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Russian norms for 500 general-knowledge questions

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Abstract

Normative studies are needed to ensure adequate experimental control. Complex materials such as general-knowledge questions are specially critical because general knowledge can differ enormously from one country to another. In this study we aimed to normativize 500 general-knowledge questions in Russia. Currently there are banks of normative questions in several languages and countries, such as English-USA and Spanish-Spain, but there are no such databases in Russian. We selected 500 questions covering diverse topics and asked 103 participants to answer them by selecting one alternative out of four. They were then asked to rate their confidence in their selection. We provide the statistics for the entire sample group and for female and male participants. This work constitutes the first attempt to create a Russian database of general-knowledge questions. This database can be used to better control experimental conditions in Psychology and Neuroscience experiments.

Keywords: General knowledge questions, recognition, calibration curves, metacognition.

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General knowledge varies from one country to another; therefore, the mere translation of tools from one language to another is usually not enough. This is one of the conclusions that can be extracted from the results of the Program for International Student Assessment (PISA), a measure of the knowledge achieved by 15-year-olds. This assessment provides each country (79 in 2018) with a comparative measure of the efficiency of their educational programs within an internationally agreed common framework and allows them to identify the most effective educational practices. Over the years, this periodic measure has reflected clear differences between countries in different areas of knowledge. The PISA program assesses mathematics, sciences and reading, designed as an indicator of "how well the students master key subjects in order to be prepared for real-life situations in the adult world" (PISA, 2019). An example of a question used in the PISA test is: "As a meteoroid approaches Earth and its atmosphere, it speeds up. Why does this happen?: (1) The meteoroid is pulled in by the rotation of Earth; (2) The meteoroid is pushed by the light of the Sun; (3) The meteoroid is attracted to the mass of Earth; (3) The meteoroid is repelled by the vacuum of space." The PISA program was first conducted in 2000 and despite the educational changes implemented by each government to increase student competitiveness, significant differences between countries remain. In sum, general knowledge varies from country to country owing to the variety of educational practices.

In cognitive research, different materials are used such us pictures, words, sentences, texts, etc. Several studies have shown that the mere translation of semantic materials into the native language of each country is not enough for simple materials such as words. Akinina, Malyutina, Ivanova, Iskra, Mannova, and Dragoy (2015) ran a study aimed primarily at validating semantic and visual material (words and pictures) in Russian to ultimately be used in experiments for designing clinical interventions of language recovery. Akinina et al. (2015) found that name agreement scores for visual stimuli influence the latencies in both object and action naming, and that name agreement and frequency were the dimensions with the highest variability depending on the use of the word in a specific area. Similar results have been also found in Spanish (Cuetos & Alija, 2003), Japanese (Nishimoto, Ueda, Miyawaki, Une, & Takahashi, 2012), and other languages. To conclude, experimental materials such as words should be normative or at least carefully selected from language databases to avoid any distortion of results. This highlights a similar need for more complex materials such as general-knowledge questions.

Traditionally, the reference for general-knowledge questions is the study conducted by Nelson and Narens (1980). However, their study was carried out with a population from the USA, and despite the authors' effort to avoid cultural references and therefore enable a wider use, the PISA reports still show us that the accuracy values can differ across countries. Recently, Tauber, Dunlosky, Rawson, Rhodes, and Sitzman, (2013) conducted a study to update the results of Nelson and Narens in which possible differences among US states was also considered and controlled in terms of accuracy and other measures. The same logic underlies in the category norms update published by Van Overshelde, Rawson, and Dunlowsky (2004). Along the same lines, Duñabeitia et al. (2016) ran a normative study of general-knowledge questions in Spain to provide a cross-cultural validation of Tauber´s data with a Spanish population. These studies highlight the need for similar normative studies in each country.

The aim of the present study is to validate in the Russian language a large pool of general-knowledge questions on different topics that can be used in different areas of study from Psychology to Neuroscience. We decided to use multiple-choice questions because they can be used in a broad range of experiments and are particularly suitable for use in experiments in which the time of stimuli presented is controlled and short. Moreover, multiple-choice question tests are widely used to measure general knowledge (e.g., PISA tests, GRE, etc), but their difficulty often relies on the lures presented along with the correct answer. The accuracy of the question: "What is the name of the so-called powerhouse of the cell?" will dramatically diverge if the alternatives offered are: mitochondria, ribosome, golgi apparatus or vesicle, or purpurin, mitochondria, DNA, feet. Adequately transforming recall to multiple-choice questions is not an easy task, whilst the other way around is easier. Moreover, multiple-choice questions are widely used in experimental research. Therefore, we decided to validate multiple-choice questions and provide the percentage of each alternative selected along with their corresponding confidence rating.

Metacognitive evaluations such as retrospective confidence judgments provide valuable information about the selection of a specific answer. Retrospective confidence is the subjective assessment of how correct a selected answer is in the case of a multiple-choice question. In the current research, confidence judgments can inform us about the perceived difficulty of the questions. Even when participants predominantly select the correct answer to a given question, if the overall confidence is low, this will indicate that the question is perceived as difficult. Moreover, confidence judgements can help us detect “consensual answers” (Koriat, 2008). These types of alternatives are often confused with the correct answer due, for example, to greater familiarity with the incorrect information. For example, since the city of Sidney is so popular in terms of sports, cultural life, and being first major capital city to enter the New Year, it is not uncommon for participants to choose Sidney over Canberra when questioned about the capital of Australia. In this case, the question itself is not perceived as difficult, but containing Sidney as an option is often misleading and conducive to error. Therefore, asking participants to specify their confidence in the correctness of their selections will make it possible to better characterize the questions and allow researchers to more finely tune selections in future studies based on their objectives.

Finally, since we collected data from a large sample size with near to equal numbers of female and male participants, we also report overall accuracy and confidence ratings split by gender.

Method

Participants

One hundred three participants (58 females, mean age = 21.97, *SD* = 4.04) recruited on social media took part in the experiment for a small monetary compensation (250 rubles per hour of experiment). Five participants did not report the number of hours of sleep; for those who did, the mean average was *M* = 7.76 (*SD* = 1.38).

Materials and Design

Five hundred two multiple-choice general-knowledge questions (GKQ) were used in the experiment. Five hundred questions were used in the experimental part and two for training. The GKQ covered different topics – history, chemistry, biology, literature, orthography and punctuation, and geography. The GKG were selected to include all levels of difficulty: easy, medium, and difficult. For each question, participants had to select one alternative and rate the confidence they had in its correctness on an eleven-point confidence scale ranging from 0% (totally unsure) to 100% (totally sure). Dependent variables were: (1) accuracy, and (2) confidence in the correctness of the selected answer.

Procedure

The experiment was programmed using SR Research Experiment Builder (SR Research, Toronto, Ontario, Canada). The experiment consisted of one training session with two questions, and 10 experimental blocks with 50 questions each. The order of appearance of the questions in the experimental blocks as well as the placement on the screen of the alternatives was fully counterbalanced for each participant. The training questions were the same for all participants.

Participants were tested individually on a computer. First, participants read and signed the informed consent form and completed the demographic data along with questions about the number of hours of sleep they got the previous night, level of education, and medication intake. They were then given instructions explaining every phase of the experiment and presented with two training questions. The experiment then started. In each trial, participants first saw the question on the screen for 4 seconds. Then, a fixation point was presented in the middle of the screen for 3 seconds, during which participants were instructed to fixate and think about the answer to the question previously presented. This time was included in order to allow participants to retrieve potential answers. Next, four alternative answers appeared on the screen and participants had to select the one they considered correct by clicking it with the mouse. In the last step, participants selected the confidence in the correctness of their selection. The experiment lasted approximately 2.5-3 hours. Between blocks, there were breaks of 2-3 minutes in which participants were instructed to move away from the computer, stretch their muscles, eat or drink small snacks, and go to the bathroom if needed. Additionally, participants could also take a rest after each question.

Results and Discussion

General characterization of the questions. Out of the 500 multiple-choice general-knowledge questions, all participants consistently chose the correct answer for eight of them. In addition, there were seven questions more for the group of females (total of 15) and 12 for the group of males (total of 17) for which participants of each gender always selected the correct choice. There were 19 questions in the entire sample for which participants only selected one of two alternatives (the other two were never selected), and 66 questions for which one of the alternatives was never chosen. All of the questions for which one, two, or three alternatives were not selected are indicated in Supplemental material.

Accuracy. Recognition tests are easier to solve than other memory tests such as cued-recall or free recall because they are based on familiarity (Martín-Luengo, Migueles, & Luna, 2012; Richardson-Klavehn, & Bjork, 1988; Tulving, 1985). This familiarity makes it challenging to create recognition questions covering all levels of difficulty. Figure 1A shows the distribution of answer accuracy. A visual inspection denotes slightly more questions with accurate answers (more questions with accuracy of over .80 than questions with accuracy below .20), but overall we obtained a homogeneous distribution.

Confidence. Figure 1B shows the distribution of the questions based on confidence ratings without considering their accuracy. This subjective experience is important in memory tasks because it is the basis for deciding whether to keep or stop searching for the correct answer. Regardless of accuracy, if we rate an answer with 85% confidence we will probably stop searching for more plausible alternatives than if our confidence rating was 20% (Koriat, Goldsmith, & Pansky, 2000). Figure 1B shows a homogeneous distribution of answers based on confidence ratings similar to the distribution of answers based on accuracy shown in Figure 1A. In this case, there are also more questions rated with high confidence than low confidence. This was normal and expected considering the accuracy values and the type of memory test.

Calibration curves. Confidence-accuracy calibration curves show the correspondence between answer accuracy (objective measure) and confidence (subjective measure) with which answers are given in a test (Juslin, Olson, & Winman, 1996). The graphical representation of a perfect calibration curve, where the x-axis represents confidence and the y-axis accuracy, is the diagonal and represents the point in which accuracy and confidence are perfectly matched (i.e., answers with .20 accuracy are rated with 20% confidence). There is “overconfidence” when the confidence rating is higher than the accuracy obtained (e.g., .50 accuracy with 70% of confidence), and “underconfidence" when the pattern is reversed, that is, lower confidence rating than the accuracy obtained (e.g., .50 accuracy with 20% of confidence).

We plotted three calibration curves, one for all the participants together, one with only female participants and another one with only male participants (see Figure 2). We also provide the amount of questions used to compute each data point. For the calibration curve to be reliable, it is recommended to have 200 data points per confidence level (Juslin, et al, 1996). All our points exceed that value.

The three calibration curves are similar and do not differ at any confidence level. Moreover, the three calibration curves show the so-called "hard-easy"-effect (Griffin, & Tversky, 1992; Luna & Martín-Luengo, 2012) for which we underestimate our abilities in easy tasks while overestimate them in difficult tasks. In the present case, the hard-easy effect is shown because easy questions were rated with lower confidence than they should be, and difficult questions were rated with higher confidence.

We computed the Calibration index (*C*; for calculations see Brewer, Keast, & Rishworth, 2002) to quantify the calibration curve to compare the female and males groups. A perfect calibration is indicated by 0, and higher values indicate a worse calibration. There were no differences in the calibration of female (M = .041, SD = .027) and male (M = .040, SD = .026), $t(44)$ = .209, p = .835. Also, both *Cs* were significantly different from 0, for females $t(44)$ = 10.156, p < .001, and for males, $t(44)$ = 9.950, p < .001.

Conclusions. This experiment was aimed to gather norms of general-knowledge questions in Russian. As explained above, these types of studies are needed in order to better control the variables we want to manipulate. The mere translation of experimental materials disregards all cultural background, which has in fact been shown to affect problem solving (Chen & Honomichl, 2004). The multiple-choice format with four options made the present battery of questions suitable for a wide variety of experiments. Moreover, the additional information obtained from the participants' subjective experience will enable experimenters to more carefully select questions to guide their experiments.

Acknowledgements

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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.

References

Akinina, Y., Malyutina, S., Ivanova, M., Iskra, E., Mannova, E., & Dragoy, O. (2015). Russian normative data for 375 action pictures and verbs. *Behavior Research Methods, 47*, 691-707. doi: 10.3758/s13428-014-0492-9.

Brewer, N., Keast, A., & Rishworth, A. (2002). The confidence–accuracy relationship in eyewitness identification: The effects of reflection and disconfirmation on correlation and calibration. *Journal of Experimental Psychology: Applied, 8*, 44–56.

Cuetos, F., & Alija, M. (2003). Normative data and naming times for action pictures. *Behavior Research Methods, Instruments, & Computers, 35*,168–177. doi:10.3758/BF03195508

Chen, Z., Mo, L., & Honomichl, R. (2004). Having the memory of an elephant: long-term retrieval and the use of analogues in problem solving. *Journal of Experimental Psychology: General*, *133*, 415-433.

Griffin, D., & Tversky, A. (1992). The weighing of evidence and the determinants of confidence. *Cognitive Psychology*, *24*, 411-435

Koriat, A. (2008). Subjective confidence in one's answers: The consensuality principle. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 34*, 945-959. doi:10.1037/0278-7393.34.4.945

Koriat, A., Goldsmith, M., & Pansky, A. (2000). Toward a psychology of memory accuracy. *Annual Review of Psychology*, *51*, 481-537. doi:10.1146/annurev.psych.51.1.481

Juslin, P., Olsson, N., & Winman, A. (1996). Calibration and diagnosticity of confidence in eyewitness identification: Comments on what can be inferred from the low confidence–accuracy correlation. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, *22*, 1304-1316. doi: 10.1037/0278-7393.22.5.1304

Luna, K., & Martín-Luengo, B. (2012). Confidence–accuracy calibration with general knowledge and eyewitness memory cued recall questions. *Applied Cognitive Psychology*, *26*, 289-295. doi: 10.1002/acp.1822

Martín-Luengo, B., Luna, K., & Migueles, M. (2012). Efecto del tipo de prueba de evaluación en la memoria y valoración de marcas publicitarias. *Escritos de Psicología*, *5*, 24-30. doi:10.5231/psy.writ.2012.0611

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*, 338-368

Nishimoto, T., Ueda, T., Miyawaki, K., Une, Y., & Takahashi, M.(2012). The role of imagery-related properties in picture naming: A newly standardized set of 360 pictures for Japanese. *Behavior Research Methods, 44*, 934–945. doi:10.3758/s13428-011-0176-7

Richardson-Klavehn, A. & Bjork, R. A. (1988). Measures of memory. *Annual Review of Psychology, 39*, 475-543. doi:10.1146/annurev.ps.39.020188.002355.

Tauber, S. K., Dunlosky, J., Rawson, K. A., Rhodes, M. G., & Sitzman, D. M. (2013). General knowledge norms: Updated and expanded from the Nelson and Narens (1980) norms. *Behavior Research Methods*, *45*, 1115-1143. doi: 10.3758/s13428-012-0307-9

Tulving, E. (1985). Memory and consciousness. *Canadian Psychologist, 26*, 1-12. doi:10.1037/h0080017.

Van Overshelde, J. P., Rawson, K., & Dunlowsky, J. (2004). Category norms: An updated and expanded version of the Battig and Montague (1969) norms. *Journal of Memory and Language, 50*, 289-335.

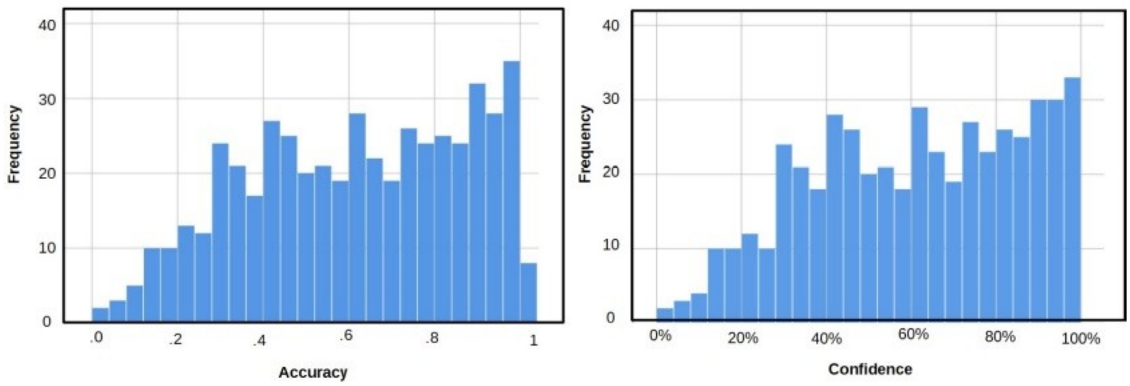

Figure 1A. Distribution of answers based on accuracy.
Figure 1B. Distribution of answers based on confidence ratings.

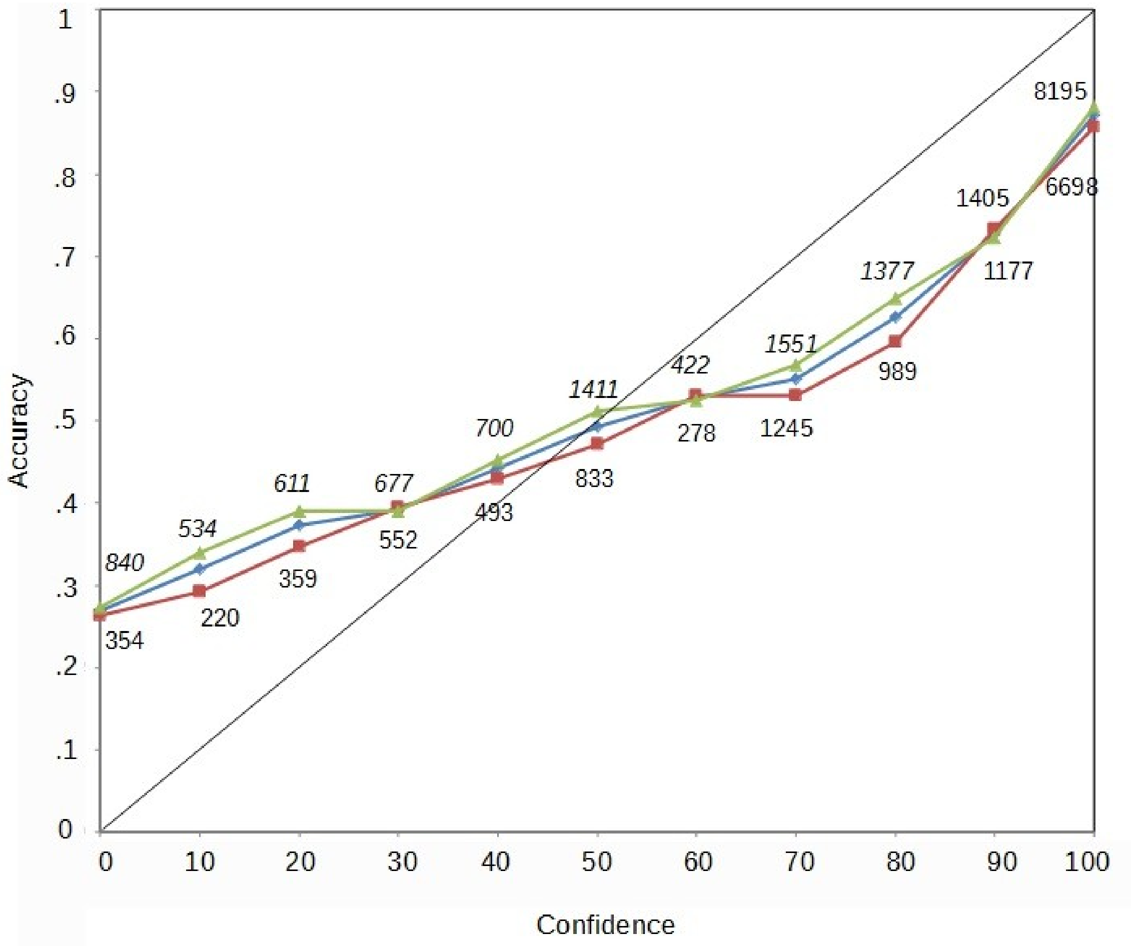

Figure 2. Calibration curves. Diamonds represent the calibration for the entire sample; triangles represent the calibration curve for female participants; squares represent the calibration curves for male participants. The numbers correspond to the amount of of points to create the calibration.