediger, 2021). One of the main advantages of this format is that participants require less time to answer them and this is an asset in experiments that require of many trials. Moreover, these types of questions measure in a more direct approach participants' knowledge because there are not alternatives that participants can use as cue (i.e., choosing by discarding other options). In sum, the evidence points towards both, objective and subjective differences of the questions in true-false format when compared with other closed format questions. Moreover, these types of questions are very useful in time limited experiment and at the same time they are a less biased measured of participant's knowledge. But, the characteristics from one format of questions to another might dramatically change. Thus, it is required to run specific normative studies in order to gather reliable indices for these questions.

Methods

Participants

Fifty-five participants (M age = 25.5, SD = 4.05, 36 females) answered the online questionnaires. All of them reported a similar educational level.

Materials

Five hundred general knowledge questions (GKQ) were used in this experiment. The questions covered different topics from Natural Sciences, Social Sciences, and Culture and Sports.

Procedure

The experiment was conducted using google forms. The questions were divided into 5 tests and delivered to participants over the period of 5 days (1 day - 1 test). For each question

participants need to indicate whether it was a true or false statement and provide their confidence in the correctness of their choice. In particular, participants answers were collected using the drop-down answer option with the following alternatives: true-completely sure, true- highly sure, true-moderately sure, true-not sure, true-totally unsure, false-completely sure, false- highly sure, false-moderately sure, false-not sure, false-totally unsure. Confidence evaluations were coded as follows: completely sure – 100%, highly sure – 80%, moderately sure – 50%, not sure – 30%, totally unsure – 0%. After completing each of the tests, participants were provided a general feedback over their performance of that test.

Results and Discussion

See Table 1 and Figure 1 for a summary of the descriptive for all the answers. The three topics have a rather similar averaged accuracy ($\sim .65$), whereas the averaged confidence is lower for the questions of the category of Culture and Sports ($M = 46.47$, $SD = 17.61$ vs $M = 52.93$, $SD = 14.26$ for Natural Sciences, and $M = 51.8$, $SD = 16.45$ for Social Sciences). In the examination of the frequency chart for all questions is noticeable that despite there is a similar proportion of answers with an accuracy between .5 to .8, and a bit higher for .8 to .9, most of the confidence ratings are concentrated between 30 to 60 %. That is, the subjective perception of participants is that the questions were more difficult than they actually are, and most of them provided a confidence rating as if they were guessing in a true/false test, 50%.

In more detail by topic, each set of questions we tested covered all ranges of difficulties and participants' confidence (see Figures 2, 3, 4). In terms of accuracy, the questions from the categories Natural Sciences and Culture and Sports seems to cover a wider and more balance range, that is, our pool of tested questions cover all ranges of difficulty. However, the questions from Social Sciences are a less homogeneously distributed.

In terms of participants' subjective perception about the difficulty of the questions there is also certain variability among the topics. Based on the place of the peaks for each of the frequency charts, the questions for Social Sciences and Culture and Sports were considered more difficult compared to Natural Sciences questions. Confidence ratings for Social Sciences and Culture and Sports are around the 30-40% whereas for Natural Sciences questions the peak is around 50-60%. Thus, despite this small numerical difference in confidence, these results indicate a rather balanced perceived difficulty regardless of the topic of the questions.

Conclusions. This study reports norms for general-knowledge questions in true-false format in Russian language. It is important to note that instead of using the traditional true-false format for the answers, we used a more detailed procedure in which participants could regulate their answers within five levels for true and another five levels for false. This modification allowed us to collect more information about the difficulty perceived by participants, therefore, more knowledge about the quality of the questions.

Our study has also some limitations as for example the participants' age range. Previous studies have pointed the need of norms adequate to the cognitive capacities of participants (Coane, & Umanath, 2021). Thus, considering that our sample is rather young, these norms should be carefully applied to other populations such as older who most of their members have some level of cognitive decline. Another limitation is directly related to the set of questions from the topic Culture and Sports. These particular set of questions will require also a careful consideration for the researchers before of being used since they are potentially more easily outdated with time. Because of this, its difficulty-objective and subjective- might change from the one reported here.

References

- Arnold, M. M., Higham, P. A., & Martín-Luengo, B. (2013). A little bias goes a long way: The effects of feedback on the strategic regulation of accuracy on formula-scored tests. *Journal of Experimental Psychology: Applied*, 19(4), 383.
- Buades-Sitjar, F., Boada, R., Guasch, M., Ferré, P., Hinojosa, J. A., & Duñabeitia, J. A. (2021). The predictors of general knowledge: Data from a Spanish megastudy. *Behavior Research Methods*, 1-12.
- Buades-Sitjar, F., Boada, R., Guasch, M., Ferré, P., Antonio Hinojosa, J., Brysbaert, M., & Andoni Duñabeitia, J. (2021). The thousand-question Spanish general knowledge database. *Psicológica*, 42(1).
- Burton, R. F. (2001). Quantifying the effects of chance in multiple choice and true/false tests: question selection and guessing of answers. *Assessment & Evaluation in Higher Education*, 26(1), 41-50. doi: [10.1080/02602930020022273](https://doi.org/10.1080/02602930020022273)
- Coane, J. H., & Umanath, S. (2021). A database of general knowledge question performance in older adults. *Behavior Research Methods*, 53(1), 415-429.
- Duñabeitia, J. A., Griffin, K. L., Martín, J. L., Oliva, M., Sámano, M. L., & Ivaz, L. (2016). The spanish general knowledge norms. *Frontiers in Psychology*, 7, 1888.
- Enders, N., Gaschler, R., & Kubik, V. (2021). Online quizzes with closed questions in formal assessment: How elaborate feedback can promote learning. *Psychology Learning & Teaching*, 20(1), 91-106. doi: 10.1177/1475725720971205
- González, R. & Nelson, T. O. (1996). Measuring ordinal association in situations that contain tied scores. *Psychological Bulletin*, 119, 159-165.

- Haladyna, T. M., Downing, S. M., & Rodriguez, M. C. (2002). A review of multiple-choice item writing guidelines for classroom assessment. *Applied Measurement in Education*, 15(3), 309–333. https://doi.org/10.1207/s15324818ame1503_5
- Huff, J. D. & Nietfeld, J. L. (2009). Using strategy instruction and confidence judgments to improve metacognitive monitoring. *Metacognition and Learning*, 4, 161-176.
- Couch, Brian A., Hubbard, Joanna K. & Brassil, Chad E. (2018). Multiple–True–False Questions Reveal the Limits of the Multiple–Choice Format for Detecting Students with Incomplete Understandings. *BioScience*, 68, 455–463, <https://doi.org/10.1093/biosci/biy037>
- Jang, Y., Wixted, J. T. & Huber, D. E. (2009). Testing signal-detection models of yes/no recognition and two-alternative-forced-choice recognition memory. *Journal of Experimental Psychology: General*, 138, 291-306.
- Kelley, M. R., & Parihar, S. A. (2018). Part-set cueing impairment & facilitation in semantic memory. *Memory*, 26(7), 1008-1018.
- Luna, K., & Martín-Luengo, B. (2012). Confidence–accuracy calibration with general knowledge and eyewitness memory cued recall questions. *Applied Cognitive Psychology*, 26(2), 289-295. doi: [10.1002/acp.1822](https://doi.org/10.1002/acp.1822)
- Maki, R. H., Willmon, C., & Pietan, A. (2009). Basis of metamemory judgements for text with multiple-choice, essay and recall tests. *Applied Cognitive Psychology*, 23, 204-222.
- Martín-Luengo, B., Zinchenko, O., Alekseeva, M., & Shtyrov, Y. Y. (2020). Russian norms for 500 general-knowledge questions. *Frontiers in Psychology*, 11, 2269.
- Metcalfe, J., & Finn, B. (2011). People’s hypercorrection of high-confidence errors: Did they know it all along? *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 37, 437–448. doi: [10.1037/a0021962](https://doi.org/10.1037/a0021962)

- Metcalfe, J., & Finn, B. (2012). Hypercorrection of high confidence errors in children. *Learning and Instruction*, 22, 253–261. doi:[10.1016/j.learninstruc.2011.10.004](https://doi.org/10.1016/j.learninstruc.2011.10.004)
- Miesner, M. T., & Maki, R. H. (2007). The role of test anxiety in absolute and relative metacomprehension accuracy. *European Journal of Cognitive Psychology*, 19, 650-670.
- Nelson, T. O., & Narens, L. (1980). Norms of 300 general-information questions: Accuracy of recall, latency of recall, and feeling-of-knowing ratings. *Journal of Verbal Learning and Verbal Behavior*, 19(3), 338-368.
- Schwartz, B. L. (2001). The relation of tip-of-the-tongue states and retrieval time. *Memory & Cognition*, 29, 117–126. doi:[10.3758/BF03195746](https://doi.org/10.3758/BF03195746)
- Smith, M., & Ferrell, W. R. (1983). The effect of base rate on calibration of subjective probability for true-false questions: Model and experiment. In *Advances in Psychology* (Vol. 14, pp. 469-488). North-Holland. doi: 10.1016/S0166-4115(08)62251-7
- Uner, O., Tekin, E., & Roediger, H. L. III. (2021). True–false tests enhance retention relative to rereading. *Journal of Experimental Psychology: Applied*. doi: [10.1037/xap0000363](https://doi.org/10.1037/xap0000363)
- Yee, E., Chrysikou, E. G., & Thompson-Schill, S. L. (2014). Semantic memory. In K. N. Ochsner & S. M. Kosslyn (Eds.), *The Oxford handbook of cognitive neuroscience, Vol. 1. Core topics* (pp. 353–374). Oxford University Press.

Table 1

Distribution, Mean (Standard Deviation) of Answers split by Topic.

	Natural Sciences	Social sciences	Culture and sports
Number of questions	259	104	137
Accuracy	0.67 (0.22)	0.68 (0.22)	0.64 (0.23)
Confidence	52.93 (14.26)	51.8 (16.45)	46.47 (17.61)

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Figure 1

Accuracy and Confidence Frequency Distribution of Answers for All Questions.

Figure 2

Accuracy and Confidence Frequency Distribution of Answers for Social Science Questions.

Figure 3

Accuracy and Confidence Frequency Distribution of Answers for Natural Science Questions.

Figure 4

Accuracy and Confidence Frequency Distribution of Answers for Culture and Sports Questions.