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Sálfræðideild

Normative Data on Two Parallel Forms of the

Cognitive Estimation Task in Icelandic

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Foreword

Submitted in partial fulfillment of the requirements of the BSc Psychology degree, Reykjavik University, this thesis is presented in the style of an article for submission to a peer-reviewed journal.

This thesis was completed in the Spring of 2020 and may therefore have been significantly impacted by the COVID-19 pandemic. The thesis and its findings should be viewed in light of that.

Útdráttur

Oft í lífinu þurfa að vera teknar ákvarðanir sem byggja á því að ekki er bersýnilegt hver rétta ákvörðunin er en samt er hægt að nálgast bestu lausnina með að beita rökrænni hugsun. Þetta kallast að bera huglægt mat á hluti (e. cognitive estimation) og hefur það verið mælt með prófi sem kallast the Cognitive Estimation Task (CET). Fólk með framheilaskaða á það til að standa sig verr en heilbrigðir í CET og er því CET góð skimun fyrir því hvort manneskja hrjáist af einhvers konar skaða á framheilasvæðum. Í þessari rannsókn var miðað að því að þýða tvær útgáfur af CET yfir á íslensku sem voru svo prófaðar á heilbrigðum einstaklingum. Prófaðir voru 72 heilbrigðir Íslendingar á aldrinum 21-65 ára í þessari rannsókn. Niðurstöður gefa upp dreifingu heilbrigðra Íslendinga á þessu prófi sem er svo hægt að nota til samanburðar. Próffræðilegir eiginleikar prófsins urðu aðeins lakari við þýðingu yfir á íslensku svo að það er ljóst að nokkuð þarf að fínpússa prófið áður en það verður tilbúið fyrir almenna notkun á Íslandi.

Lykilorð: Cognitive Estimation Task, CET, framheilaskaði, heilabilun

Abstract

Often in life decisions need to be made without the knowledge of what the apparent right choice is but nonetheless people are usually quite good at making the right assumptions to what solution is close to be the best one. This is called cognitive estimation which can be measured with a test called the Cognitive Estimation Task (CET). People that suffer from frontal lobe damage tend to perform poorer on the CET than healthy individuals and that is why CET can be a good tool to assess whether there might be a possibility of frontal lobe damage in a person. In this study two version of the CET were translated into Icelandic and tested on healthy individuals. Seventy and two healthy Icelandic people aged 21-65 years of age took part in this study. The results show the distribution of the answers of healthy Icelandic people which can be used as comparison. The psychometric properties of the measure suffered from being translated and tested on Icelanders so it is clear that some refining is needed before these versions of CET can be used in Iceland.

Keywords: Cognitive Estimation Task, CET, frontal lobe damage, dementia

Normative Data on Two Parallel Forms of the Cognitive Estimation Task in Icelandic

Cognitive estimation is used when information about a subject can not be accurately remembered. This cognitive function is often used in everyday life because not all information is available all the time, so the need to make reasonable estimations is necessary for creating responses which are appropriate in different scenarios. If this cognitive estimation is somewhat disturbed it can influence a person's decision making. Therefore, it is important that this cognitive quality can be measured in an unbiased matter.

Shallice and Evans (1978) created a measure of this quality which is called the Cognitive Estimation Task (CET). The CET is made up of questions that require participants to come up with estimated answers since the answer to the questions is not something that is known accurately but can be estimated through cognition. Numerous versions of CET have been published since the first one in 1978 as questions become outdated and adjustments need to be made across cultures and between languages (Wagner et al., 2010).

There are factors that can have an impact on how well a person can use their cognitive estimation well and one prominent is damage to the frontal lobes (Sala et al., 2004; Stanhope et al., 1998; MacPherson et al., 2014; Smith & Milner, 1984). Cognitive estimation requires a lot of factors to work together so the estimation can be accurate. Frontal lobes have been shown to be very important when it comes to executive functions (Stuss & Levine, 2002) which resonates with why people with damaged frontal lobes would have less ability to create accurate estimations. People with frontal lobe damage tend to perform poorly on the CET compared to individuals who do not have frontal lobe damage (Shallice & Evans, 1978; MacPherson et al., 2014). Therefore, the CET can be used to give some idea to whether a person is suffering from some damage to the frontal lobes. Frontal lobe damage is not the only reason why people can

perform poorly on the CET. There are numerous other reasons why the ability to make proper cognitive estimations is lacking in people which includes Alzheimer's disease (Sala et al., 2004; Levinoff et al., 2006; Brand et al., 2002), Korsakoff's disease (Brand et al., 2003; Kopelman et al., 1999) and other form of dementia (Mendez et al., 1998; Billino et al., 2008; Leng & Parkin, 1988). This list is not an exhaustive one and there is probably no limit for the causes of a poor ability to perform cognitive estimations.

In the case of a patient named EVR (Eslinger & Damasio, 1985) who had frontal lobe damage there were numerous measures done on him. EVR showed good performance in normal tests for numerous cognitions such as language, memory and calculation and was logical in his thoughts about ethical problems and politics. He understood everything that he was asked of and seemed nonchalant about the whole experience. It then came as a surprise that EVR had a really hard time when it came to make the right choices in real-life situations. This showed that even though EVR had scored high on multiple measures of cognition it all fell apart when making accurate assessments of what was the right choice in each instance. People with frontal lobe damage can often perform well on regular neuropsychological tests which are often very structured which make people lead to believe that there is no brain damage apparent. It does not become apparent until people have to try to use their executive functions to make real-life decisions that there is something amiss in their train of thought (Eslinger & Damasio, 1985; Shallice & Evans, 1978). It is thus important to examine whether a person has a difficult time making accurate assessments so there is a less of a chance that a person is wrongly diagnoses not having frontal lobe damage.

Two parallel versions of CET were created by MacPherson et al. (MacPherson et al., 2014) which consisted of nine questions each. These versions of the CET were developed to be

more up to date than older versions of the CET and in these versions people were encouraged to think thoroughly about their answers and were allowed to change their mind as often as they liked so the measure would be as accurate as possible (MacPherson et al., 2014). Since these measures were parallel it was convenient to use them both to get two results from similar tests without having to worry about practice effects.

To the author's knowledge there were no CET in Icelandic that could be used to assess cognitive estimation at the time of the study. The CET can be a strong tool in helping physicians assess whether there is some evidence for frontal lobe damage in a person (Shallice & Evans, 1978; Sala et al., 2004). There is much to be gained to have a strong Icelandic version of CET which is current and has good psychometric properties.

In this study an Icelandic version of these two parallel versions of CET (MacPherson et al., 2014) were tested on Icelandic individuals who had no history of brain damage or other degenerative brain diseases. The aim of the research was to create normative data for the two versions of CET (MacPherson et al. 2014) for the Icelandic population and to also see if the measures would be compatible after translation with the original measures which were in English. The similarities between the internal stability of the original measures and the Icelandic versions were examined and whether there was any disparity in the variance of each item between different versions of CET.

Method

Participants

Seventy and two healthy Icelandic adults of the age between 21-65 (M = 31.51, SD = 8.97) took part in this research, thereof were 38 men and 34 women. There was a requirement for participation that the participant had not been diagnosed with any form of dementia and had not

received a serious head injury. All participants had Icelandic as their first language. Six participants (8.3%) had a master's degree or a PhD, 39 participants (54.2%) had a Bachelor degree, 24 participants (33.3%) had finished college education or some other compatible education and 3 participants (4.2%) started college but did not finish. There were no participants who did not finish the lowest level of education in Iceland. The participants gave their full written consent to take part in this research. Participants were recruited through an online advertisement, word of mouth and the Psychology department of Reykjavik University. The participants had no financial or personal gain to obtain from this research. No traceable personal information about the participants was gathered by the researcher.

Measures

Two parallel measures of cognitive estimation were used which are called The Cognitive Estimation Task (CET). The versions used in this research were Icelandic translations of two parallel forms of the CET which were developed by Macpherson et al. (2014). Each measure consists of nine questions which were aimed at testing the strength of the skill of using cognitive estimation. Each question is built up in such a way that there is little chance that a correct answer is known but a good estimate can be done through cognition. Examples of these kind of questions are "How many notes on a piano?" and "What is the length of a regular necktie?". Both questions are from the CET measures used (Macpherson et al., 2014). These measures got the name CET A and CET B. CET A and CET B had relatively low reliability with a Cronbach's $\alpha = .44$ and Cronbach's $\alpha = .51$, respectively and the Guttman split-half reliability coefficients were .47 and .59, respectively. There are no available psychometric properties for the Icelandic translation of these versions of the CET since this is the first time they have been translated and tested in Icelandic.

For each item on these versions of CET there was a possible error score ranging from 0-3. If your answer were between the 20th percentile and 80th percentile then you would be awarded an error score of 0 which was considered as normal. Answers that were more than the 80th percentile but less than or equal to the 90th percentile or were equal to or more than the 10th percentile but less than the 20th percentile would generate an error score of 1 which is quite extreme. Answers that were more or equal to the 5th percentile but less than the 10th percentile or more than the 90th percentile but lower or equal to the 95th percentile would generate an error score of 2 which was considered extreme. Answers that were lower than the 5th percentile or higher than the 95th percentile generated an error score of 3 which were very extreme. Every error score for each question would be added together for each version of CET and then the sum would represent a total error score which could be in the range 0-27 for either CET A or CET B. The higher the error score a person would accumulate the more lack of the the ability to use cognitive estimation properly.

Procedure

Before the CET was administered people were told that knowing the right answer to the questions was not important but rather answering to the best of your ability. The researcher also told participants that he did not know the answers himself so there would be no help in trying to assess the reactions of the researcher when questions were answered. This was done so the participants would not chance their answers if the researcher reacted in a certain manner to an answered question.

The CET was administered to people verbally either face to face with the researcher or via a phone call. The participants could answer each question with the measure unit of their choice and if there was any trouble understanding the questions the researcher could elaborate on

what they meant by the question, which often helped clarify any misunderstanding regarding the questions. By administering the test verbally the researcher ensured that most of the questions were answered accurately and took away the possibility of cheating on the measure by looking up the right answers to the questions. Participants could change their answers as many times as they liked so impulsivity would be less of a factor in the choice of answers. It took every participant around ten minutes to complete the measure but there was no time limit for finishing it.

Statistical analysis

To assess whether the internal consistency of the measures held it's standard through translation the Cronbach's alpha coefficient (Cronbach & Meehl, 1955) and Guttman split-half reliability coefficienst (Guttman, 1945) were used. The data gathered from that was then compared to the internal consistency from the original study. To assess whether items were normally distributed the Shapiro-Wilk test of normality (Shapiro & Wilk, 1965) was used. Multivariate Analysis of Variance (MANOVA) was performed to see whether there was any significant difference between the answers of men and women.

Results

The descriptive statistics of all the items in measure CET A and CET B can be found in Table 1 and Table 2, respectively. In addition to that there is information about the skewness and kurtosis of each item in both CET A and CET B and results from the Shapiro-Wilk tests of normality in Table 1 and Table 2, respectively. All of the items except one had variance that significally deviated from normal distribution according to the Shapiro-Wilk test of normaility. The only item who had variance that did not deviate significantly from normal distribution was: „Hver er hámarkshraði Harley-Davidson mótorhjóls?". Since the measure is designed in such a

way that answers are almost always going to be valid there were no missing or unusable items in the study.

Table 1

Minimum and maximum values for each item of CET A and their means and standard deviations.

Item	Unit	Min.	Max.	Mean	SD	Skewness	Kurtosis	Shapiro-Wilk
Hver er hámarkshraði Harley-Davidson mótorhjóls?	km/h	80.00	400.00	230.43	59.34	-.04	.73	.98
Hver er meðallengd á nýfæddu barni?	cm	20	60	45.75	9.13	-1.10	.56	.85**
Hversu hratt hlaupa veðhlaupahestar?	km/h	15	200	70.53	30.25	2.12	6.62	.80**
Hver er meðalskokkhraði fólks?	km/h	5.00	30.00	11.24	5.60	1.56	2.33	.83**
Hversu mörg lauf eru í appelsínu?	segments	4.00	20.00	9.18	2.56	1.26	3.94	.88**
Hversu langur er nýr blýantur?	cm	7.00	30.00	16.03	4.58	.39	.01	.95*
Hver er hámarkshraði blettatígurs?	km/h	30.00	300.00	99.83	40.48	2.05	8.12	.82**
Hver er meðallengd fjallahjóls fyrir karla?	m	.60	3.50	1.61	.41	.88	6.07	.89**
Hversu margir takkar eru á hefðbundnu lyklaborði?	keys	30	160	64.07	24.43	1.77	4.07	.85**

*Note. * = p < .01, ** = p < .001*

Table 2

Minimum and maximum values for each item of CET B and their means and standard deviations.

Item	Unit	Min.	Max.	Mean	SD	Skewness	Kurtosis	Shapiro-Wilk
Hver er meðalgönguhraði dæmigerðs heilbrigðs fullorðins karlmanns?	km/h	2.00	17.00	4.99	2.57	2.01	5.97	.81**
Hversu langt er hefðbundið hálsbindi?	m	.10	2.50	.92	.43	.69	1.81	.94*
Hversu hröð er hraðasta uppgjöfin í tennis?	km/h	20.00	300.00	102.07	57.87	.74	.66	.95*
Hversu margar nótur eru á hefðbundnu píanói?	notes	10.00	300.00	68.49	39.91	3.21	16.40	.74**
Hvað er elsti Íslendingurinn gamall?	age	101.00	120.00	105.76	3.39	1.30	2.95	.90**
Hver er lengd hryggs hjá meðalmanneskju?	cm	20.00	200.00	76.94	25.73	1.20	6.43	.89**
Hver er hámarkshraði hjólreiðamanns?	km/h	20.00	160.00	69.67	25.18	1.10	1.71	.92**
Hversu margir strengir eru í hörpu?	strings	5	200	45.71	39.34	1.91	4.89	.81**
Hver er hámarkshraði Formúlu 1 bíls?	km/h	190.00	900.00	347.25	96.80	2.67	14.11	.80**

Note. * = $p < .01$, ** = $p < .001$

The internal reliability of the Icelandic versions of CET A and CET B was calculated using Cronbach's alpha with CET A having Chronbach's $\alpha = 0.256$ and for CET B the Cronbach's $\alpha = 0.072$. Split-half reliability was measured using Guttman's lambda-2 coefficient which was 0.401 for CET A and 0.159 for CET B. This shows that both CET A and CET B have low internal reliability and split-half reliability with CET A showing stronger internal reliability and split-half reliability than CET B which has poor internal and split-half reliability. By checking whether the internal stability of CET A and CET B would change if any items were

removed from the measures there was only one item in each measure which would make the internal stability greater if it were removed. For CET A it was the item "Hver er hámarkshraði Harley-Davidson mótorhjóls?" which would make the Cronbach's $\alpha = 0.398$ and for CET B it was the item "Hver er hámarkshraði Formúlu 1 bíls?" which would the Cronbach's $\alpha = 0.376$. By removing these two questions from the measures it would dramatically increase their inner stability.

To assess whether there was significant difference in the answers between men and women a Multivariate Analysis of Variance (MANOVA) was performed. The results for all the items can be seen in table 3 for CET A and table 4 for CET B. There were only three items that showed to differ significantly between men and women. There were two that were in CET A; "Hversu hratt hlaupa veðhlaupahestar?" and "Hver er meðalskokkhraði fólks?". There was one item in CET B that differed significantly; "Hversu hröð er hraðasta uppgjöfin í tennis?". All these items are measuring speed in different settings.

Table 3

Results from Multivariate Analysis of Variance on each item of CET A by gender with means and

standard deviations.

Item	Unit	Men Mean	Men SD	Women Mean	Women SD	*F*
Hver er hámarkshraði Harley-Davidson mótorhjóls?	km/h	225.68	48.39	235.74	70.00	.51
Hver er meðallengd á nýfæddu barni?	cm	44.21	10.28	47.47	7.42	2.33
Hversu hratt hlaupa veðhlaupahestar?	km/h	63.16	18.43	78.76	38.16	5.05*
Hver er meðalskokkhraði fólks?	km/h	9.84	4.13	12.79	6.59	5.30*
Hversu mörg lauf eru í appelsínu?	segments	9.42	2.96	8.91	2.05	.71
Hversu langur er nýr blýantur?	cm	15.82	3.90	16.26	5.30	.17
Hver er hámarkshraði blettatígurs?	km/h	92.18	26.83	108.38	50.76	2.95
Hver er meðallengd fjallahjóls fyrir karla?	m	1.63	.28	1.60	.52	.12
Hversu margir takkar eru á hefðbundnu lyklaborði?	keys	66.26	24.99	61.62	23.91	.65

Note. * = $p < .05$

Table 4

Results from Multivariate Analysis of Variance on each item of CET B by gender with means and

standard deviations.

		Men		Women		
Item	Unit	Mean	SD	Mean	SD	*F*
Hver er meðalgönguhraði dæmigerðs heilbrigðs fullorðins karlmanns?	km/h	4.45	1.76	5.58	3.16	3.62
Hversu langt er hefðbundið hálsbindi?	m	1.02	.40	.82	.44	3.91
Hversu hröð er hraðasta uppgjöfin í tennis?	km/h	119.47	52.19	82.62	58.41	8.00*
Hversu margar nótur eru á hefðbundnu píanói?	notes	74.55	49.31	61.71	24.75	1.88
Hvað er elsti Íslendingurinn gamall?	age	105.68	2.91	105.85	3.90	.04
Hver er lengd hryggs hjá meðalmanneskju?	cm	80.50	18.73	72.97	31.63	1.55
Hver er hámarkshraði hjólreiðamanns?	km/h	70.92	23.39	68.26	27.34	.20
Hversu margir strengir eru í hörpu?	strings	45.97	41.38	45.41	37.56	.00
Hver er hámarkshraði Formúlu 1 bíls?	km/h	348.34	72.94	346.03	119.14	.01

Note. * = $p < .01$

Discussion

The internal and split-half reliability of the Icelandic versions of the CET A and CET B is

much poorer than the original versions with the CET B being way worse. It comes as a surprise

that there is such a big difference in how the Icelandic CET A and CET B fair when it comes to

their internal and split-half reliability since these two versions were considered parallel. If one

question is removed from each measure as mentioned above the inner reliability of each version

becomes much more similar. There is apparent that through translation of these versions of CET

there has been some change in the reliability of the measures. This might be due to different kind of cultural background of the populations used in each study or by translating the original measure it has lost some of it's qualities.

It is quite interesting that the questions that raise the inner stability if removed for CET A and CET B are „Hver er hámarkshraði Harley-Davidson mótorhjóls?" and „Hver er hámarkshraði Formúlu 1 bíls?", respectively. Both of these questions regard the maximum speed possible of a motor vehicle. Since these questions lower the internal stability of both versions it could well be that knowledge of automobiles is somewhat different in Iceland than it is in the population that the untranslated versions (MacPherson et al., 2014) were originally tested on. It would be ideal to try to examine how this measure fares in Icelandic with these two items taken out altogether or replaced by some other items.

There was significant difference in how men and women answered three questions in the two versions of CET. As stated earlier these questions were "Hversu hratt hlaupa veðhlaupahestar?", "Hver er meðalskokkhraði fólks?" and "Hversu hröð er hraðasta uppgjöfin í tennis?". All these questions required participants to come up with estimations related to the speed of an object. There might be some difference in the way men and women experience speed of objects since these subjects are not favored more by one gender more than the other. Since this is supposed to be a representative sample of both men and women it is not ideal that three questions of a total 27 questions differ between gender. It could be beneficial to better these versions of CET A and CET B with switching out these questions with other ones that do not show any statistical difference between men and women in their answers.

There is not still known whether this translation of these versions of CET difffers in answers between people with frontal lobe damage and healthy people. This translation might not

be sensitive to measure whether there is a possibility of frontal lobe damage in a patient. It would be valuable to research whether there is a statistical difference in the total error scores for both people with frontal lobe damage and a healthy control group with these translated versions of CET A and CET B. It should also be noted that a high error score on the CET does not have to mean that a person has frontal lobe damage. As stated before there can be numerous reasons for the lack of ability to create appropriate cognitive estimations. Further testing is thus always needed before anything is established about the state of a person's brain.

The item „Hversu mörg lauf eru í appelsínu?" has shown to be easily misunderstood since the Icelandic words for segments of an orange varies between age groups and cultural backgrounds. It is thus necessary to give detail on what exactly is meant by this question to avoid any confusion. The two most common words used for the segments of an orange in Icelandic are „lauf" and bátar" which translates to leaves and boats. Leaves are more used by the older generation of people but boats the younger generations. Some participants in this study even thought it was a trick question with which they gleefully replied: „There are no leaves on an orange!". So people can take these questions quite literally and I imagine the same would be for asking how many boats there are in an orange but that should be avoided if the person administering the test is really clear on what is being meant by the question.

There was no participant who did not finish the lowest academic level which in itself is rare in the Icelandic community. So this normative data should be used with that knowledge that it might not represent that group of people. This sample of people is quite educated as a whole which could skew the results since research suggests that performance on the CET becomes greater with higher education (MacPherson et al., 2014). Data needs to be gathered on the

population that has the lowest degree of education since this sample does not represent that group of Icelandic people.

Some of the questions asked are not straight forward so it might be needed by researchers to provide additional information about the question if there is a confusion about what kind of an answer is expected. It is essential that the participants completely understand the questions and what is expected of them. There should be no room for people to fail on the questions due to lack of understanding of the words spoken or the context in which they are presented.

Due to the effects of the Covid-19 pandemic it was not available to meet people face to face to get their answers on the CET. This made is so that some participants answered the measure face to face but others through the phone. This might have been a factor in how people answered but that effect is probably really small and should not have a significant influence on the outcome. The researcher tried to implement the same procedure either through phone or in person as much as possible.

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