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## RAT-PL – CONSTRUCTION AND VALIDATION OF POLISH VERSION OF REMOTE ASSOCIATES TEST\*

This article presents the process of constructing and validating the Polish version of the Remote Associates Test (RAT-PL). The test consists of 17 items of three words that are remotely associated with the solution (fourth word). This test has high reliability and moderate difficulty. As expected, the results of RAT-PL were positively associated with intelligence, questionnaire measures of intuitive processing as well as with openness to ideas and values. However, when controlling for intelligence and intuition in the regression analysis, relationships with openness were not statistically significant. The RAT-PL can be a valuable tool for Polish researchers who study intuition, insight and creativity.

**Keywords:** remote associates test, intuition, insight, intelligence, openness to experience, creativity

*TELEPHONE, COOK, BIBLE* – what kind of association connects these words? Perhaps, after a few ineffective trials, the word – *BOOK* – would suddenly come to the Reader’s mind accompanied by positive emotion and belief that surely this is the right answer. In other words, the Reader would probably have had “Aha!” experience preceded by the insight (Bowden and Jung-Beeman, 2003a; Nosal, 2011; Nosal, 2016).

The Mednicks (Mednick and Mednick, 1967) are considered as the authors of this type of task (*Remote Associates Test*, RAT). They developed it to measure creative ability. Sarnoff Mednick (1962) argued that associative processes are the basis of creativity. The author assumed that for a person who has the highest potential to generate a creative (i.e., atypical and useful) solutions,

the hierarchy of associations is very broad and flattened, which enables remote ideas to connect easily. During the process of creating this test, he came to the conclusion that, in order to measure creative thinking, the test should enforce connections between the different elements to create new solutions, through finding common associations. To avoid privileging specific groups, it was necessary to use stimuli (in this case words) which were well-known. According to Mednick (1962, p. 227), after the criteria were defined, “the test almost constructed itself”.

The RAT is commonly used in both, the classic form (search for a solution to the triad words) as well as in a modified version (Dorfman, Shames and Kihlstrom, 2004). For instance, in the Dyads of Triads (DOT) task an item consists of

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two sets of three words, and only one triad in each pair is coherent. In this task, participants are asked to quickly guess which one of them has correct solution (Bowers, Regehr, Balhazard and Parker, 1990; Sweeklej and Balas, 2015). Although the participants often said that they did not know the correct answer, they accurately indicated the triad that had a solution. The RAT and its modifications are widely used in research on creative thinking and solving problems that require insight (Ansburg, 2000; Bowden and Jung-Beeman, 2003a), intuition (Langan-Fox and Shirley, 2003; Sobków, 2014) and affect (Balas, Sweeklej, Pochwatko and Godlewska, 2012; Sweeklej, Balas, Pochwatko and Godlewska, 2014; Sweeklej and Balas, 2015; Topolinski and Strack, 2009). There are currently several hundreds of RAT items available in English (e.g., see Bowden and Jung-Beeman, 2003b, or the websites: <http://www.remote-associates-test.com/>, <http://socrates.berkeley.edu/~kihlstrm/RATest.htm>). However, the RAT is strongly influenced by cultural background and language. For example, during the construction of the German version of RAT, the authors took into account the differences between East and West Germany, matching the appropriate vocabulary to the region (Urban, 2004). Due to the strong influences of culture and language, it is problematic to directly translate the original triads proposed by the Anglo-Saxon researchers.

Therefore, specific versions of the RAT were created according to the culture, for example Jamaican (Hamilton, 1982), Dutch (Chermahini, Hickendorff and Hommel, 2012) or Japanese (Baba, 1982). Despite the RAT being discussed by Polish researchers in books about intuition and creative thinking (Balas, Godlewska, Pochwatko and Sweeklej, 2009; Karwowski, 2009a; Nęcka, 2003), and some versions of it were being used in research (Balas et al., 2012; Paulewicz, Chuderski and Nęcka, 2007; Sweeklej

et al., 2014; Sweeklej and Balas, 2015), a published and validated Polish version of this test is not yet available<sup>1</sup>. Therefore, we believe that the RAT-PL will be a valuable tool for Polish researchers.

## SUMMARY AND HYPOTHESES

Despite a long history and widespread use of the RAT and its modifications, there is little research on the validity and the structure of this test (for notable exception see: Lee, Huggins and Therriault, 2014). Usually, researchers reported only difficulty and solving times of different RAT items (e.g. Bowden and Jung-Beeman, 2003b). Hence, it is not clear what this test exactly measures.

Previous studies have shown that high scores in the RAT were associated with higher intelligence measured by both, the Raven's Progressive Matrices test and the verbal scale in the Wechsler test (Chermahini et al., 2012; Lee et al., 2014) as well as with other tasks that require insight (Ansburg, 2000; Lee et al., 2014; Paulewicz et al., 2007). Despite of Mednick's assumption that the RAT measures creative abilities, no significant correlations with the creativity tests based on divergent thinking have been found (Lee et al., 2014). Moreover, Lee and colleagues (2014) have doubts about whether or not this test actually measures general creative thinking. The authors assume that it may be a measure of one component of creativity that is independent of divergent processing, and which, in turn, is related to other convergent thinking tests.

On the other hand, there is evidence to believe that the results obtained in the RAT may also be associated with intuitive abilities which are complementary to intelligence (Nosal, 2011). Searching for correct answers in the RAT is largely unconscious, beyond self-control of the

<sup>1</sup> Our observation of lack of validated Polish version of RAT, is also confirmed by Karwowski (2009a, p. 123) and it was noticed by a translator of Dorfman's et al. chapter (2004, p. 287).

individual, and within an intuitive System 1 (Kahneman, 2012). Additionally, more open minded individuals can show greater flexibility and tolerance to ambiguity, which is essential in solving RAT tasks. However, the results of research in this area are inconclusive. On the one hand, Aitken Harris (2004) showed a positive correlation between RAT and Openness to Ideas, but on the other hand, Lee and colleagues (2014) did not observe a significant association with a total score in the Openness to Experience. Moreover, they regarded this personality trait as an indicator of the discriminant validity of the tested tool (due to the fact that Openness to Experience is related to divergent processing). However, in this case, insignificant correlation with the RAT could be caused by the use of the openness scale consisting of only two test items. Additionally, Openness to Experience is not a homogeneous trait and the relationships with the RAT may vary depending on the components.

In conclusion, based on previous theories and research, we assumed that the RAT-PL will have a one-factor structure and will correlate positively and moderately with measures of intelligence, and positively but weakly with self-reported measures of intuition (in particular with subjective assessment of intuitive abilities) and components of Openness to Experience (especially with Openness to Ideas).

## STUDY 1

The goal of Study 1 was to develop a preliminary version of the RAT, as well as exploring its structure and reliability.

### Method

#### Subjects

One hundred and sixty eight people (94 females) with age ranging from 18 to 65 ( $M_{\text{age}} = 27.3$ ;  $SD_{\text{age}} = 7.9$ ) participated in this study. More than a half (53.6%) of them was studying psychology.

### Materials and procedure

#### Item's construction

Basing on original items of the RAT (Bowden & Jung-Beeman, 2003b; Bowers et al., 1990), 50 triads in Polish were generated. According to Mednick's suggestion (1962), the items containing specialist vocabulary or associations characteristic for specific population, were excluded. For example, in a word-triad: WŁOSY [Eng. hair], KORZEN [Eng. root], ŁZA [Eng. tear], participants should generate a fourth word that should be related to each cue words. In this example, CEBULA [Eng. onion/bulb/hair root] was the solution, because in Polish a root of a hair is called "cebula", a bulb [in Polish "cebula"] is a type of a root, and cutting onion [in Polish "cebula"] evokes tears. Basing on pilot studies (in summary  $N = 119$ ) 25 word triads were chosen. They diversified in difficulty (from 21% to 74% correct answers) and had one dominating solution.

#### Procedure

Twenty-five word triads (chosen in pilot studies) appeared randomly on the computer screen for 30 seconds. If participant found the solution before this time limit, s/he could press the "space" key and enter the solution. After 30 seconds, cue words disappeared and participant should have typed the solution or a phrase: "don't know".

Because construction of Polish version of the RAT was not the main goal of this research project, apart from this task, participants were solving additional tests (the study lasted about 60–70 minutes). A detailed description of these tasks may be found in an unpublished doctoral dissertation (Sobków, 2014).

### Results

#### Answers coding

Six competent judges rated the answers provided by participants, by assessing how strong was the relationship between proposed solution and each three cue words. Basing on these judgments, additional correct solutions were added to

two word triads: *AKTOR* [Eng. actor], *SZERYF* [Eng. sheriff], *NOC* [Eng. night] – an additional correct solution: *WESTERN*; and *GAPA* [Eng. dope], *WIATR* [Eng. wind], *INSTRUMENT* [Eng. instrument] – an additional correct solution: *FUJARA* [Eng. drip/pan-pipe]. Moreover, two triads were excluded: *KAPUSTA* [Eng. cabbage], *BÓL* [Eng. pain], *CHUSTA* [Eng. scarf], and *PIWO* [Eng. beer], *MECZ* [Eng. match], *BRZUCH* [Eng. belly]. Using this answer key, participants' responses were coded binary (1 – correct solution, 0 – wrong solution/lack of solution).

### *Psychometric properties of a test*

Exploratory factor analysis (by the method of principal axis factoring) was conducted on these binary answers ( $N = 168$ ). KMO measure = 0.732 suggested adequate sample and Bartlett test of sphericity  $\chi^2(253) = 561.999$ ;  $p < .001$  revealed that data are correlated in population. Basing on theoretical assumptions and a shape of a scree plot, we decided to choose a one-factor structure, which explained 13.6% of variance.

Six items were excluded from a scale because of low factor loadings ( $< .30$ ):

- *MYSZ* [Eng. mouse], *PLEŚŃ* [Eng. mildew], *ZAPIEKANKA* [Eng. casserole] – factor loading: .224;
- *MUZYKA* [Eng. music], *HUTA* [Eng. smeltery], *PIERWIASTEK* [Eng. element] – factor loading: .246;
- *ŚMIERĆ* [Eng. death], *DZIURA* [Eng. hole], *OWCA* [Eng. sheep] – factor loading: .251;
- *POCIĄG* [Eng. train], *SKLEP* [Eng. shop], *PRL* [Eng. Polish People's Republic] – factor loading: .268;
- *GAPA* [Eng. dope], *WIATR* [Eng. wind], *INSTRUMENT* [Eng. instrument] – factor loading: .276;
- *ROŚLINY* [Eng. plants], *LAIK* [Eng. layperson], *ŚWIATŁO* [Eng. light] – factor loading: .298.

In result, the scale consisted on 17 items, had a good reliability ( $\alpha = .751$ ) and moderate difficulty (minimum = 0, maximum = 16,  $M = 7.3$ ,  $SD = 3.7$ ). Distribution of results was symmetrical: Skewness = 0.105,  $SE_{skewness} = 0.187$  (quotient of skewness and standard error of skewness was 0.561, what is lower than critical point 1.98; Field, 2013). The analogical procedure revealed that this distribution was mesokurtic (Kurtosis = -0.629;  $SE_{kurtosis} = 0.373$ ; and a quotient = 1.68)<sup>2</sup>. We can conclude, that the scores in RAT-PL did not deviate significantly from normal.

## STUDY 2

The goal of Study 2 was to confirm a one-factor structure of RAT-PL, as well as to verify its validity basing on relationships with measures of intelligence, intuition and Openness to Experience.

### **Method**

#### *Subjects*

Two hundred and six people (140 females) with age ranging from 18 to 55 ( $M_{age} = 25.1$ ;  $SD_{age} = 7.6$ ) participated in this study. Most of them finished secondary (49.5%) or higher education (44.7%). Participants were recruited via announcement posted on an internet website.

#### *Materials*

##### *RAT-PL*

Seventeen items selected in Study 1 (see Table 1) were used. Each triad was displayed randomly on the computer screen for 30 seconds (or until response).

##### *Myers-Briggs Type Indicator (MBTI)*

Myers-Briggs Type Indicator (MBTI) is a test developed basing on the Jung's theory of psychological types (Dudek, 2006). This theory descri-

<sup>2</sup> Shapiro-Wilk test (168) = 0.980;  $p = .015$  revealed that a distribution of results was significantly different from a normal distribution. However, this result could be driven by large sample size (see Field, 2013).

Table 1. Items of the RAT-PL (in Polish and English) with correct answers, percentage of correct answers and mean solution times

Item	Cue words (triads)	Correct answer (solution)	% participants solving item correctly in Study 2	Mean solution time* (sec)
RAT-PL1	<i>aktor, szeryf, noc</i> [actor, sheriff, night]	<i>gwiazda, western</i> [star, western]	47	12.2
RAT-PL2	<i>brew, broń, architektura</i> [eyebrow, weapon, architecture]	<i>luk</i> [bow/arch]	41	10.9
RAT-PL3	<i>dama, kredyt, menu</i> [queen, credit, menu]	<i>karta</i> [card]	38	13.2
RAT-PL4	<i>drzewo, król, ząb</i> [tree, king, tooth]	<i>korona</i> [crown]	44	13.0
RAT-PL5	<i>drzwi, rycerz, spodnie</i> [door, knight, pants]	<i>zamek</i> [lock/castle/zipper]	56	11.4
RAT-PL6	<i>grzebień, korzeń, mądrość</i> [comb, root, wisdom]	<i>ząb/zęby</i> [tooth, teeth]	33	14.8
RAT-PL7	<i>komiks, wdowa, sieć</i> [comic book, widow, web]	<i>pająk</i> [spider]	51	15.7
RAT-PL8	<i>oko, lody, uchwyt</i> [eye, ice cream, grip]	<i>gałka</i> [eyeball/scoop/knob]	44	10.4
RAT-PL9	<i>owoc, kolor, wybuch</i> [fruit, color, explosion]	<i>granat</i> [pomegranate/dark blue/grenade]	69	7.8
RAT-PL10	<i>ryba, miasto, zęby</i> [fish, city, teeth]	<i>Piła</i> [saw/sawfish]	19	15.7
RAT-PL11	<i>samolot, próba, telewizor</i> [airplane, dry run, television]	<i>pilot</i> [airman/pilot/remote control]	29	18.6
RAT-PL12	<i>sygnał, stop, pokój</i> [signal, stop, peace/room]	<i>znak</i> [sign]	38	14.5
RAT-PL13	<i>telefon, kucharz, biblia</i> [telephone, cook, Bible]	<i>księga/książka</i> [book]	49	13.3
RAT-PL14	<i>telefon, spiżarnia, jądro</i> [telephone, pantry, nucleus]	<i>komórka</i> [cell/closet]	33	14.4
RAT-PL15	<i>urodziny, ogień, W-F</i> [birthday, fire, physical education]	<i>świeca/świeczka</i> [candle/shoulder stand]	31	19.2
RAT-PL16	<i>więzienie, opakowanie, błąd</i> [prison, package, error]	<i>pudło/pudełko</i> [box/miss/clink]	31	14.8
RAT-PL17	<i>zamek, odlot, pięciolinia</i> [lock/castle/zipper, migration, stave]	<i>klucz</i> [key/clef/skein]	33	18.6

Note: \* Mean time until pressing a “space” key (only when correct answer was provided).

Table 2. The Sense of Intuition Scale (SoIS)

		Strongly disagree	Rather disagree	Rather agree	Strongly agree
1	I'm very good in guessing games.	1	2	3	4
2	It happens, that I know something, but do not know the source of this knowledge.	1	2	3	4
3	Sometimes, I have very remote/distant associations.	1	2	3	4
4	Correct solutions come to my mind spontaneously.	1	2	3	4
5	Sometimes, I spontaneously/unwillingly learn things.	1	2	3	4
6	It happens, that I experience sudden insight.	1	2	3	4
7	Sometimes, I know what happens next, in example in a movie or a book.	1	2	3	4
8	I trust my intuition/hunch.	1	2	3	4
9	Often, I guess the punchline of a joke.	1	2	3	4
10	Usually, I need only few tips to make a decision or find a solution to a puzzle.	1	2	3	4

Note: The SoIS was developed and validated in Polish language.

bes four functions, by which people experience the world: sensation, intuition, feeling, and thinking. Despite critics, this test has been widely used in research on intuition (Kaufman et al., 2010; Langan-Fox and Shirley, 2003). In the present study, we used Polish adaptation of MBTI proposed by Nosal and Piskorz (1991). Especially important for validation of the RAT-PL was the Intuition scale, which in Jungian theory is related to a global style of information-gathering (perception). Items in this scale concentrate on preference for creative solutions and imagery. Moreover, previous studies revealed that this scale is related to scores in creativity tests based on divergent thinking (Cheng, Kim and Hull, 2010; Furnham, Crump, Batey and Chamorro-Premuzic, 2009).

#### *Sense of Intuition Scale (SoIS)*

The Sense of Intuition Scale (SoIS) was used as a second self-reported measure of intuition. This scale was constructed in our previous research project. The SoIS consists of 10 items, that were based on results of psychological experiments and theories on symptoms and manife-

stations of intuitive processing. For example: “It happens, that I know something, but do not know the source of this knowledge” or “Usually, I need only few tips to make a decision or find a solution to a puzzle” (the translation of all items is available in Table 2). This scale has good reliability ( $\alpha = .743$ ) and focuses on subjective experience of intuition’s manifestations.

#### *Openness to Experience*

We used six subscales of the Openness to Experience scale from NEO-PI-R (in Polish adaptation by Siuta, 2006): Fantasy, Aesthetics, Feelings, Actions, Ideas and Values. Items from these subscales were combined with other self-reported measures along with an unified response scale (it this case it was changed from 5 to 4-point scale).

#### *Raven’s Advanced Progressive Matrices (RAPM)*

The Raven’s Progressive Matrices test is one of the most commonly used method for studying fluid intelligence (Nęcka, 2002). In this study, we used a shortened version RAPM (based on Jawo-

rowska & Szustrowa, 1991). Similarly, as in the original procedure, participants were familiarizing with the task, by solving few easy items, next they were solving 18 test matrices on increasing difficulty (without time constrains).

### Verbal analogies

The verbal analogies were chosen as a second measure of intelligence. Previous studies revealed that the results obtained in similar tests were related to the factor of fluid intelligence (Nęcka, 2002). From a set of verbal analogies constructed by Nosal, 25 items were chosen. Each item consisted of a pair of words, that were connected via some relation, for example: “wędkarz” [Eng. fisherman] and “ryba” [Eng. fish] (relation: a fish is caught by a fisherman), third word displayed below, in example “bramkarz” [Eng. goalkeeper], and four answers, in example: A: “boisko” [Eng. playground], B: “piłka” [Eng. ball], C: “wędka” [Eng. fishing rod], D: “mecz” [Eng. match]. Participant’s task was to find the relation in the first pair of words, use this relation to the word displayed below, and choose one of four answers.

### Procedure

The study was conducted in the computer lab and lasted approximately 1.5 hour. The sequence of tasks was randomized. Similarly to Study 1, construction of the RAT-PL was not the main goal of a project, and a detailed description of a procedure and all tasks completed by participants can be found in an unpublished doctoral dissertation (Sobków, 2014).

### Results

#### Psychometric properties of a test

Similarly to Study 1, participants solved on average 6.9 ( $SD = 3.9$ ) of triad, with the minimum of 0 and the maximum of 17 correctly solved items. The distribution of results was symmetrical: Skewness = 0.219,  $SE_{skewness} = 0.169$  (quotient of skewness and standard error of skewness was 1.30). Analogical procedure revealed that this distribution was mesokurtic (Kurtosis = -0.709;  $SE_{kurtosis} = 0.377$ ; and a quotient = 1.88)<sup>3</sup>. We can conclude, that the scores in RAT-PL did not deviate significantly from normal. Good reliability ( $\alpha = .793$ ) and a one-factor struc-

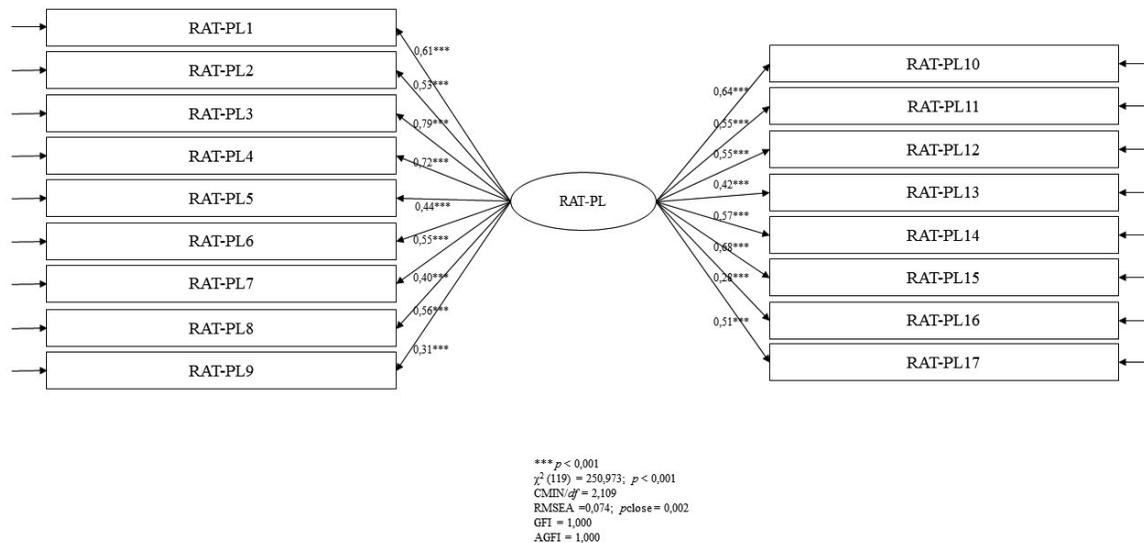


Fig. 1. Confirmatory factor analysis of RAT-PL

<sup>3</sup> Shapiro-Wilk test (206) = 0.974;  $p = .001$  revealed that a distribution of results was significantly different from a normal distribution. However, this result could be driven by large sample size (Field, 2013).

ture of the test were confirmed (see Fig. 1)  $\chi^2(119) = 250,973; p < 0,001; CMIN/df = 2,109; RMSEA = 0,074; pclose = 0,002; GFI = 1,000; AGFI = 1,000.$

### Validity of RAT-PL

Correlations analyses with RAT-PL and measures of intelligence, intuition and openness to experiences were performed (Table 3). According to our hypotheses moderate and positive correlations with RAPM ( $r = .36$ ) and Verbal analogies ( $r = .40$ ) were found. Relationships with self-reported measures of intuition (MBTI: Intuition and SoIS), as well as with two components of Openness to Experience (Openness: Ideas and Openness: Values) were weak, but significant (Pearson's  $r$  from .15 to .25).

To better understand the nature of obtained relationships, a hierarchical regression with RAT-PL score as a dependent variable was carried out (Table 4). In the first step, intelligence measures were entered into the model. This model explained 18.2% of variance and both

predictors were significant (for RAPM  $b^* = .21$  and for Verbal analogies  $b^* = .29$ ). This result suggests that, apart from the general intellectual potential (related to the speed of processing), also the vocabulary is important factor influencing results obtained in RAT-PL.

In the second step, self-reported measures of intuition were entered into the model. This operation significantly increased explained variance of RAT-PL by 3.3%. However, this effect was evoked by the Sense of Intuition Scale ( $b^* = .17, p = 0.01$ ), but not MBTI: Intuition. These results suggest that, the score obtained in RAT-PL depends not only on intelligence, but also on subjective assessment of intuitive abilities.

In the third step, six subscales of Openness to Experience were entered into the model. Interestingly, this operation did not increase explained variance of RAT-PL and all the predictors were insignificant. Probably, the percentage of shared variance between RAT-PL and Openness to Ideas and Values (observed in correlation analysis) was already explained by intelligence and intuition.

Table 3. Correlations among RAT-PL, intuition, intelligence, and subscales of Openness to Experience

	1	2	3	4	5	6	7	8	9	10
1 RAT-PL	-									
2 RAPM	<b>.36***</b>	-								
3 Verbal analogies	<b>.40***</b>	<b>.51***</b>	-							
4 MBTI: Intuition	<b>.15*</b>	.07	<b>.18**</b>	-						
5 SoIS	<b>.19**</b>	-.01	.04	<b>.31***</b>	-					
6 Openness: Fantasy	<b>.11</b>	.04	.12	<b>.64***</b>	<b>.48***</b>	-				
7 Openness: Aesthetics	<b>.12</b>	-.06	.03	<b>.41***</b>	<b>.34***</b>	<b>.43***</b>	-			
8 Openness: Feelings	<b>.05</b>	-.19**	-.04	<b>.33***</b>	<b>.30***</b>	<b>.50***</b>	<b>.46***</b>	-		
9 Openness: Actions	<b>.10</b>	-.02	.07	<b>.38***</b>	<b>.41***</b>	<b>.28***</b>	<b>.31***</b>	<b>.29***</b>	-	
10 Openness: Ideas	<b>.25***</b>	<b>.20**</b>	<b>.30***</b>	<b>.39***</b>	<b>.45***</b>	<b>.42***</b>	<b>.34***</b>	<b>.16*</b>	<b>.26***</b>	-
11 Openness: Values	<b>.22***</b>	<b>.14*</b>	<b>.31***</b>	<b>.23***</b>	<b>.22***</b>	<b>.20**</b>	<b>.20**</b>	<b>.15*</b>	<b>.29***</b>	<b>.30***</b>

Note: RAT – Remote Associates Test, RAPM – Raven's Advanced Progressive Matrices, MBTI – Myers-Briggs Type Indicator, SoIS – Sense of Intuition Scale.

\*  $p < .05$ ; \*\*  $p < .01$ ; \*\*\*  $p < .001$ .

Table 4. Hierarchical regression with the RAT-PL score as a dependent variable, and intelligence, intuition and subscales of Openness to Experience as predictors

Step		<i>b</i> *	<i>t</i>	<i>p</i>	Semipartial correlation coefficient	R <sup>2</sup>	ΔR <sup>2</sup>
1	<b>RAPM</b>	<b>.21</b>	<b>2.83</b>	<b>.005</b>	<b>.18</b>		
	<b>Verbal analogies</b>	<b>.29</b>	<b>3.96</b>	<b>.001</b>	<b>.25</b>	<b>.190***</b>	
2	MBTI: Intuition	.03	0.45	.654	.03		
	SoIS	<b>.17</b>	<b>2.60</b>	<b>.010</b>	<b>.16</b>	<b>.222***</b>	<b>.033*</b>
3	Openness: Fantasy	-.11	-1.17	.242	-.07		
	Openness: Aesthetics	.05	0.67	.502	.04		
	Openness: Feelings	.07	0.86	.394	.05		
	Openness: Actions	-.03	-0.43	.669	-.30		
	Openness: Ideas	.06	0.71	.480	.04		
	Openness: Values	.06	0.79	.428	.05	<b>.237***</b>	<b>.015</b>

Note: RAPM – Raven’s Advanced Progressive Matrices, MBTI – Myers-Briggs Type Indicator, SoIS – Sense of Intuition Scale; *b*\* – standardized coefficient.

\*  $p < .05$ ; \*\*\*  $p < .001$ .

## DISCUSSION

### Summary of results

In a series of studies, a tool with good psychometric properties was constructed. The test consists of 17 items, is characterized by good internal consistency, moderate difficulty, and the distribution of its results is not significantly different from normal. The analysis of the validity of the tool showed that, as in previous studies (Chermahini et al., 2012; Lee et al., 2014), it is significantly correlated with measures of intelligence.

In addition, the results of the RAT-PL were associated with self-reported measures of intuition – in particular with the Sense of Intuition Scale. Most importantly, the Sense of Intuition Scale explained the percent of RAT variance independent from intelligence, which may indicate the important role of unconscious processing in finding remote association. Processes associated with intuition and intelligence remain in the mind in constant interaction and are com-

plementary to each other (Nosal, 2011, 2016). Depending on the characteristic of the situation, for example time constrains, the one or the other may gain in importance. Intuitive processes considerably speed up the integration of information, and fast acts of insight and structures detection are the essence of intuition. These structures and insights are then evaluated by intelligence. When intuitive processes run at a lower level and the comprehensive structure of the relationship does not appear in the mind, the role of analysis and information integration (which is the basis of intelligence) increases. Interestingly, the correlation of the RAT-PL with the second scale of intuition – from the MBTI – became insignificant when the model was controlled for the sense of intuition and intelligence. On the one hand, it shows that our Sense of Intuition Scale may be a more appropriate tool to evaluate the subjective intuitive abilities than the commonly used MBTI. On the other hand, the items of the intuition scale from the MBTI largely concern creativity. Furthermore, studies have shown

associations between this scale and measures of divergent processing (Cheng, Kim and Hull, 2010; Furnham et al., 2009), and Lee and colleagues (2014) noticed that the RAT rather measures a component of creativity which is responsible for convergent processing. These authors even consider the measure of divergent thinking as an indicator for the discriminant validity of the RAT. Therefore, a lack of relationship between the RAT and intuition from the MBTI (with control of intelligence and sense of intuition) is coherent with their argumentation and can confirm the validity of the RAT-PL. Interesting results have also been observed when analysing the relationships between the components of Openness to Experience and the RAT-PL. On the one hand, similarly to correlations obtained by Aitken Harris (2004), the results of the RAT were associated with Openness to Ideas. On the other hand, when intuition and intelligence were controlled, these relationships became insignificant. Therefore, it is perhaps not “flexibility” and mind openness, but the general potential of intellect and vocabulary (which are associated with the mind openness) that favour more frequent experiencing of insight in this task. Additionally, this result is consistent with findings of Lee and colleagues (2014) who treated the Openness to Experience as a discriminant validity indicator of the RAT.

### Limitations and future studies

Reported studies have some limitations, which should be mentioned here. They were conducted in the computer lab, and the entire procedure was long-lasting, what is not in favour of intuitive processing. Insights often come during relaxation, in extensive attention and in paratelic motivation (Kolańczyk, 2009; Nęcka, 2003).

Due to the fact that studies were long-lasting and exhausting for participants, as in Aitken Harris (2004) we decided to use only subscales of Openness to Experience of the NEO-PI-R and decreased the number of matrices in Raven’s test. Those steps helped to shorten the duration of the

study for approximately 40 minutes. In addition, we decided to combine items of Openness to Experience with other self-report measures and the response scale was unified (it was changed from a 5 to a 4-point scale). This means that our results (e.g. in terms of the achieved means) are not comparable with the standard version, and it is impossible to refer them to population norms. However, the change of scale or the reduction of the items should not significantly affect the structure identified relationships.

In order to increase the reliability of the RAT-PL, a time limit to solve each of the triads was introduced and a return to previous items was precluded. Insights often appear suddenly and without conscious control. Perhaps some solutions revealed after this 30-seconds period. Moreover, due to the observed relationship between intelligence and the time of the inspection (Grudnik and Kranzler, 2001), the time constraints could perhaps artificially increased relationship between the RAT-PL and the RAMP. It is worth to notice that introduced time limit (maximum 30 seconds per triad) was comparable (or even longer) to similar studies (Aitken Harris, 2004; Bowden and Jung-Beeman, 2003b; Chermahini and al., 2012; Lee and al., 2014). Furthermore, the average time of the triad solution (less than 20 seconds) was considerably shorter than the time limitation used by us. On the other hand, time constraints is sometimes used by researchers to reduce analytical thinking and force a participant to use the primary and more intuitive System 1 (e.g. Finucane et al., 2000). Therefore, time constraints was not necessarily in favour of a stronger association with intelligence. Theoretically, one could even receive the opposite effect, because finding remote associations depends largely on unconscious processes. To verify and better understand the relationship between intelligence and the result in the RAT, it would be necessary to conduct an experimental study in which the time constrains to solve the RAT-PL would be manipulated. Additionally, we can hypothesize that in the case of modified

version of the RAT – “Dyads of Triads” (DOT) in which the participant has to quickly identify which of the two triads have a coherent solution, we could obtain lower correlations between DOT and tests of intelligence.

It should also be noted that in presented studies metacognitive feelings were not controlled. It was not tested how they came to the solution, whether, the solution appeared suddenly and spontaneously or was accompanied by a feeling of “warmth”. Therefore, it cannot be excluded that participants reached a part of solutions in an analytical way, and not with insight. The solution for this problem could be, for example, to ask participants to describe the process which they used or apply psychophysiological equipment or neuroimaging techniques (similarly as in different research, Ilg et al., 2007; Jung-Beeman et al., 2004).

In addition, it is necessary to continue research on the structure and discriminant validity of the RAT-PL. The set of items developed by us explained a small percentage of the variance in the exploratory factor analysis (see Study 1) which can be caused by a relatively small number of items or dichotomous nature of the response. To increase the range of explained variance, it would be worth to develop more and more diverse (e.g. in terms of the type of relations connecting individual words) items. On the other hand, in terms of further research on the discriminant validity of this tool, it is worth to use the divergent task such as those proposed by Guilford (compare e.g. Nęcka, 2003) or Karwowski (2009b), while in our study this variable was measured only indirectly (through the results of intuition in the MBTI and Openness to Experience). In addition, an interesting measure of the discriminant validity would be to use the Need for Cognition Scale (Matusz, Traczyk, Gąsiorowska, 2011) as an indicator of individual differences in processing information within the System 2. We can hypothesize that relationships of the RAT-PL with the Need for Cognition Scale would be insignificant or be weaker than those observed

with the Sense of Intuition Scale (questionnaire measure of processing within the System 1).

In summary, test constructed by us can be used in scientific research on creative thinking, insight or intuition in its original form and may as well constitute a good basis for creating modifications (e.g. Dyads of Triads).

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## RAT-PL – KONSTRUKCJA I WALIDACJA POLSKIEJ WERSJI TESTU ODLEGŁYCH SKOJARZEŃ

### ABSTRAKT

W artykule przedstawiono proces konstrukcji oraz walidacji polskiej wersji testu odległych skojarzeń (*Remote Associates Test*, RAT-PL). Test ten składa się z 17 triad słów, do których należy odnaleźć wspólne odległe skojarzenia. Narzędzie to charakteryzuje się dobrą rzetelnością oraz umiarkowaną trudnością. Zgodnie z oczekiwaniami, wyniki w teście wiązały się pozytywnie z inteligencją oraz kwestionariuszowymi miarami przetwarzania intuicyjnego. Zbadano również związki z komponentami otwartości na doświadczenie. Wynik ogólny w RAT-PL pozytywnie korelował z otwartością na idee oraz na wartości, jednakże przeprowadzona analiza regresji wykazała, iż przy kontroli inteligencji oraz intuicji związki te były nieistotne statystycznie. RAT-PL może stanowić wartościowe narzędzie dla badaczy zajmujących się intuicją, wglądem oraz twórczością.

**Słowa kluczowe:** test odległych skojarzeń, intuicja, wgląd, inteligencja, otwartość na doświadczenie, twórczość