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### Article

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1 Validation and psychometric properties of the Russian version of the  
2 Touch Experiences and Attitudes Questionnaire

3

4 The Russian version of the Touch Experiences and Attitudes  
5 Questionnaire

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## 25 **Abstract**

26 It has been demonstrated that nurturing and affiliative touch is essential for human emotional and physical  
27 well-being throughout our entire life. Within the last 30 years a system of low-threshold  
28 mechanosensitive C fibers innervating the hairy skin was discovered and described; this system is  
29 hypothesized to represent the neurobiological substrate for the affective and rewarding properties of  
30 touch. This discovery opens new perspectives for multidisciplinary research of the role of affiliative  
31 social touch in health and disease, and calls for establishing novel psychometric tools assessing individual  
32 differences in the domain of affective touch.

33 The main objective of the study was to construct and validate a Russian version of the Touch Experiences  
34 and Attitudes Questionnaire (TEAQ), a self-report measure recently developed to quantify individual  
35 experience and attitude to social and affective touch. A pool of 117 items was translated into Russian and  
36 all the items were assessed for appropriateness for Russian culture (232 participants). After exploring the  
37 factor structure (468 participants), we composed a 37-item questionnaire (TEAQ-37 Rus) characterized  
38 by good reliability and a clear 5-factor structure, covering the aspects of attitude to intimate touch,  
39 attitude to friendly touch, attitude to self-care, current intimate touch experiences, and childhood touch  
40 experiences. Confirmatory factor analysis (551 participants) has demonstrated good consistency and  
41 reliability of the 5-factor structure of the TEAQ-37 Rus. Cross-validation research demonstrated moderate  
42 positive correlations between predisposition to social touch and emotional intelligence; positive  
43 correlations with extraversion and openness facets of the Big Five personality model were also found. As  
44 predicted, participants with higher TEAQ scores rated all observed kinds of touch as more pleasant, with  
45 a particular preference for slow touch.

46 We anticipate that this questionnaire will be a valuable tool for researchers of social touch, touch  
47 perception abnormalities, and the importance of touch experiences for emotional and mental health.

48

## 49 **Introduction**

### 50 **Affective touch throughout human life**

51 Communication via the sense of touch has long been perceived as an important aspect of human social  
52 interaction. A large body of literature attests to its cultural, social, and emotional significance and it may  
53 seem natural to acknowledge the importance of gentle caring touch and the role it plays in our social and  
54 emotional well-being, but there was no general agreement about this amongst psychologists up until the  
55 mid 20<sup>th</sup> century. John B. Watson, an instigator of the School of Behaviorism and one of the most  
56 influential psychologists of early 20<sup>th</sup> century, stated that, in order to bring up their children properly,  
57 parents should “never hug and kiss them, never let them sit on your lap”. An untouched child would  
58 “enter manhood so bulwarked with stable work and emotional habits that no adversity can quite  
59 overwhelm him” [1]. His approach was shared by Haarer [2], who authored one of the most popular  
60 German books on child care for several decades, with the last edition published as late as 1987 [3]. A  
61 similar point of view, if not as radical, is still popular in some cultures, and parents are often advised not  
62 to ‘spoil’ their children with excessive physical affection [4]. In the 1940’s and 1950’s revolutionary  
63 research carried out by Spitz in nurseries and infant hospitals [5] proved that a generous amount of  
64 nurturing touch is as vital as air and food, and that infants devoid of caring touch often die from a so-  
65 called ‘hospitalism’, a condition described in late 19<sup>th</sup> century referring to infants’ failure to thrive and to  
66 stunningly high death rates [6]. Impressed by Spitz’s work, Berne postulates that “a stroke may be used as  
67 the fundamental unit of social action” [7]. A mother’s reassuring touch is linked to a more beneficial type  
68 of attachment in view of Bowlby’s theory [8]: a securely attached infant both seeks and is comforted by  
69 physical contact with their mother [9]; a comprehensive review of the data linking touch and attachment  
70 is provided by Duhn [10]. The importance of touch for shaping the emotional brain is thoroughly  
71 supported by animal research data. A classical paper by Harlow [11] shows that infant monkeys who had  
72 been removed from their mothers prefer a surrogate mother made of soft cloth to one made of wire that  
73 provided food, pinpointing the importance of tactile perception in nurturing. The work of Meaney [12]  
74 provided further evidence that rat pups receiving high levels of licking and grooming touch in the early  
75 neonatal period have significantly lower stress responses, an effect which prevails to adulthood: adult  
76 offsprings with increased licking-grooming show lower responses to stress [13]. Recently this protecting

77 effect of maternal touch has been replicated in humans: a copious amount of maternal stroking can  
78 reverse the potentially harmful epigenetic effects induced by prenatal maternal depression followed by  
79 postnatal maternal depression [14].  
80 Affective touch retains its key role for human emotional well-being throughout our entire life. Cochrane  
81 [15] identified that a lack of social touch, either during childhood or at present, greatly increased one's  
82 vulnerability to depression. Eaton et al. found that a simple touch on the shoulder before mealtime  
83 resulted in an increase of nutritional intake in institutionalized elderly, preventing health risks related to  
84 malnutrition [16]. Further evidence of the benefits of touch comes from research on the effects of  
85 massage showing a reduction in salivary cortisol, an increase in urinary serotonin metabolite levels, and  
86 reduction in depression and pain [17]. The popularity of massage in improving well-being is known in  
87 many cultures, and there is a plethora of less founded 'alternative medicine' based therapies claiming  
88 miracle "cures" as a consequence of the laying-on of hands. However, until recently, a neurobiological  
89 explanation of these benefits has been lacking with most research in the area being carried out by  
90 psychologists, ethologists and social care professionals.

91

## 92 **C-tactile system: neural substrate mediating affective touch** 93 **perception**

94 Neurobiological research performed within the last 25 years has reinforced the earlier behavioral insights  
95 into the importance of touch for child's development and revealed that there indeed is a specific neural  
96 substrate for perceiving the emotional properties of gentle touch. Our current understanding is that the  
97 human somatosensory system has in fact two tactile sub-modalities, one providing the well-recognized  
98 discriminative touch input to the brain, and the second – the affective or emotional input. A system of  
99 low-threshold mechanosensitive C-fibers innervating the hairy skin of the body (C-tactile or CT-  
100 afferents) has been identified and characterized [18-20]; this system is hypothesized to represent the  
101 neurobiological substrate for affective and rewarding properties of touch (for review see [21]). These  
102 nerve fibers are slowly conducting and respond to low-force, innocuous touch; they were first discovered  
103 by Vallbo et al. [18] using a technique called microneurography that allows electrophysiological

104 recording of the activity of single axons in a conscious participant [22]. Electrophysiological and  
105 psychophysical research revealed that properties of CT fibers and the corresponding mechanoreceptors  
106 are optimized for response to naturally occurring nurturing touch, i.e. to stroking stimuli with delivered  
107 with velocity of ~5 cm/sec [20, 23] and at normal human skin temperature [24]. It has been shown that  
108 pleasant touch delivered to hairy skin is processed primarily in limbic-related cortex [25-27, 20]. The CT  
109 system, with its slow response to stimulation and lack of topographic specificity, is best equipped to  
110 fulfill an affective rather than discriminative function, encoding the rewarding and affiliative properties  
111 of close physical contact. It provides positive reinforcement to skin-to-skin contacts with other people,  
112 serves as a reward mechanism enhancing attachment, and helps to keep us 'in touch', both literally and  
113 figuratively. The CT affective touch hypothesis is presented in authoritative review papers [28, 29] and in  
114 major textbooks of neuroscience [30-34].

115

## 116 **Assessing affective touch**

117 The majority of papers revealing the link between CT system, social touch, and neurodevelopment were  
118 published within the last three decades, and it is becoming clear that this area of research is crucial for  
119 understanding neural mechanisms underlying different aspects of human somatosensory perception and  
120 can be vital in research on a range of developmental, neurological, and behavioral disorders related to  
121 tactile perception abnormalities.

122 The main factors affecting touch experience and attitudes can be grouped into two clusters: 1) physical  
123 properties of a delivered stimulus (force, velocity, texture, temperature etc.), along with the properties or  
124 conditions of the skin being touched, and 2) the factors related to social and cultural context. Probably the  
125 most important social factor regulating permissibility of social touch and influencing touch-related  
126 emotional experience is the strength of the social bond between the interacting people [33]. According to  
127 the touch attitudes and behaviors prevailing in a given culture, a culture can be classified as contact or  
128 non-contact [34]; the typical patterns may widely vary for people with different strength of the social  
129 bond (partners, relatives, friends, strangers) or for different contexts related to age, gender, social roles  
130 etc. It has also been demonstrated that social and cultural attitudes and expectations can mediate touch

131 perception through cognitive labelling [35] or even by feeding false information on the gender of a person  
132 providing manual touch stimulation [36]. Exposure to everyday social touch also modulates pleasantness  
133 ratings and hedonic discrimination ability [37].

134 To move further into the domain of translational research we have to be equipped with a range of  
135 appropriate research tools, including neuroscience methods assessing physiological responses directly,  
136 psychophysical protocols for controlled stimulus delivery, and psychometric tools and clinical scales  
137 enabling us assess behavior, attitudes, and experiences, and to take into account social and cultural  
138 factors.

139

## 140 **Psychophysical protocols and stimulus databases**

141 Robotic tactile stimulation technique (RTS) was developed to deliver stroking stimuli with maximum  
142 precision and control over timing, force and velocity [23], and several studies have used a range of  
143 experimental observation protocols using RTS [20, 23, 38, 39]. Manual stimulus delivery protocols were  
144 also used in several research papers [40-42], and it was confirmed that pleasantness rating for strokes  
145 delivered by robotic and manual stimulation correspond very closely [43]. Most of the data that laid the  
146 foundation of CT affective touch hypothesis were obtained using RTS or manual touch delivery  
147 protocols, microneurography, neuroimaging methods, and subjective rating scales (Likert type or visual  
148 analogue scales). Another approach to assess perceived pleasantness of touch was recently suggested by  
149 Walker et al. [44], who used a series of short (5 sec) video clips depicting slow and fast strokes and static  
150 touch delivered by hand to different body sites. The clips were intentionally made as impersonal as  
151 possible by choosing close up angles not revealing the faces of the actors; the somewhat artificial nature  
152 of the interaction and a clear lack of social context helps the viewers to concentrate on purely sensory  
153 aspects of touch. Subjective ratings of the perceived pleasantness of the touch were found to be very  
154 consistent and confirm that people strongly prefer slow touch to fast or static touch. A different approach  
155 was taken by Masson and Op de Beeck [45] who created and validated a set of short video clips depicting  
156 socio-affective touch events naturally occurring at different typical social contexts; this video set is more  
157 suitable for capturing the social aspects of emotional touch perception.

## 159 **Social touch questionnaires**

160 There is a range of scales and questionnaires assessing individual, social, and cultural differences in terms  
161 of experiences and attitudes to affiliative social touch in different situations and contexts.

162 Most of the available measures are related to touch perception abnormalities in childhood (for review see  
163 [32]). For the purposes of our study the most closely related questionnaires are the touch avoidance

164 measure (TAM) [46] measuring negative attitude to touch with the opposite or same sex; the familial  
165 touch orientation scale [47] assessing familial touch experience and linking it to attitude to and

166 frequencies of sex-related social touch in public places; its modified version, Recollection of Early

167 Childhood Touch scale [48]; the tactile type questionnaire (TACTYPE) [49] assessing ‘tactile tendency’

168 (attitudes to tactile interactions with same sex or different sex peers) in college-age students; the

169 Questionnaire on Physical Contact Experience (QPCE) [15], a very brief 8-item measure assessing

170 experiences of good, bad, and neutral touch, currently and in childhood along with current and childhood

171 experience of love; and the Social Touch Questionnaire [50], a 20-item scale focused on being

172 comfortable or having negative feelings in different situations related to social touch and devised to

173 measure the impact of social anxiety on attitude to social touch. A recently developed questionnaire, the

174 Touch Experiences and Attitudes Questionnaire (TEAQ) [51] is, probably, the first questionnaire

175 assessing both attitudes and life experiences that has an established and validated factor structure. The

176 original English (UK validated) version has 57 items and includes six subscales: Friends and Family

177 Touch (FFT), Current Intimate Touch (CIT), Childhood Touch (ChT), Attitude to Self-Care (ASC),

178 Attitude to Intimate Touch (AIT), and Attitude to Unfamiliar Touch (AUT). The original TEAQ and the

179 scoring instructions are provided in Supporting information (S1 Table). The validation studies ascertained

180 its good internal consistency, construct validity in terms of discriminant validity, known-group validity

181 and convergent validity, and criterion-related validity in terms of predictive validity and concurrent

182 validity. Good concurrent and predictive validity of the TEAQ compared to other physical touch

183 measures (TAM, the Familial Touch Orientation (FTO) scale, the TACTYPE questionnaire, the Touch

184 Test, the QPCE, the Physical Contact Assessment Questionnaire and the STQ) was identified.



185 As for the situation in Russia, we were unable to find in Russian any psychometric measure assessing  
186 attitudes to and experiences of social touch, with a reported factor structure and psychometric properties.  
187

## 188 **Aim and general design of the study**

189 Our general research aim was to construct and validate a Russian version of the Touch Experiences and  
190 Attitudes Questionnaires (TEAQ). This measure would be able to assess attitudes to different kinds of  
191 social touch occurring in different social contexts, and to report childhood and current touch experiences.  
192 There are clear cultural differences in behaviors related to social touch within different cultures [52, 53],  
193 leading to possible natural differences in factor structures of different national versions of multi-factor  
194 psychometric tools. Our goal was to maximize the content validity for the Russian version, rather than  
195 mechanistically reproducing the factor structure of the original English version of the TEAQ. This was to  
196 be achieved by using a relatively wide initial pool of items (same as for the original English version of the  
197 TEAQ) and by following the same steps as in the original English study to create an operational Russian  
198 version. Such an approach may help to achieve higher content validity for each culture, similarly to the  
199 approach suggested by the creators of International Personality Item Pool [54]. Such questionnaire should  
200 also be well-suited for use with large and diverse samples of Russian-speaking respondents, including  
201 clinical and vulnerable populations, therefore special attention should be paid to good cultural  
202 admissibility of all the items. According to the aforementioned methodological considerations, the study  
203 was performed in four stages:

204 **Study 1:** Assessing appropriateness of the items from the original English item pool for Russian culture.

205 **Study 2:** Exploratory factor analysis yielding an operational Russian version of the TEAQ (the TEAQ-  
206 Rus) with acceptable consistency and reasonable factor structure.

207 **Study 3:** Confirming the factor structure with an independent sample of participants and reporting  
208 general psychometric properties on the TEAQ-Rus.

209 **Study 4:** Identifying possible demographic differences in the TEAQ-Rus responses and cross-validating  
210 the TEAQ-Rus against other personality constructs (Big Five traits and emotional intelligence) and other  
211 touch assessment tools.

212 In the present study we tested the following hypotheses:

213 1) the resulting Russian version of the TEAQ would have a consistent factor structure reflecting attitudes  
214 to social touch, and childhood and current experiences of social touch; the factor structures of English and  
215 Russian versions of the TEAQ should be reasonably similar with possible minor differences due to  
216 cultural specifics;

217 2) similarly to the original English version [51], the TEAQ-Rus subscale scores would be significantly  
218 influenced by gender and cohabiting conditions and, to a much smaller degree, may be influenced by  
219 education or age cohorts;

220 3) the subscales of the TEAQ-Rus would have good discriminant validity against other personality  
221 measures, and would show positive correlations with emotional intelligence, reflecting the affiliative role  
222 of affective touch;

223 4) participants with higher total TEAQ score would rate all kinds of observed touch as more pleasant, and  
224 would show stronger preference for slow strokes.

225

## 226 **Study 1**

227 The aim of Study 1 was to pilot test the original pool of 117 TEAQ items, and to assess the appropriateness  
228 of the items for Russian culture and their perceived connotations. As a result of Study 1, a subset of items  
229 characterized by both adequate cultural appropriateness and reasonably high item-total correlations would  
230 be selected for further analyses.

### 231 **1.1. Methods**

#### 232 **Participants**

233 Participants were recruited through snowball sampling. To increase control over snowball sampling, the  
234 number of the referrals was limited, all the referrals were instructed to try to collect the data from people  
235 with different age, social, and educational background, and collected responses from no more than 10  
236 participants per referral. All the referrals were qualified psychologists (at least a BA degree in psychology);

237 they were instructed to invite for participation people of diverse age and social backgrounds. All the  
238 participants (N=232) freely agreed to answer a questionnaire and gave informed consent. Study 1, as with  
239 all the other Studies reported in the present article, was approved by the Pushkin Institute research ethics  
240 committee. Participants age varied between 16 and 79 years (M = 26.9, SD = 9.7), 149 participants were  
241 female (64%) and 83 (36%) were male. Male and female samples did not differ significantly in terms of  
242 age ( $p=0.670$ ); mean age and SDs were also similar (Female: Mean = 26.68, SD = 9.25; Male: Mean =  
243 27.25, SD = 9.27).

## 244 **Materials**

245 The original item pool was developed in English by Trotter et al. [55] and consisted of 117 statements  
246 describing different kinds of positive affective touch (mostly hugs, kisses, skin-to-skin and hair-to-skin  
247 contact, self-care, touching animals and different textures) occurring in appropriate social contexts with  
248 partners, friends or relatives, and unfamiliar people, along with several general statements regarding social  
249 touch.

250 Translation of the items into Russian was performed independently by three certified translators (one  
251 holding PhD degree in Psychology, one in Neuroscience). A consensus version was composed collegially  
252 by the translators and an impartial editor. Back-translation performed independently by two translators  
253 unfamiliar to the original revealed no meaningful disagreement with the original version. The expert  
254 committee has reviewed the translation and the general suitability of the item pool (how representative are  
255 the items of Russian typical touch behaviors, how fully they cover different contexts typical for social  
256 touch in Russian culture) and has assessed both as good. The items were used with a 5-point Likert scale  
257 of agreement ('Disagree strongly' = 1, 'Disagree a little' = 2, 'Neither agree nor disagree' = 3, 'Agree a  
258 little' = 4, 'Agree strongly' = 5), as was suggested by the authors of the original item pool. The complete  
259 set of questions in English and in Russian is provided in Supporting information (S2 Table).

## 260 **Procedure**

261 The data were collected by the researchers via a paper and pencil questionnaire at a room at the university.  
262 At the beginning, the participants were told that the aim of the study was to adapt for Russian-speaking  
263 population a questionnaire originally composed in English. The participants were encouraged to make their  
264 comments regarding the content of the items, their acceptability and admissibility for Russian culture. After

265 completion they were asked whether or not the questionnaire and individual items measures touch  
266 experiences and their attitudes to social touch, in order to assess face validity of the questionnaire. It was  
267 highlighted that there were no right or wrong answers for the items. The participants were assured that all  
268 collected data would be confidential and anonymous and that no individual data would be analyzed.

## 269 **Qualitative and statistical analysis**

270 For Study 1 and for all other Studies responses for negatively phrased items were reverse scored so  
271 that all item scores would reflect more positive attitude to touch or more frequent experiences. All  
272 statistical analyses were performed using Statistica 10.0 software. More than 40% percent of the  
273 participants expressed explicit complaints that the questionnaire was too long and incorporated  
274 inappropriate or seemingly irrelevant questions. According to this feedback, two simple criteria were  
275 formulated to exclude the items from the item pool used for exploratory factor analyses in Study 2:

- 276 1) Items deemed inappropriate by at least 20% of the participants were to be excluded.
- 277 2) Any items with very low item-total correlation ( $r < 0.1$ ) were to be excluded to further reduce the  
278 volume of the item pool. This low threshold was selected as we could have expected the subscales within  
279 the scale to be relatively independent from each other.

## 280 **1.2. Results**

281 Items containing explicit questions on intimate life were excluded as inappropriate, as 68% of participants  
282 of the Study 1 sample considered them to be inadmissible for wide use in a questionnaire for Russian culture  
283 (e.g., Q30, “I enjoy the physical intimacy of sexual foreplay”; Q57, “I enjoy having sex”). The inclusion of  
284 explicitly sex-related items that are considered inappropriate by a large part of the respondents would affect  
285 the respondents’ experiences, causing possible vexation or embarrassment of the respondents and could  
286 have compromised the integrity of respondents’ answers to the other questions.

287 Cronbach’s  $\alpha$  as a measure of the TEAQ-117 internal consistency was 0.93, demonstrating a high level of  
288 items’ consistency. Despite that, 27 items had item-total correlations below 0.1; these items were also  
289 excluded from further analyses. A pilot exploratory factor analysis confirmed that none of these items had  
290 factor loadings higher than 0.4 on any of the factors for 5-factor or 6-factor models prompted by Cattell’s  
291 scree test [57]. Individual examination of items excluded due to low item-total correlations revealed that at  
292 this stage all the items concerning touch other than interpersonal touch and self-care touch were excluded,

293 namely, touching or feeling different surfaces, “I don’t like the feel of wool against my skin”,  $r=-0.04$ ),  
294 itching (Q1, “Having an itch scratched is very enjoyable”,  $r=0.03$ ) along with several general items that do  
295 not relate directly to touch, concerning emotional experiences (Q62, “I was alone a lot during my  
296 childhood”,  $r=0.00$ ), or skin quality (Q82, “I have dry skin”,  $r=-0.04$ ).

297 A pool of 85 retained items was selected for use in Study 2; each of the items was deemed appropriate for  
298 general Russian adult population.

299

## 300 **Study 2**

301 The goal of the second Study was to perform exploratory analysis for the reduced 85-item Russian TEAQ  
302 pool and to construct a reasonably brief questionnaire with good content and construct validity and a  
303 consistent factor structure to serve further as a suggested operational Russian version of the TEAQ.

### 304 **2.1. Methods**

#### 305 **Participants**

306 A separate sample of 468 participants was recruited through a highly controlled version of snowball  
307 sampling, according to the procedure described in Participants section of Study 1. All the participants freely  
308 agreed to answer a questionnaire at this stage, 306 (65%) were female and 162 (35%) were male.  
309 Participants age varied between 16 and 79 years ( $M = 25.9$ ,  $SD = 9.7$ ). Male and female samples did not  
310 differ significantly in terms of age ( $p=0.119$ ); mean age and SDs were also similar (Female: Mean = 25.40,  
311  $SD = 9.73$ ; Male: Mean = 26.87,  $SD = 9.56$ ).

#### 312 **Materials and Procedure**

313 The participants completed a questionnaire composed of 85 TEAQ items. Data were collected personally  
314 by the researchers via a paper and pencil questionnaire. At the beginning, the participants were told that the  
315 aim of the study was to adapt for Russian-speaking population a questionnaire originally composed in  
316 English. It was highlighted that there were no right or wrong answers for the items. The participants were  
317 assured that all collected data would be confidential and anonymous and that no individual data would be  
318 analyzed.

#### 319 **Statistical analysis and predictions**

320 At this stage, the primary goal was to obtain the clearest and the most interpretable factor structure, therefore  
321 we used principal component analysis (PCA) as a factor extraction technique with varimax rotation [56].  
322 All statistical analyses were performed using Statistica 10.0 software. After assessing the PCA component  
323 structure each individual item was to meet each of three preset criteria in order to be included into a brief  
324 operational Russian TEAQ version: 1) an item exclusion should lead to decrease of overall Cronbach's  $\alpha$ ;  
325 2) an item should have the highest loading of at least 0.4 for any component [57]; 3) the two highest loadings  
326 of an item should not be too similar (a difference of at least 0.1 was required).  
327 We expected that as a result of Study 2 we would compose a reasonably brief questionnaire of 30 to 60  
328 items with an easily interpretable factor structure reflected in 3 to 7 subscales; the factor structure was  
329 expected to be reasonably similar to the factor structure of the original English version of the TEAQ, with  
330 one or more PCA components corresponding to each of the major domains of childhood touch, current  
331 touch, and attitudes to different touch-related behaviors.

## 332 **2.2. Results and Discussion**

333 Cronbach's alpha for the complete 85 item set was high (0.935) demonstrating high level of items'  
334 consistency, with an average inter-item correlation of 0.157. The Kaiser-Meyer-Olkin Measure of Sampling  
335 Adequacy value was 0.901 with significance level for Bartlett's Test of Sphericity  $\leq 0.001$ , therefore the  
336 dataset was considered fit for PCA.

### 337 **Principal component analysis**

338 According to Cattell's scree test [57], five component decision was selected for detailed analysis.  
339 Eigenvalues for this solution are presented in Table 1. We can see that five components account for 41.8%  
340 of the variance with the largest eigenvalue for the first component (18.93). The latter components have very  
341 similar eigenvalues of 5.32 to 3.14.

342

343 **Table 1. Eigenvalues and percentage of variance explained for the 5-factor solution (Stage 2).**

	Eigenvalue	Total variance (%)	Cumulative eigenvalue	Cumulative total variance (%)
Factor 1	18.93	22.27	18.93	22.27
Factor 2	5.32	6.26	24.25	28.53
Factor 3	4.48	5.27	28.74	33.81
Factor 4	3.62	4.26	32.36	38.07
Factor 5	3.14	3.70	35.51	41.78

344

345

346

347 According to the content of items loading highest on each factor, the five component solution yielded an  
 348 easily interpretable factor structure. Consistent to the predictions, there were separate components for  
 349 childhood touch experiences (ChT subscale, e.g. “My parents regularly cuddled me as a child”; “As a child  
 350 I would often hug family members”) and for current touch. Only items related to intimate touch scored high  
 351 on this component therefore the subscale was defined as Current Intimate Touch (CIT subscale, e.g. “Most  
 352 days I get a hug or a kiss”, “I can always find somebody to physically comfort me when I am upset”). Three  
 353 components reflected attitudes to different kinds of affective touch events: attitude to intimate touch (AIT  
 354 subscale, e.g. “I find a hug very comforting when I am upset”; “I like to stroke the skin of someone I know  
 355 intimately”), general attitude to friendly social touch and to touch with friends and relatives (Attitude to  
 356 Friendly Touch or AFT subscale, e.g. “I enjoy having my skin groomed by other people”, “Physical contact  
 357 with other people is important to me”), and attitude to self-care (ASC subscale, e.g. “I like using body  
 358 lotions”, “I like the feel of shower gels against my skin”).

359 Analysis of individual item loadings and effects of their exclusion on Cronbach's  $\alpha$  reveals that only 37  
 360 items matched all the three inclusion criteria. The 37-item version had very high consistency (Cronbach's  
 361  $\alpha=0.9201$ ) with average inter-item correlation of 0.24. Each subscale also had high consistency (all  
 362 Cronbach's  $\alpha$  above 0.82). The paper and pencil version of the TEAQ-37 Rus with scoring instructions is  
 363 also provided in Supporting information (S3 Table). Copyright of the TEAQ-37 Rus remains with the  
 364 authors.

365 For all the items of the TEAQ-37 Rus the factor loadings, item-total correlations, and Cronbach's  $\alpha$  if  
366 deleted are provided in Supporting information (S4 Table) for the Study 2 sample.

367 There were several groups of items that failed to integrate into this factor structure during Studies 1 and 2,  
368 one of such groups including attitudes to touch interactions with unfamiliar or less familiar people. Very  
369 few comparative studies of nonverbal behavior assessing Russians have been published in international  
370 peer reviewed journals, but the existing data point that according to Hall's classification modern Russian  
371 culture is predominantly non-contact [59, 60], with particular reservation towards physical contacts with  
372 strangers; unfamiliar touch that occurred quite frequently during Soviet times in crowded places and public  
373 traffic can be unwillingly tolerated but never sought [61]. Another possible culture-specific facet of item  
374 selection may be related to items related to hugs occurring in different contexts: most items concerning  
375 habitual use of hugs as an informal greeting were excluded (i.e. "I always greet my friends and family by  
376 giving them a hug" or "I usually hug my family and friends when I am saying goodbye") but the majority  
377 of items concerning hugs as emotionally meaningful interactions were retained and included into either  
378 AIT subscale ("Hugging someone is a good way of consoling them", "Sometimes I just need to be hugged")  
379 or into CIT subscale ("Most days I get a hug or a kiss"). In Russian culture hugs are reserved for closer  
380 friends and are often used in a more intimate manner, not as a social greeting but as a genuine gesture of  
381 affection or consolation [60]. Opposite is true for handshakes that are a very common formal or semi-formal  
382 greeting, but normally used between men only (possibly by women but usually on very formal occasions);  
383 this is reflected in the results of a post-hoc ANOVA for a handshake related item ("I often shake hands with  
384 people") showing a very robust effect of gender ( $F = 119.40, p < 0.001$ ) with mean value for the item for  
385 females of 2.52 ( $SD = 1.27, Mode = 1$ ), and for males of 3.86 ( $SD = 1.26, Mode = 5$ ). Overall, such gender  
386 differences raised a concern that the unequal females to males ratio in our sample would possibly  
387 compromise the item composition and the factor structure. Separate exploratory factor analyses were run  
388 for males and females, and the differences were found to be very minor, reflecting no significant influence  
389 on the item composition and the factor structure of the TEAQ-37 Rus due to the sample gender composition.

390 In summary, Study 2 led to the construction of a 37-item Russian version of the TEAQ (TEAQ-37 Rus)  
391 which was characterized by high internal consistency and a clear five-factor structure (Attitude to Friendly  
392 Touch (AFT), Childhood Touch (ChT), Attitude to Self-Care (ASC), Current Intimate Touch (CIT), and  
393 Attitude to Intimate Touch (AIT)). The TEAQ-37 Rus was suggested as an operational version for Studies



394 3 and 4 (confirmatory factor analysis and validating the TEAQ-37 Rus against other psychometric  
395 measures). Psychometric properties of the TEAQ-37 Rus will be reported in details according to the data  
396 obtained from the confirmation sample (Study 3), to eliminate possible interference of the responses to the  
397 items of the TEAQ-37 Rus with responses to the items excluded from further analyses during Study 2.

## 398 **Study 3**

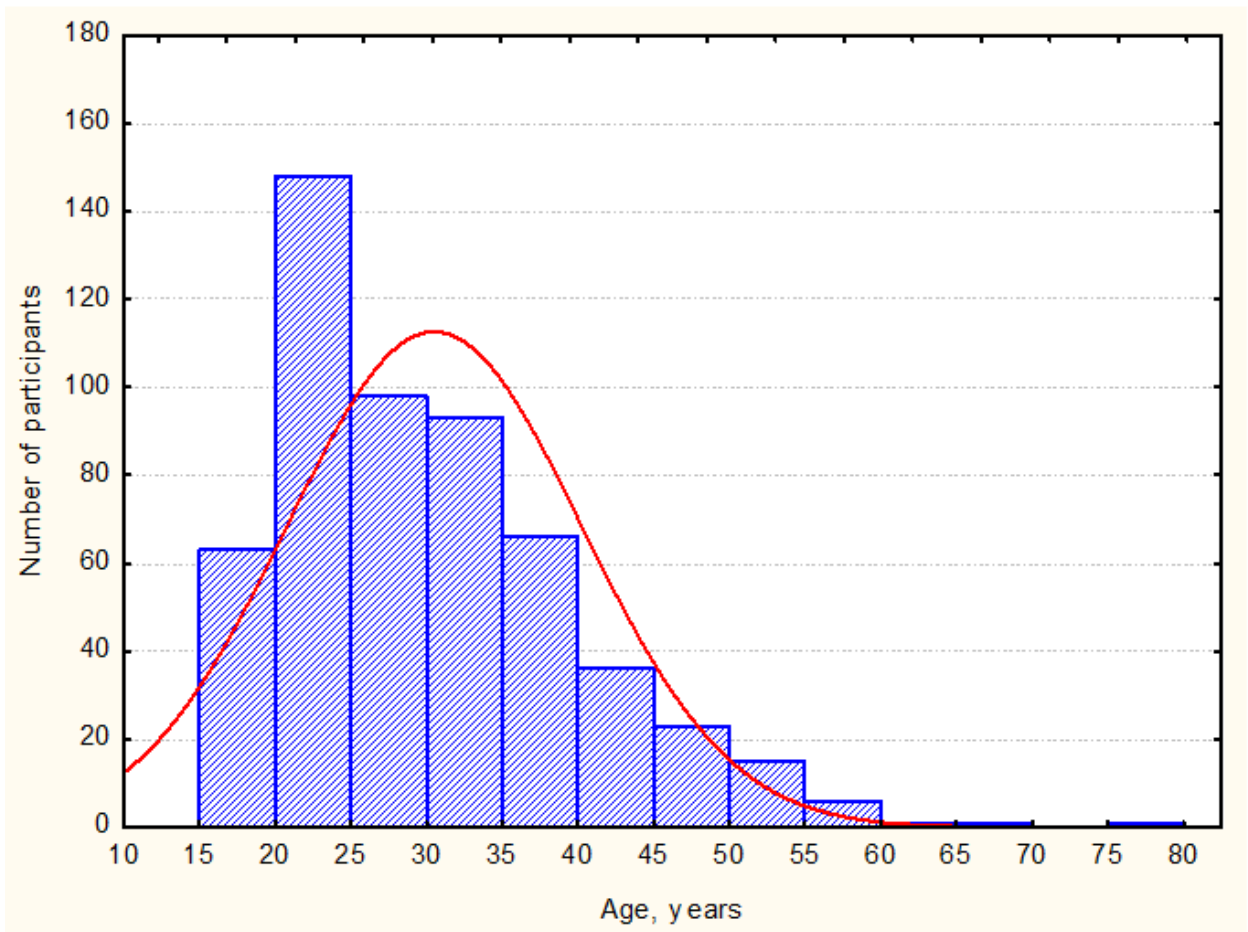
399 At this stage of the research we aimed to confirm internal consistency and the validity of the previously  
400 obtained factor structure of the 37-item version of Russian TEAQ (TEAQ-37 Rus) with confirmatory factor  
401 analysis (CFA) using the data collected from the third sample of Russian speaking participants and to  
402 describe general psychometric properties of this version of the questionnaire.

### 403 **3.1 Methods**

#### 404 **Participants**

405 To increase the ecological validity of the CFA sample the data collection was performed by two methods:  
406 a) Group A: a highly controlled version of snowball sampling as described above, providing minimal  
407 participation bias, 280 participants (167 female, 113 male); and b) Group B: data collected through an  
408 internet survey to increase the coverage of different social and age groups, 271 participant (209 female, 62  
409 male). For the purposes of Study 3 both samples were included in a general sample and analyzed together.  
410 The total sample included 551 participants (376 female, 68%), with no missing TEAQ-37 Rus, age, or  
411 gender data for any of the participants. Participants age varied between 16 and 79 years ( $M = 30.5$ ,  $SD =$   
412  $9.76$ ), age distribution across the sample is reported in Fig 1. Male and female samples did not differ  
413 significantly in terms of age ( $p=0.54$ ); mean age and SDs were also similar (Female: Mean = 30.69,  $SD =$   
414  $10.21$ ; Male: Mean = 30.14,  $SD = 8.71$ ).  
415

416 **Fig 1. Age distribution for Study 3 sample.**



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## 426 **Materials and Procedure**

427 All the data for the Study 3 were collected through online forms. The participants from Group A completed  
428 the forms at a room at the university, the participants from Group A completed the forms at home. The  
429 participants completed the TEAQ-37 Rus along with several other psychometric tools to assess construct

430 and concurrent validity of the TEAQ-37 Rus within Study 4, so the samples for studies 3 and 4 were the  
431 same. For the details on other questionnaires and psychometric instruments used see Study 4, Methods. The  
432 composition of the questionnaires for different subsamples was different in order to keep the assessment  
433 time within reasonable limits. Total average assessment time did not exceed 30-35 minutes for any  
434 subsample. The participants within each subgroup were randomly assigned to one of 4 questionnaire  
435 sequences with counterbalanced order of questionnaires. According to the collected feedback, all the  
436 questionnaires and the whole procedure was tolerated well.

### 437 **Statistical analysis**

438 CFA was performed in AMOS 21.0.0 software using method of maximal likelihood. The criteria used to  
439 determine goodness of model fit were a Root Mean Square Error of Approximation (RMSEA), a  
440 Comparative Fit Index (CFI), Relative chi-square (CMIN/DF), and Non-normed fit index NNFI (TLI) [62].  
441 Re-assessment of the factor structure was also performed at this stage to report Cronbach's  $\alpha$  and factor  
442 loadings for all the items for the TEAQ-37 Rus for the validation sample. Factor analysis settings were  
443 identical to Study 2 (PCA as factor extraction technique, Varimax rotation. Distribution assessments  
444 (Kolmogorov-Smirnov test) and subscale cross-correlation analysis were performed to evaluate general  
445 psychometric properties of the subscales.

446

### 447 **3.2. Results and discussion**

448 **CFA.** Initial analysis was performed for a five factor model where each item loaded for only one factor,  
449 with no consideration for possible loadings for two factors and variances of errors for individual items. This  
450 model demonstrated nearly satisfactory fit (see Model 1 in Table 2). A modified Model 2 considering  
451 covariances of errors for items with similar content (item pairs 33-25, 33-37, 36-27, 3-2, 7-34, 28-9, 35-21,  
452 26-12, 19-16, 8-4, 4-5) demonstrated satisfactory fit (Table 2) [62]. The path diagram for the CFA is  
453 provided at Fig 2.

454

455 **Table 2. CFA fit indices of assessed models (Stage 3).** CMIN/DF - Relative chi-square; CFI -  
456 comparative fix index; NNFI (TLI) - non-normed fit index; RMSEA - root mean square error of  
457 approximation.

458

Model	CMIN/DF	CFI	NNFI (TLI)	RMSEA
1	3.809	.817	.803	.071
2	2.922	.877	.865	.059

459

460

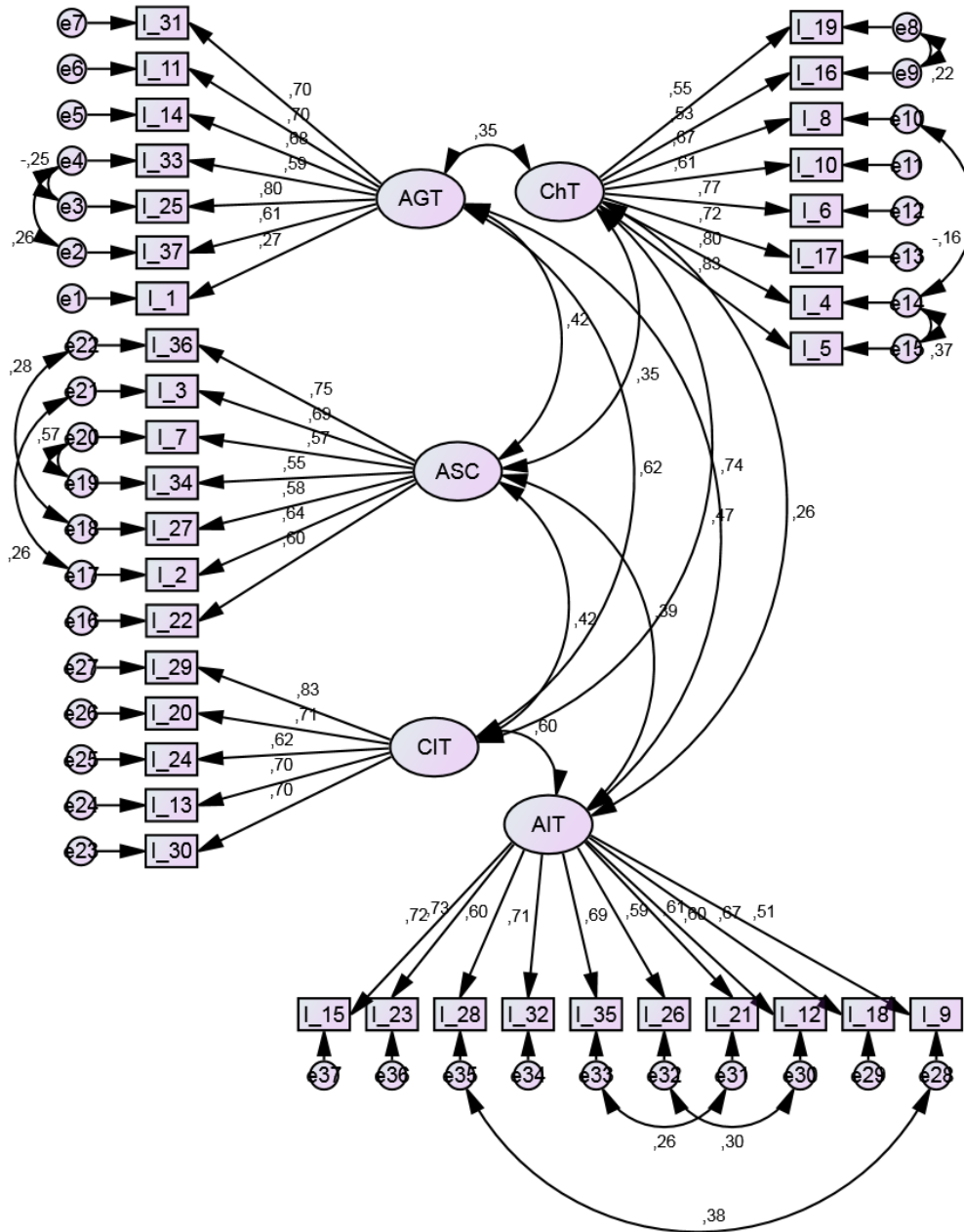
461

462 **Fig 2. CFA Path diagram for Model 2 of the TEAQ-37 Rus.**

463 Rectangles indicate measured variables and large ellipses represent TEAQ-37 Rus subscales. Covariances  
 464 of errors between items with similar content are shown.

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471 **Replication of the original factor structure and reporting general**  
472 **psychometric properties**

473 The principal component analysis repeated for Study 3 sample corresponded very closely to the results of  
474 the CFA; the same five components were observed as for Study 2 sample: Attitude to Friendly Touch  
475 (AFT), Childhood Touch (ChT), Attitude to Self-Care (ASC), Current Intimate Touch (CIT), and Attitude  
476 to Intimate Touch (AIT). The 5-factor model explained 54% of the total variance. The item loads were  
477 very good to moderate, the worst load being 0.427 and the next worst being 0.499. General scale  
478 reliability and factor reliabilities were high (total Cronbach's  $\alpha = 0.920$ , Cronbach's  $\alpha$  for the factors  
479 ranging from 0.88 to 0.83). The factor loads for all the items, Cronbach's  $\alpha$ , and percentage variance  
480 explained for all the subscales are shown in Table 3.

481

483 **Table 3: TEAQ-37 Rus Factor Structure.** Factor loading of each item are shown. (R) after item  
 484 numbers denotes reverse scored items. At the bottom of the table Cronbach's  $\alpha$  and percentage variance  
 485 explained by each factor are given.

Items of the TEAQ-37 Rus, with numbers	AFT	ChT	ASC	CIT	AIT
31. I enjoy having my skin groomed by other people	<b>0.72</b>	0.04	0.08	0.25	0.16
11. Physical contact with other people is important to me.	<b>0.66</b>	0.12	0.15	0.12	0.28
14. I enjoy grooming other people's skin.	<b>0.66</b>	0.07	0.06	0.18	0.23
33. I am on huggable terms with quite a few people	<b>0.63</b>	0.14	0.11	0.09	0.18
25. In general, I would describe myself as a physically affectionate person.	<b>0.51</b>	0.12	0.12	0.36	0.42
37. I like it when my friends and family greet me by giving me a hug.	<b>0.50</b>	0.21	0.27	0.04	0.42
1 (R). I dislike people being very physically affectionate towards me.	<b>0.43</b>	-0.01	-0.09	0.06	0.04
5. My parents regularly cuddled me as a child	0.08	<b>0.85</b>	0.02	0.14	-0.00
4. There was a lot of physical affection during my childhood	0.06	<b>0.79</b>	0.10	0.20	-0.04
17. As a child my parents always comforted me when I was upset	-0.04	<b>0.78</b>	0.02	0.11	0.02
6. As a child I would often hug family members	0.22	<b>0.73</b>	0.08	0.13	0.09
10. As a child my parents would tuck me up in bed every night and give me a hug and a kiss goodnight	0.03	<b>0.69</b>	0.07	-0.01	0.09
8. As a child I found a hug from my parents when I was upset made me feel much happier	0.17	<b>0.64</b>	0.18	0.09	0.19
16. My mother regularly bathed me as a child	-0.05	<b>0.61</b>	0.22	0.03	0.11
19. As a child my parents would often hold my hand when I was walking along with them.	0.04	<b>0.60</b>	0.13	0.12	0.17
36. I like to use face masks on my skin	0.13	0.11	<b>0.78</b>	0.12	0.06



3. I like using body lotions	0.14	0.14	<b>0.70</b>	0.11	0.01	
7. I like to use bath essence when having a bath	0.00	0.11	<b>0.68</b>	0.05	0.18	
34. I like having a bath with lots of bubble bath.	-0.01	0.06	<b>0.67</b>	0.10	0.15	
27. I like exfoliating my skin	0.13	0.05	<b>0.66</b>	0.14	-0.02	
2. I like using moisturisers on my skin	0.08	0.14	<b>0.65</b>	0.07	0.13	
22. I like the feel of shower gels against my skin.	0.09	0.06	<b>0.63</b>	0.07	0.17	
29. I often have my skin stroked.	0.26	0.22	0.11	<b>0.78</b>	0.09	
20. Most days I get a hug or a kiss.	0.15	0.16	0.15	<b>0.70</b>	0.12	
24. I often share a romantic kiss	-0.07	0.12	0.10	<b>0.67</b>	0.38	
13. I can always find somebody to physically comfort me when I am upset	0.13	0.29	0.10	<b>0.64</b>	0.16	
30. I often hold hands with someone I am fond of.	0.35	0.12	0.15	<b>0.57</b>	0.28	
15. I enjoy being cuddled by someone I am fond of	0.24	0.09	0.01	0.04	<b>0.73</b>	
23. I enjoy holding hands with someone I am fond of	0.13	-0.02	0.17	0.26	<b>0.69</b>	
28. Kissing is an enjoyable part of expressing romantic feeling	-0.08	0.07	0.04	0.35	<b>0.67</b>	
32. I like to stroke the skin of someone I know intimately	0.14	0.01	0.05	0.36	<b>0.64</b>	
35. I find a hug very comforting when I am upset	0.34	0.10	0.25	0.08	<b>0.63</b>	
26. It's good to console people you know well with strokes and hugs	0.21	0.08	0.03	0.07	<b>0.63</b>	
21. Sometimes I just need to be hugged	0.27	-0.02	0.20	-0.04	<b>0.63</b>	
12. Hugging someone is a good way of consoling them.	0.36	0.12	0.10	-0.01	<b>0.59</b>	
18. I enjoy the feeling of my skin against someone else's if I know them intimately	0.22	0.04	0.03	0.27	<b>0.58</b>	
9. Kissing is a great way of expressing physical attraction.	-0.02	0.15	0.04	0.26	<b>0.56</b>	
<b>Total variance explained</b>	<b>0.54</b>	0.09	0.12	0.10	0.09	0.14
<b>Cronbach's <math>\alpha</math></b>	<b>0.92</b>	0.84	0.85	0.84	0.83	0.88

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489 The confirmatory analyses yielded results proving adequate face validity and internal consistency of the  
490 37-item version of the questionnaire (TEAQ-37 Rus). This version is therefore treated as an operational  
491 Russian version of the TEAQ in this manuscript and all the further statistical analyses in Study 3 and  
492 Study 4 are performed for the TEAQ-37 Rus. All the resulting subscales are scored and named according  
493 to the initial factor analysis and CFA results: Attitude to Friendly Touch (AFT), Childhood Touch (ChT),  
494 Attitude to Self-Care (ASC), Current Intimate Touch (CIT), Attitude to Intimate Touch (AIT). The total  
495 TEAQ-37 Rus score is calculated as the sum of the subscale scores.

496 Mean TEAQ-37 Rus score for the sample was 122.33 (SD = 22.15), there were no participants who got  
497 highest or lowest possible score (185 or 37), so no floor or ceiling effect was observed. The total TEAQ-  
498 37 Rus score distribution for the Study 3 data sample was assessed as not differing significantly from  
499 normality (K-S test,  $p > 0.1$ ). The distributions of all the subscales was also normal or close to normal  
500 ( $p > 0.001$  for all the subscales). No prominent ceiling or floor effects was observed for any subscale. The  
501 most prominent skewness and the largest ceiling effects (7.63%) were observed for AIT subscale, indicating  
502 that gentle touch between close people is generally perceived as very pleasant by the majority of our  
503 participants.

504 All the subscales significantly correlated with each other (all  $p < 0.0001$ ), with low to moderate strength of  
505 the observed correlations (see Table 4). Attitude to personal grooming correlated least with other  
506 components and current social touch correlated most. The strongest correlation was between AFT and AIT  
507 ( $r = 0.62$ ). The weakest correlation was between ChT and AIT ( $r = 0.25$ ).

508

509 **Table 4. TEAQ-37 Rus subscale data.** Mean and standard deviations are provided for subscale score  
 510 sums, and correlation coefficient values are given for correlations between the subscales.

	Means	SD	AFT	ChT	ASC	CIT	AIT
<b>AFT</b>	22.63	5.765	-	0.30	0.33	0.49	0.62
<b>ChT</b>	25.05	7.423	0.30	-	0.30	0.40	0.25
<b>ASC</b>	18.68	5.671	0.33	0.30	-	0.33	0.33
<b>CIT</b>	15.80	5.164	0.49	0.40	0.33	-	0.53
<b>AIT</b>	40.35	7.099	0.62	0.25	0.33	0.53	-

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## 522 **Study 4**

523 At this stage of the research we aimed to test experimental hypotheses 2, 3, and 4, by identifying possible  
524 demographic differences in TEAQ-37 Rus responses and by assessing construct and criterion validity of  
525 the TEAQ-37 Rus. For general details of the sample composition and the experimental procedure see Study  
526 3, Methods.

527 At the beginning of Study 4, after obtaining and validating the factor structure of the TEAQ-37 Rus, and  
528 after assessing the data on the English version of the TEAQ [51], it was possible to formulate and to put to  
529 test more specific experimental hypotheses to further expand previously formulated general experimental  
530 hypotheses 2 and 3 (see Introduction):

531 2.1) Female participants would have higher general TEAQ-37 Rus score, and particularly higher score at  
532 ASC TEAQ-37 Rus subscale;

533 2.2) The correlation between age and attitudes toward social touch would be insignificant or relatively  
534 small, though for experience-related subscales there may be a difference between different age groups,  
535 particularly for childhood experience, due to gradually improving attitude to nurturing family touch from  
536 1970-1980s to 1990-2000s [4, 62]; education would have little to no effect on TEAQ-37 Rus score;

537 2.3) People living alone would score lowest on current intimate touch, and people living with partners  
538 would score highest;

539 3.1) In terms of convergent and discriminant validity measured against the Big Five factors, the TEAQ-37  
540 Rus subscales would have insignificant to low strength correlations with the Big Five factors, except for  
541 Extraversion and Openness factors that would have low to moderate strength positive correlations with the  
542 TEAQ-37 Rus subscales;

543 3.2) There would be weak to moderate positive correlation with emotional intelligence for the TEAQ-37  
544 Rus subscales.

545

### 546 **4.1. Participants and methods**

## 547 **Demographics**

548 Age and gender effects were assessed for all of the Study 4 sample participants (n=551). For the majority  
549 of the participants data were collected for education (n = 399); most participants had higher education (n =  
550 276), 77 participants had unfinished higher education, and 46 participants had general school or vocational  
551 school education. Cohabiting status was assessed for 325 participants (243 female, 82 male), response  
552 options were “Living alone” (n = 56), “With a spouse/partner” (n = 151), and “With relatives other than a  
553 spouse/partner, or with friends/peers” (n = 147).

## 554 **Psychometric measures**

555 The TEAQ-37 Rus and demographic assessment questions preceded several other psychometric tools to  
556 assess construct and concurrent validity of the TEAQ-37 Rus. Different combinations of psychometric  
557 instruments were used for different population subsamples to provide a range of measures to validate  
558 against, keeping in mind that total assessment time should not exceed 30-35 minutes for any participant.  
559 To the best of our knowledge, the TEAQ-37 Rus is the only psychometric measure in Russian that assesses  
560 attitudes to and experiences of social touch, with reported factor structure and psychometric properties,  
561 therefore it was not possible to validate it against established touch-related self-report questionnaires. To  
562 assess the discriminant validity of the TEAQ-37 Rus, we have collected data on personality traits according  
563 to the Big Five model, and on EmIn measure of emotional intelligence. To assess the criterion validity of  
564 the TEAQ-37 Rus and to further assert the link between the psychometric measures of touch and the C-  
565 tactile system, the TEAQ-37 Rus was also validated against the Affective Touch Video clips. A sample of  
566 325 participants (243 female, 82 male) completed the TEAQ-37 Rus, NEO-FFI, and viewed Affective  
567 Touch Video clips (always in this particular sequence); a smaller sample of 74 participants completed the  
568 TEAQ-37 Rus and EmIn.

## 569 **Big Five personality trait assessment**

570 Big Five personality model [63] was used for cross-validation as one of the most widely used personality  
571 models focusing on personality traits related to social performance. There are several questionnaires in  
572 Russian assessing the Big Five personality traits developed for adults [64]. The most popular and better

573 validated versions are adaptations of the NEO-PI-R and the NEO-FFI [65], an adaptation of Goldberg's  
574 100-item IPIP scale [66], and yet another Russian version of the NEO-FFI [67, 68]. The latter Russian  
575 version of NEO-FFI was selected for the purposes of the study as it is reasonably brief and its factor  
576 structure has been extensively replicated on different samples [69, 70].

### 577 **EmIn questionnaire**

578 EmIn questionnaire was selected to measure emotional intelligence as it the most widely used and  
579 thoroughly validated Russian questionnaire for self-assessment of emotional intelligence [71-75]. It is  
580 composed of 46 items and provides general score for self-assessed emotional intelligence, and subscale  
581 scores for Emotion Recognition (ability to recognize emotions in self and others), Emotion Management  
582 (ability to manage the emotional state of self and others), Interpersonal Emotional Intelligence (ability to  
583 recognize and manage emotions of others), and Self-directed Emotional Intelligence (ability to recognize  
584 and manage own emotions).

### 585 **Affective Touch Video clips**

586 To test the experimental hypothesis 4 and to assess criterion validity of the TEAQ-37 Rus, for a population  
587 subsample we administered short video clips depicting actors being touched by another person at different  
588 velocities and at different body sites. Subjective ratings of perceived pleasantness of the touch (325  
589 participants; 243 female, 82 male) were recorded. The video set used for the present study were similar to  
590 the set developed earlier by Walker and colleagues (2017) but was significantly expanded: there were two  
591 actor pairs (a male touching a female and a female touching a male), three velocities (static touch, slow  
592 strokes with a velocity of 5 cm/s, and fast strokes with a velocity of 30 cm/s), and eight different body skin  
593 sites being touched (palm, hand, dorsal and ventral forearm, upper arm, back, side of the face, and back of  
594 the head), 48 videos total. All the videos were 6 s long, had original quality of Full HD (1920×1080 pixels)  
595 at 25 fps rate, and were presented at 240 p YouTube quality. Close up angles were used in order not to  
596 reveal the faces of the actors, to make the videos less personal. Examples of the videos in YouTube quality  
597 are provided in Supporting information (S4 – S6 videos), and the whole video set is available on request.  
598 The videos were presented in four randomly assigned counterbalanced sequences. After watching each  
599 video clip the participants rated the perceived pleasantness of the touch for the person being touched, on a

600 Likert scale from 1 (very unpleasant) to 7 (extremely pleasant). It has been previously demonstrated that  
601 videos depicting slow strokes are consistently rated as the most pleasant kind of touch for hairy skin sites  
602 (Walker et al., 2017).

## 603 **Statistical analysis**

604 According to the results of distribution tests (see Study 3) and taking into account large sample sizes, the  
605 distributions were close enough to normality to justify the use of parametric statistics for correlations and  
606 between-group comparisons for total TEAQ-37 Rus scores and subscale scores, therefore Pearson's  
607 correlation coefficients ( $r$ ) were used. Bonferroni correction was applied as appropriate for all multiple  
608 comparisons where specific predictions had not been formulated.

609 One way between group ANOVAs were used to assess the effects of gender (Gender Group (2)), cohabiting  
610 status (Cohab Group (3)) and education (Education Group (3)) on the TEAQ-37 Rus subscale scores for  
611 each subscale. To evaluate the relationship between TEAQ-37 Rus scores and perceived pleasantness of  
612 touch in touch video clips we had divided the sample into two groups based on TEAQ-37 Rus total scores,  
613 median split: TEAQ-37 Rus < 122 ( $n = 167$ ) and TEAQ-37 Rus  $\geq 122$  ( $n = 170$ ). Omnibus repeated  
614 measures ANOVA (TEAQ Group (2) \* Velocity (3) \* Site (8) \* Actor Pair (2)) was used to evaluate  
615 relations between TEAQ-37 Rus score and perceived pleasantness of touch depicted in video clips.  
616 Greenhouse-Geisser sphericity corrections were used where appropriate (corrected  $p$  values are provided).  
617 Scheffé's post hoc tests were used as both within-group and between-group comparisons were of interest.

## 618 **4.2. Results**

### 619 **Demographic group effects**

620 Means and SDs for all the TEAQ-37 Rus subscales for gender, education and cohabiting status groups are  
621 provided in Table 5.

622

623 **Table 5. Demographic group data for Study 4.**

	Gender				Cohabiting Status						Education					
	Female (N=376)		Male (N=175)		Single (N=58)		With Relatives/Friends (N=128)		With a Partner (N=151)		School (N=46)		Unfinished Higher (N=77)		Higher (N=276)	
Subscale	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
AFT	23.13	5.84	21.58	5.46	21.47	7.10	22.59	6.17	22.77	6.09	21.96	6.63	21.62	6.17	23.17	6.17
ChT	25.45	7.85	24.18	6.36	23.60	6.49	23.41	7.70	23.97	7.74	23.92	8.28	25.22	8.20	24.22	7.30
ASC	20.26	5.15	15.28	5.24	16.95	4.63	18.62	5.57	17.81	5.81	18.35	5.73	18.25	5.30	18.23	5.86
CIT	16.38	5.11	14.57	5.08	12.14	4.83	13.70	5.31	17.64	4.53	14.53	6.07	15.32	5.54	15.92	5.25
AIT	41.15	6.89	38.63	7.25	39.53	6.91	40.42	8.17	41.56	6.20	40.86	7.63	40.03	7.98	41.22	6.86

624

625

626 **Gender.** According to the ANOVAs for the TEAQ-37 Rus subscales, female participants scored  
 627 significantly more for Attitude to Self-Care ( $p_{\text{corr}} < 0.001$ ), Attitude to Friendly Touch ( $p_{\text{corr}} = 0.016$ ),  
 628 Attitude to Intimate Touch ( $p_{\text{corr}} < 0.001$ ), and Current Intimate Touch ( $p_{\text{corr}} < 0.001$ ) subscales; there were  
 629 no relations between Gender and Childhood touch ( $p_{\text{corr}} = 0.21$ ). The most robust Gender effect, consistent  
 630 with the predictions, was observed for Attitude to Self-Care (see Table 5).

631 **Age.** A correlation of low strength but of relatively high significance due to large sample size ( $r = -0.16$ ,  
 632  $p_{\text{corr}} = 0.001$ ) was observed for Childhood Touch subscale reflecting that participants of older cohorts tended  
 633 to receive slightly less affective touch in their childhood. No significant correlations with Age were  
 634 observed for any other TEAQ-37 Rus subscale (all  $r_s < 0.06$ , all  $p_{\text{Suncorr}} > 0.15$ ).

635 **Cohabiting status.** Between group ANOVAs revealed that the effect of Cohabiting status was significant  
 636 only for Current Intimate Touch subscale ( $F(2, 322) = 35.19$ ,  $p_{\text{corr}} = 0.001$ ,  $\eta_p^2 = 0.18$ ), pointing that, as  
 637 expected, participants living with spouses or partners had the highest amount of tactile interactions with  
 638 close people, and participants living alone had the lowest CIT score (see Table 5). No significant effects  
 639 were observed for any other TEAQ-37 Rus subscale (all  $p_{\text{Suncorr}} > 0.10$ ).

640 **Education.** Between group ANOVAs revealed no significant effect of education level on any TEAQ-37  
 641 Rus subscale (all  $p_{\text{Suncorr}} > 0.1$ ).

642 **Validation of TEAQ-37 Rus against other psychometric measures**



643 **Big Five personality factors.** The correlations of the TEAQ-37 Rus subscales with the Big Five personality  
 644 factors are given in Table 6. Consistent with the predictions, the strongest correlations were observed for  
 645 Extraversion (r values ranging from 0.47 for AFT subscale to 0.20 for ASC subscale). Weak but significant  
 646 correlations with all the TEAQ-37 Rus subscales were observed for Openness (r ranging from 0.25 to 0.18).  
 647 For Agreeableness weak significant correlations were observed for AFT, ChT, CIT, and AIT (r ranging  
 648 from 0.30 to 0.18) but not for ASC. Conscientiousness correlated with CIT only, and Neuroticism correlated  
 649 with AFT only. All the significant correlations with the Big Five personality factors were positive for all  
 650 the TEAQ-37 Rus subscales.

651

652 **Table 6. Correlations of the TEAQ-37 Rus subscales with the Big Five personality factors (r values).**

	Neuroticism	Extraversion	Openness	Agreeableness	Conscientiousness
<b>AFT</b>	0.01	<b>0.47</b>	<b>0.25</b>	<b>0.30</b>	-0.02
<b>ChT</b>	-0.07	<b>0.27</b>	<b>0.17</b>	<b>0.18</b>	0.00
<b>ASC</b>	<b>0.21</b>	<b>0.20</b>	<b>0.20</b>	0.09	0.05
<b>CIT</b>	-0.05	<b>0.44</b>	<b>0.22</b>	<b>0.18</b>	<b>0.15</b>
<b>AIT</b>	0.06	<b>0.38</b>	<b>0.23</b>	<b>0.23</b>	0.03
<b>TEAQ-37 Rus Total</b>	0.04	<b>0.49</b>	<b>0.30</b>	<b>0.28</b>	0.05

653

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655

656 **Emotional intelligence (EmIn).** The correlations of the TEAQ-37 Rus subscales with different facets of  
657 emotional intelligence, as measured by EmIn, are given in Table 7. All the significant correlations with the  
658 EmIn subscales were positive for all the TEAQ-37 Rus subscales. Consistent with the predictions, there  
659 was a significant correlation of moderate strength ( $r = 0.33$ ) between total TEAQ-37 Rus score and total  
660 EmIn score. While all the TEAQ-37 Rus subscales had positive significant correlations with Interpersonal  
661 Emotional Intelligence ( $r$  ranging from 0.30 to 0.54) and with Emotion Recognition ( $r$  ranging from 0.30  
662 to 0.45), no significant correlations were found for Self-directed Emotional Intelligence, and for Emotion  
663 Management the only significant correlation was observed with CIT TEAQ-37 Rus subscale.

664

665 **Table 7. Correlations of the TEAQ-37 Rus subscales with the EmIn subscales (r values).**

	Interpersonal EI	Self-directed EI	Emotion Recognition	Emotion Management	EmIn Total
<b>AFT</b>	<b>0.39</b>	0.06	<b>0.34</b>	0.16	<b>0.28</b>
<b>ChT</b>	<b>0.41</b>	0.04	<b>0.31</b>	0.18	<b>0.28</b>
<b>ASC</b>	<b>0.30</b>	-0.11	<b>0.30</b>	-0.07	0.12
<b>CIT</b>	<b>0.54</b>	0.11	<b>0.45</b>	<b>0.26</b>	<b>0.40</b>
<b>AIT</b>	<b>0.31</b>	0.04	<b>0.32</b>	0.05	0.21
<b>TEAQ-37 Rus Total</b>	<b>0.50</b>	0.03	<b>0.44</b>	0.14	<b>0.33</b>

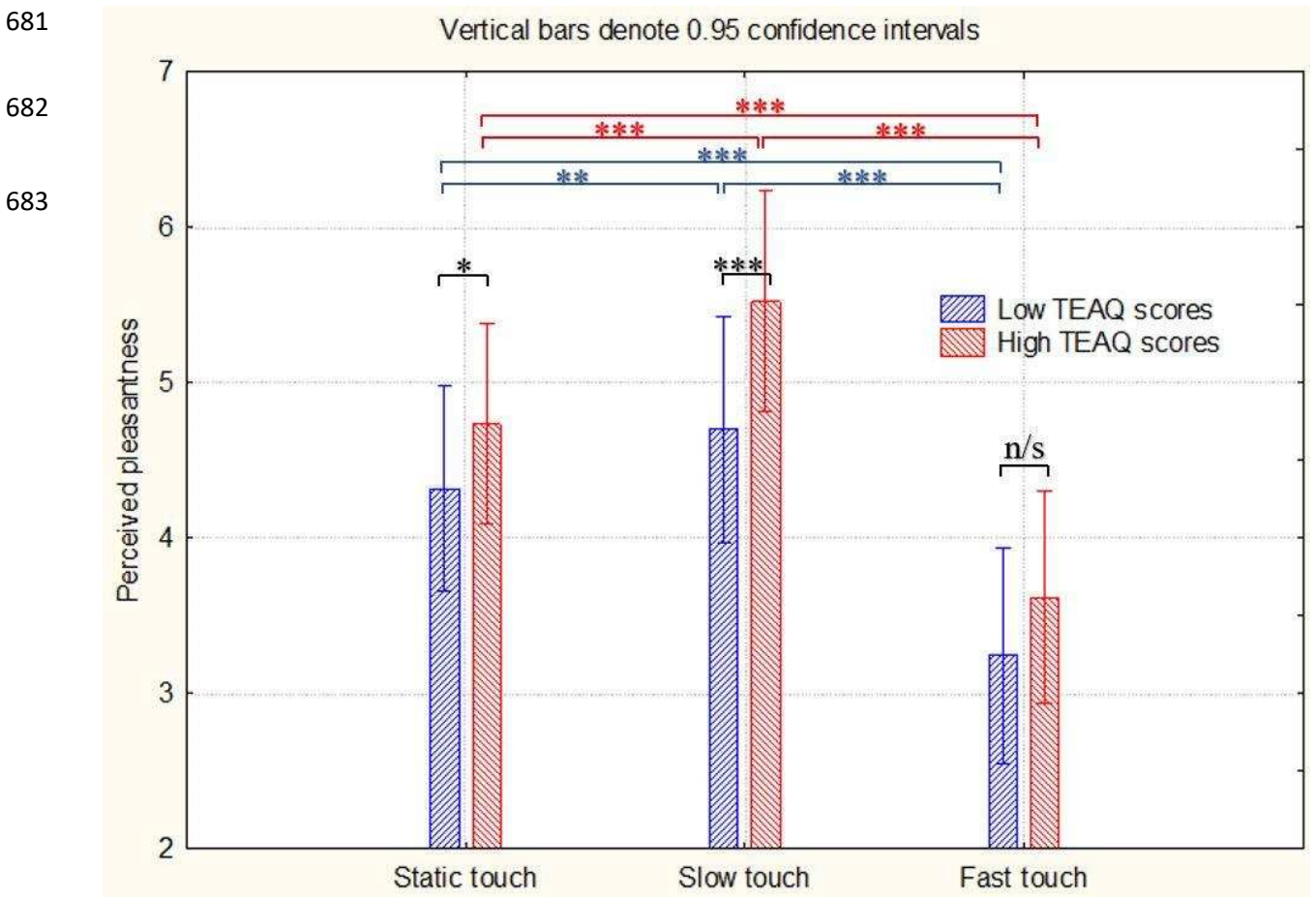
666

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668 **Affective touch video.** In terms of general effects an extremely robust effect of Velocity was observed  
 669 ( $F(2, 646)=419.77, p_{\text{corr}}<0.001$ , partial eta-squared  $\eta^2=0.56$ ) along with highly significant effect of skin site  
 670 ( $F(7, 2261) = 55.24, p_{\text{corr}}<0.001, \eta_p^2 = 0.14$ ) and interaction Velocity\*Site ( $F(14, 4522) = 33.50, p_{\text{corr}}<0.001$ ,  
 671  $\eta_p^2=0.09$ ) revealing that, according to the expectations, there was a very strong preference of slow strokes  
 672 compared to fast strokes, and a somewhat smaller but still a very significant preference for slow strokes  
 673 over static touch for all the sites with hairy skin (for all post hoc comparisons  $p<.001$ ). In terms of TEAQ-  
 674 37 Rus group-related effects there was a highly significant effect of Group ( $F(1, 323)=27.08, p_{\text{corr}} <0.001$ ,  
 675  $\eta^2=0.08$ ) and an interaction Group\*Velocity ( $F(2, 646)=8.68, p_{\text{corr}}=0.001, \eta^2=0.03$ ). Post-hoc comparisons  
 676 (Fig 3) indicate that, as predicted, participants with higher TEAQ-37 Rus scores rated all the kinds of touch  
 677 as more pleasant, with a particularly stronger preference for slow, CT-optimal touch.

678 **Fig 3. Perceived pleasantness ratings of touch videos for participants with low and high total TEAQ-**  
 679 **37 Rus scores.**

680 Stars indicate significance levels in post hoc tests (\*:  $p<.05$ , \*\*:  $p<.01$ , \*\*\*:  $p<.001$ ).



## 684 **General Discussion**

### 685 **Culture-specific and biologically determined aspects of emotional** 686 **touch**

687 The aim of this study was to construct a Russian version of the TEAQ questionnaire originally designed in  
688 English to assess attitudes to and experience of affective touch and validated on a British population sample  
689 [51, 55], and to test the first evidence of its validity and reliability. A large initial pool of 117 touch-related  
690 items, after being subject to cultural appropriateness examination and principal component analysis, was  
691 reduced to a reasonably compact 37-item questionnaire characterized by good face validity and clear five-  
692 factor structure. The factors related to Attitude to Friendly Touch subscale (AFT), Childhood Touch  
693 subscale (ChT), Attitude to Self-Care subscale (ASC), Current Intimate Touch subscale (CIT), and Attitude  
694 to Intimate Touch subscale (AIT). Very high Cronbach's  $\alpha$  for the whole scale and high Cronbach's  $\alpha$  for  
695 all the subscales suggested good reliability. The reliability of the 5-factor structure of the TEAQ-37 Rus  
696 was confirmed using CFA with a satisfactory model fit on a separate sample; high values for Cronbach's  $\alpha$   
697 were also replicated. The cohort for this study was characterized by reasonably good age coverage. Due to  
698 the nature of the recruitment process the validation sample was somewhat skewed towards university  
699 students and people with higher education but there were no noticeable effects of education on TEAQ-37  
700 Rus scores indicating that the TEAQ-37 Rus would yield similar results for people with different social  
701 backgrounds within a given culture; further research is needed to provide better estimates for influence of  
702 social and subcultural backgrounds on touch-related attitudes and behaviors.

703 The British version of the TEAQ was constructed and validated on similar samples (618 participants for  
704 exploratory factor analysis sample at the item reduction stage, 71.2 % female, mean age 26.9; 704  
705 participants for CFA sample, 73.7% female, mean age 27.4), and has a very similar factor structure. There  
706 are 57 items yielding 6 factors, with five factors being very closely equivalent to the factors of the TEAQ-  
707 37 Rus (childhood touch, friendly touch, attitude to self-care, attitude to intimate touch and current intimate  
708 touch). The only factor present in the original English version that has not been reproduced on the Russian  
709 samples is 'Attitude to Unfamiliar Touch'; we would presume that this is probably a consequence of a very  
710 reserved attitude towards physical contacts with unfamiliar people and of low incidence of voluntary

711 physical contacts with strangers in Russian culture. If it is indeed the case, tolerance to touch with strangers  
712 in Russian-speaking populations may be better accounted not by general attitude to the positive aspects of  
713 touch but by other personality traits and attitudes, including attitude to personal boundaries. This  
714 explanation is supported by the results from a large cross-cultural study assessing attitudes to acceptability  
715 of social touch [31] revealing that Russians use touch in more conservative patterns compared to all the  
716 other countries participating in the study (UK, Italy, France and Finland). The factor structure of the TEAQ  
717 versions has also confirmed the importance of emotional bond strength revealing that distinct patterns of  
718 tactile behavior and attitudes are naturally observed for interactions with emotionally close people, with  
719 friends, and with strangers, though preferred and admissible patterns may vary from culture to culture. In  
720 general, the data for the British and the Russian samples support our hypothesis 1 that general factor  
721 structure of the TEAQ would be similar for different cultures. The nature of the item selection process  
722 implemented in the study helps to ensure that each national version is characterized by good content validity  
723 for each given language and culture but it may also slightly decrease compatibility of national versions due  
724 to larger differences in item content within each subscale. Analysis of this discrepancy supported by further  
725 research of touch lexicon (see e.g. [74]) and of possible culture-specific differences of social touch  
726 perception and touch-related behaviors would lead to better understanding of culture-related aspects of  
727 affective touch. Such understanding would also benefit from research on particularly ‘contact’ (i.e.  
728 Southern European or Latin countries) or ‘noncontact’ (some Eastern Asian countries or Native Americans)  
729 cultures [53].

730 Other avenues of research investigating relationships between culture-dependent and biologically  
731 determined aspects of emotional touch would be using questionnaire-based measures along with tools  
732 providing more direct assessment of physiological and emotional response to touch in settings where the  
733 influence of cultural and social context is minimized or manipulated. In the present study we have used a  
734 similar approach to assess the construct validity of the TEAQ-37 Rus and to see how TEAQ score is related  
735 to perceived pleasantness of person-to person touch depicted in videos with a relatively impersonal and  
736 socially neutral context. Participants with higher TEAQ-37 Rus scores rated all kinds of touch as more  
737 pleasant, and, according to our initial predictions stemming from a hypothesis of the mediating role of CT-  
738 system in affective touch perception [21], had a stronger preference for slow strokes over fast strokes and

739 static touch, fully supporting experimental hypothesis 4. In view of this, the TEAQ-37 Rus seems to be a  
740 good screening tool for pre-selecting possible participants with different predisposition towards social touch  
741 for further psychophysiological studies of affective touch.

## 742 **Social touch, demographic differences, and personality traits**

743 The results of Study 4 fully confirmed our experimental hypothesis 2 and revealed pronounced gender  
744 effects and an influence of cohabiting status on current experience of intimate touch. Gender effects should  
745 be taken into account when interpreting TEAQ-37 Rus scores, particularly for the Self-Care subscale.

746 The TEAQ-37 Rus has revealed good discriminative validity when compared against the Big Five  
747 personality traits measured with a Russian version of the NEO-FFI. Consistent with our predictions, low to  
748 moderate positive correlations were observed between TEAQ-37 Rus subscales, and Extraversion and  
749 Openness subscales, thus supporting our experimental hypothesis 3. A somewhat unexpected positive  
750 correlation was found between Neuroticism and Attitude to Self-Care (ASC) subscale. A post-hoc  
751 explanation can be provided for this correlation, linking higher neuroticism to elevated need for physical  
752 acceptance and reassurance which is provided by self-induced activation of the C-tactile system. Indeed,  
753 primate behavioral data reveal that inhibition of the endogenous opioid reward system leads to increased  
754 need for grooming behavior [75]. Individuals with higher neuroticism and social anxiety may resort to self-  
755 grooming as to an easy option: when you feel bad, pamper yourself. Further research on populations with  
756 clinical or subclinical levels of anxiety would shed more light on this link.

757 According to our current understanding of the role of affective touch and CT system in shaping the  
758 emotional brain, it was predicted that TEAQ scores would correlate with emotional intelligence. The study  
759 confirmed these predictions, yielding robust positive correlations between all the TEAQ-37 Rus subscales  
760 (including Childhood Touch), and Emotion Recognition and Interpersonal Emotional Intelligence EmIn  
761 subscales ( $r$  values between 0.30 and 0.54), pointing to a strong link between social touch and empathy.  
762 This effect is even more impressive if we take into account that TEAQ-37 Rus contains no items directly  
763 related to social competences, and EmIn contains no touch-related items. The number of participants who  
764 completed EmIn questionnaire was relatively low though (74 subjects), so these results should be treated

765 as preliminary, and the strength of the link between emotional intelligence and social touch should be  
766 confirmed on larger samples.

## 767 **Use of the TEAQ-37 Rus for clinical and subclinical populations**

768 The TEAQ-37 Rus was developed with an intent to use it with other psychometric tools and neurobiological  
769 measures in order to investigate the role of touch in human emotional well-being, for different clinical and  
770 non-clinical populations, including conditions like depression, eating disorders, autism etc. Assessment of  
771 the skewness of the subscales revealed that there is no floor-effect for any subscale; it is possible to presume  
772 therefore that the TEAQ-37 Rus can be used for clinical and subclinical populations characterized by  
773 decreased tolerance for social touch, as with anorexia patients or high functioning autists. Although the  
774 TEAQ-37 Rus was initially targeting adult population, inspection of the items' content reveals no objection  
775 to using the TEAQ-37 Rus for teenagers. Further research on more diverse samples is sought but at the  
776 moment the TEAQ-37 Rus seems to be a good and flexible enough tool for enhancing our knowledge of  
777 importance of nurturing and affiliative touch in both health and disease.

## 778 **Other considerations and limitations**

779 The current Russian version of the TEAQ has good overall psychometric properties but some prospects for  
780 further refinement can be outlined. The number of questionnaire items for each subscale of the TEAQ-37  
781 Rus is unequal, ranging from 5 to 10 items as a result of following criteria for item retentions that were set  
782 prior to discovering the actual factor structure of the TEAQ-Rus. This can be combated by creating a shorter  
783 version of the questionnaire as the next step of the research; elimination of the items loading high on several  
784 factors and the items with low factor loading may also improve both the factor structure and the model fit.  
785 Another aim would be to construct a measure of social touch equally suitable for use in different cultures;  
786 this can be achieved at later stages of research after collecting more data for different 'contact' and 'non-  
787 contact' cultures.

## 788 **Conclusions**

789 The Touch Experiences and Attitudes Questionnaire is a self-report measure assessing experiences and  
790 attitudes in the domain of affective touch. The Russian version constructed in the present study, the TEAQ-  
791 37 Rus, has distinct and reliable 5-factor structure, and covers the aspects of general attitude to social touch,  
792 attitude to intimate touch, attitude to self-care, current experiences of intimate touch, and memories of touch  
793 experiences in childhood. To our best knowledge, the TEAQ is the first available self-report-measure  
794 suitable for assessment of affective touch experiences and attitudes for which the factor structure has been  
795 determined and validated. We anticipate that this questionnaire will be a valuable tool for researchers of  
796 social touch, nonverbal communication, touch perception abnormalities, and the importance of childhood  
797 touch experiences for human emotional well-being.

798



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803 collection and analysis.

## 804 **Supporting information**

805 S1 Table. Original 57-item version of the TEAQ with scoring instructions.

806 S2 Table. The complete set of questions in English and in Russian for the initial 117-item TEAQ pool.

807 S3. The TEAQ-37 Rus with scoring instructions (in Russian with English translation provided).

808 S4 Table. TEAQ-37 Rus item data for the Study 2 sample (factor loadings, item-total correlations, and  
809 Cronbach's  $\alpha$  if deleted).

810 S5-S7 Videos. Examples of the videos depicting touch interactions (different velocities and skin sites).

811 S8 Table. Stage 1 TEAQ-117 dataset (all the cases),

812 S8 Table. Stage 2 TEAQ-85 dataset (all the cases). Russian text labels are provided for better data  
813 traceability.

814 S9 Table. Stage 3-4 sample (the TEAQ-37 Rus, NEO-FFI, EmIn, Affective Touch Video, and subsample  
815 source data, all the cases, Russian text labels are provided for better data traceability).

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