

Global study of social odor awareness

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2
3 **10 Abstract**

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5 **11** Olfaction plays an important role in human social communication, including multiple
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7 **12** domains in which people often rely on their sense of smell in the social context. The
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9 **13** importance of the sense of smell and its role can however vary inter-individually and
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11 **14** culturally. Despite the growing body of literature on differences in olfactory performance or
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13 **15** hedonic preferences across the globe, the aspects of a given culture as well as culturally
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15 **16** universal individual differences affecting odor awareness in human social life remain
16
17 **17** unknown. Here, we conducted a large-scale analysis of data collected from 10,794
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19 **18** participants from 52 study sites from 44 countries all over the world. The aim of our research
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21 **19** was to explore the potential individual and country-level correlates of odor awareness in the
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23 **20** social context. The results show that the individual characteristics were more strongly related
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25 **21** than country-level factors to self-reported odor awareness in different social contexts. A
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27 **22** model including individual-level predictors (gender, age, material situation, education and
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29 **23** preferred social distance) provided a relatively good fit to the data, but adding country-level
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31 **24** predictors (Human Development Index, population density and average temperature) did not
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33 **25** improve model parameters. Although there were some cross-cultural differences in social
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35 **26** odor awareness, the main differentiating role was played by the individual differences. This
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37 **27** suggests that people living in different cultures and different climate conditions may still
38
39 **28** share some similar patterns of odor awareness if they share other individual-level
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41 **29** characteristics.

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45 **30** *Keywords:* odor awareness; olfaction; smell; culture
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31 **Introduction**

32 Olfaction plays an important role in human social communication (Stevenson, 2010),
33 including multiple domains in which people often rely on their sense of smell in the social
34 context. For example, odors influence assessments of one's attractiveness (Roberts et al.,
35 2011) and personality (Sorokowska et al., 2012), they enhance the proneness to displaying
36 prosocial behaviors (Baron, 1997) and can influence social desirability (Regenbogen et al.,
37 2017).

38 The importance of the sense of smell in the social context can however vary across
39 individuals. Odor awareness reflects the extent to which people are affected by odors in
40 everyday life and their metacognition of olfactory sensations (Smeets et al., 2008). In existing
41 olfactory awareness scales (Cupchik and Phillips, 2005; Smeets et al., 2008; Croy et al., 2010)
42 much attention is paid to social odors (e.g., "Do you notice the smell of people's breath or
43 sweat?", "Do you pay attention to the perfume, the aftershave or deodorant other people
44 use?"). An odor-oriented person pays much attention to odors in everyday life and is likely to
45 feel positive or negative affect as a result of exposure to certain odors. Higher awareness
46 might intensify the emotions resulting from exposure to a partner's odor (Smeets et al., 2008).
47 Further, it is suggested that odors play an important role in attachment and romantic
48 relationships (Schaal, 1997; Cupchik and Phillips, 2005). For example, sense of smell aids
49 selection of heterozygous mates (Winternitz et al., 2017). At the same time, romantic love
50 reduces women's attention to body odors obtained from men other than their current partner,
51 which is considered as evidence for love being an emotion helping intimate partners to
52 maintain their relationship (Lundström and Jones-Gotman, 2009).

53 In addition to certain individual variation, social odor responsiveness and awareness
54 seems to vary between cultures (Ferdenzi et al., 2011; Ferdenzi, Mustonen, Tuorila, & Schaal,
55 2008; Schleidt, Hold, & Attili, 1981; Saxton et al., 2014; Seo et al., 2011). The cultural

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3 56 differences in attitudes towards odors seem to appear early in development as they are
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5 57 observable also in children (Ferdenzi et al., 2011, 2008; Saxton et al., 2014). Nevertheless, to
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7 58 date, only a few cross-cultural studies on odor awareness exist; additionally, they usually
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9 59 cover a small number of countries which limits possible conclusions on factors potentially
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11 60 underpinning the observed differences. For example, Saxton and colleagues (2014) found that
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13 61 Namibian children reported higher social odor awareness than Czech children. In a different
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15 62 study, Mexicans described odors as more important than did Koreans, Czechs and Germans,
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17 63 and recalled more odors pertaining to “social” category than members of other cultures (Seo
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19 64 et al., 2011). Still, it is not clear why such results are observed and whether cross-cultural
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21 65 differences would be also present between members of other cultures. We aimed to address
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23 66 these gaps in the current study.
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28 68 *Country-level factors*

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31 69 As olfaction plays a role in proxemics and interpersonal distancing (Ferdenzi et al., 2008; Seo
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33 70 et al., 2011), the first factor that could potentially affect social olfactory awareness on the
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35 71 country level is whether the culture is described as contact or noncontact (Hall, 1966; Mazur,
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37 72 1977; Sussman and Rosenfeld, 1982). Yet, the contact-noncontact grouping seems to be more
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39 73 anecdotal than evidence-based (see Sorokowska et al., 2017), since no clear criteria for such
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41 74 division have been examined and described. A factor related to proxemics in this context is
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43 75 *population density*. Living in populous sites may increase the closeness and frequency of
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45 76 social contacts and enhance the exposure to odors in everyday life (Cleaveland et al., 2001;
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47 77 Jones et al., 2008). In addition, through mere exposure, it could also increase a person’s
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49 78 familiarity with odors in different social contexts, influencing olfactory perception (Ferdenzi
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51 79 et al., 2012) and awareness of social odors.
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3 81 Second of the country-level variables is *temperature*, because it has been shown to be
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5 82 related to preferred social proximity, perception of social exclusion, focus on relationships
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7 83 and interpersonal communication (Zhong and Leonardelli, 2008; IJzerman and Semin, 2010;
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9 84 Sorokowska et al., 2017). Thus, indirectly, temperature may influence exposure to social
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11 85 odors and their relative importance, since engagement in olfaction-related activities is
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13 86 associated with odor awareness (Martinec Nováková, Fialová & Havlíček, 2018; Martinec
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15 87 Nováková, Varella Valentova, & Havlíček, 2014; Martinec Nováková and Vojtušová
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17 88 Mrzílková, 2016). For example, odor exposure in children predicts (Martinec Nováková and
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19 89 Vojtušová Mrzílková, 2016) and even increases (Martinec Nováková et al., 2018) their
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21 90 olfactory awareness. Further, from the physiological point of view, temperature is related to
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23 91 sweating and thus to more intense body odor, to which people from countries with higher
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25 92 average temperature are more exposed. This could also change body odor-related behaviors
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27 93 and perception of social odors. Intensified body odor can be seen as a stronger stimulus in
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29 94 communication, but on the other hand it may be commonly masked by fragranced cosmetics,
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31 95 and the use of odorants can affect people's body odor and the way they are perceived by
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33 96 others (Sorokowska, Sorokowski, & Havlíček, 2016; but see Lenochová et al., 2012).

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35 97 Socio-economic status, is one of the factors that might differentiate odor awareness
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37 98 similarly to its hypothesized influence on preferred social distance (Sorokowska et al., 2017).
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39 99 On a country-level, this variable can be expressed in the Human Development Index (HDI),
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41 100 which reflects a country's gross national income per capita, average life expectancy, and
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43 101 expected education levels. However, because incomes within one country can vary greatly
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45 102 even in countries with high HDI, we need to consider socio-economic status from both
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47 103 individual and country-level perspectives. Potential mechanisms of influence of socio-
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49 104 economic status on olfactory awareness are discussed below, in the section describing
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51 105 individual-level variables.
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107 *Individual factors*

108 Besides exploring country-level characteristics ascribed to the entire populations, the aim of
109 this paper is to establish links between individual factors and social odor awareness; among
110 these *gender* is one of the most salient ones. Women value odors more than men in mating
111 (Havlicek et al., 2008; Herz and Cahill, 1997; Herz and Inzlicht, 2002), and outside mating
112 contexts (Havlicek et al., 2008), suggesting their relatively higher odor awareness in the social
113 context. Further, odor awareness is linked to female-stereotyped activities in childhood and
114 adulthood (Nováková et al., 2014). Nevertheless, although the gender difference in olfactory
115 performance is quite well documented (yet, not pertaining to all odor-related tasks, for a
116 review see Doty & Cameron, 2009), still little is known about gender effect in the context of
117 attention paid to social odor cues.

118 Another individual factor, potentially related to odor awareness, is *age*. Some studies
119 find odor awareness to be correlated with olfactory abilities (Smeets et al., 2008), and
120 olfactory acuity changes with age (Sorokowska et al., 2015). Specifically, people below 20
121 years of age and above 60 years of age score lower in identification tests than people aged 20-
122 60. The relative decline in odor identification after age 60 is broadly described and refers to
123 an immense percentage of society (Larsson et al., 2005; Doty and Kamath, 2014). Prior to age
124 20, olfactory skills are known to increase as a function of experience and cognitive
125 development (Ferdenzi et al., 2012). Due to the impairment of smell abilities with age and in
126 line with some previously published data (e.g., Dematte et al., 2011), we hypothesize that
127 older participants will display lower odor awareness also in the social context (but see Croy,
128 Buschhüter, Seo, Negoias, & Hummel, 2010).

129 Both low levels of *education* and *material situation* can affect personal hygiene
130 (Cleland and van Ginneken, 1988; Kuusela et al., 1997; Ilika and Obionu, 2002). Because

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3 131 odor awareness is related to behaviors such as avoidance of people with an unpleasant smell,
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5 132 paying attention to odorants or noticing other people's sweat or breath (Smeets et al., 2008),
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7 133 people who are exposed to strong, unpleasant social odorants in their everyday life are likely
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9 134 to become accustomed and pay less attention to them. Consequently, they may score lower on
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11 135 measures of social odor awareness. As odor identification has been shown to be influenced by
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13 136 education (Larsson, Nilsson, Olofsson, Nordin, 2004; Liu, Wang, Lin, Lin, Fuh, Teng, 1995),
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15 137 it is likely that education alters also odor awareness through an indirect connection with
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17 138 olfactory acuity (Smeets et al., 2008). On the other hand, people in a non-industrialized
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19 139 society of Tsimane' were found to have lower thresholds of odor detection (Sorokowska et
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21 140 al., 2013), while hunter-gathers from Malaysia exhibited notably developed ability to identify
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23 141 odors (Majid & Kruspe, 2018). These exceptional olfactory abilities could probably be due to
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25 142 environmental pressures that promoted olfaction as a useful sense for hunting, fishing,
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27 143 gathering and horticulture. Yet, because our sample comprises mostly industrialized societies
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29 144 where sense of smell is no longer used for hunting or foraging, we hypothesize that better
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31 145 education and higher socio-economic status will be positively correlated with social odor
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33 146 awareness.

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37 147 Further, higher exposure to interpersonal odors is likely to vary with subjectively
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39 148 preferred interpersonal distance, as detecting other people's odor is related to closer contact
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41 149 (Schleidt et al., 1981; Ferdenzi et al., 2008). Consequently, people who feel more comfortable
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43 150 in personal or intimate contact use their sense of smell more frequently and actively in the
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45 151 social context, which, in turn, makes them more likely to be odor-aware than people who
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47 152 prefer greater interpersonal distance. Relatedly, they could often rely on odors during social
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49 153 judgements. Preferred social distance is, however, known to vary both as a function of
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51 154 cultural and individual differences, so it is important to control it for each participant
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53 155 individually (Sorokowska et al., 2017).

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3 156 Generally, despite the growing body of literature on differences in olfactory
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5 157 performance or hedonic preferences across the globe, we still do not know which aspects of
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7 158 the culture affect olfactory awareness. Further, while affective responses to specific odors are
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9 159 known to vary and reflect familiarity with the stimuli (Ferdenzi et al., 2012), little is known
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11 160 about the subjective importance of social odors in everyday life across different countries. In
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13 161 order to cover the broad spectrum of variables potentially correlated with odor awareness, it is
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15 162 crucial to conduct a study on a large sample, including participants from various geographic
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17 163 regions. Therefore, we conducted a large-scale analysis of data collected from 10,794
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19 164 participants from 52 study sites all over the world. Our research aimed at exploring a number
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21 165 of potential individual and country-level correlates of odor awareness in the social context.
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23 166 This is the first to date global research focused on social odors, providing data from a large
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25 167 number of cultures about potential individual- and cultural-level factors related to the
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27 168 importance of the sense of smell and role of odors in the social context.
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32 170 **Materials and methods**

33 171 *Ethics Statement*

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35 172 This study was approved by the ethical board of the Institute of Psychology, University of
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37 173 Wroclaw (and other ethical committees in countries where additional approvals were
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39 174 necessary). The work was performed in accordance with the Declaration of Helsinki for
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41 175 Medical Research involving Human Subjects. All participants provided written, informed
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43 176 consent prior to their inclusion in the study.
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49 178 *Participants*

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51 179 The sample in this investigation comprised 10,794 individuals: 4896 men and 5855 women
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53 180 (43 participants decided not to disclose their gender, they were excluded from further analyses
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3 181 involving this variable). Participants' age ranged from 17 to 88 years, with $M = 39.62$ and SD
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5 182 $= 11.71$. Participants lived in 44 countries and 52 sites – as there were multiple sites in Brazil
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7 183 (3), India (3), Nigeria (3), and Turkey (3). The study sites included: Argentina, Austria, Brazil
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9 184 (Natal), Brazil (Porto Alegre), Brazil (Rio de Janeiro), Bulgaria, Canada, China, Colombia,
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11 185 Croatia, Czech Republic, Estonia, Germany, Ghana, Greece, Hong Kong, Hungary, India
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13 186 (Chennai), India (Bangalore), India (Guwahati), Indonesia, Iran, Italy, Kazakhstan, Kenya,
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15 187 Malaysia, Mexico, Nigeria (Benin), Nigeria (Enugu), Nigeria (Ondo), Norway, Pakistan,
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17 188 Peru, Poland, Portugal, Romania, Russia, Saudi Arabia, Serbia, Slovakia, South Korea, Spain,
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19 189 Sweden, Switzerland, Thailand, Turkey (Ankara), Turkey (Antalya), Turkey (Sivas), Uganda,
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21 190 Ukraine, United Kingdom, and USA.

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24 191 The participants were recruited by investigators in their respective countries. In most
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26 192 study locations, the participating groups comprised both a community sample and a student
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28 193 sample. Community samples were recruited in neighborhoods of large markets and shopping
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30 194 malls, neighborhoods of university facilities, local administration offices, public parks and
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32 195 other city facilities, and among members of vocational courses conducted at different
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34 196 universities (for example in Hungary, Peru, Norway, Poland, Saudi Arabia, Ghana, Brazil,
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36 197 Nigeria, the Netherlands, Ukraine, Korea, Canada, Kenya, Austria, United Kingdom, South
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38 198 Korea, Italy). In some countries, in addition to locations specified above, the research was
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40 199 conducted during individual visits in participants' homes – this was done, for example, in
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42 200 Kazakhstan, China, Croatia, Hungary. Further, we used chain-referral method (snowball
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44 201 sampling) – in all participating countries the researchers invited friends and family members
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46 202 of the participants, their acquaintances, and their students to take part in the study. Finally,
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48 203 some samples included also parents of children taking part in a different project (USA), and
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50 204 participants recruited through online and journal announcements (Italy and USA).
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3 205 All participants were naïve to the hypotheses of the study, they completed the
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5 206 questionnaires independently and individually. The data collection was a part of a larger
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7 207 project—the participants took part also in a study on interpersonal distance preferences
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9 208 (Sorokowska et al., 2017), and in some countries, married participants completed additional
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11 209 questionnaires on their marital satisfaction (Hilpert et al., 2016; Sorokowski et al., 2017).
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16 211 ----- Table 1 Here -----
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20 213 *Measures and Procedure*

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22 214 The data were collected by co-authors and their respective research teams. All respondents
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24 215 took part in the study voluntarily and provided written consent prior to participation. They
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26 216 were not compensated for their participation. Participants completed paper-and-pencil
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28 217 questionnaires – the original version of the questionnaire was in English, but in all non-
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30 218 English speaking countries, the questions were translated to the native language by
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32 219 researchers fluent in English and a given language using back-translation procedures (Brislin,
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34 220 1970).
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37 221 The social odor awareness questionnaire applied in this study comprised items from
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39 222 the Odor Awareness Scale (Smeets et al., 2008). The participants did not complete the full
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41 223 scale, instead, we selected 6 items related to perception of odors in interpersonal situations,
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43 224 i.e., “Do you pay attention to the perfume, the aftershave or deodorant other people use?”;
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45 225 “How important is it to you that your partner has a pleasant smell?”; “Do you notice the smell
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47 226 of people’s breath or sweat?”; “When someone has an unpleasant body odor, does that make
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49 227 you find him or her unattractive?”; “When someone has a pleasant body odor, so you find him
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51 228 or her attractive?”; “You are in a public space sitting close to someone who has an unpleasant
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53 229 smell. Do you look for another seat if possible?”. In all questions, we used original response
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3 230 scales and verbal descriptors. The range of possible results was between 6 and 30 points. The
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5 231 reliability of this scale in the whole sample was good (Cronbach's $\alpha = .80$), similarly as
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7 232 reliability within-countries (min $\alpha = .53$ [Bulgaria], max $\alpha = .87$ [South Korea], median $\alpha =$
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9 233 $.76$), with only two countries reliability estimated as below $.60$ (Bulgaria, $\alpha = .53$, Saudi
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11 234 Arabia, $\alpha = .59$).

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14 235 In addition to participants' report on gender and age, we measured their education
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16 236 level quantified as "1 – no formal education, 2 – primary school, 3 – secondary school, 4 –
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18 237 high school or technical college, 5 – bachelor or masters degree". The material situation was
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20 238 rated on a 5-point scale, from "1 – much better than average in my country" to "5 – much
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22 239 worse than average in my country". Further, the participants declared their preferred
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24 240 interpersonal distance to (a) a stranger, (b) an acquaintance, and (c) a close person. Answers
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26 241 were given on a distance (0-220 cm) scale anchored by two human-like figures, labeled A for
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28 242 the left one and B for the right one. Participants were asked to imagine that he or she is
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30 243 Person A. The participant was asked to rate how close a Person B could approach, so that he
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32 244 or she would feel comfortable in a conversation with Person B. The participants marked the
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34 245 distance at which Person B should stop on the scale below the figures (see Sorokowska et al.,
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36 246 2017 for details of the method). Based on the participants' reply, we calculated mean
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38 247 preferred interpersonal distance for each person. In addition, we analyzed country-level
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40 248 variables: population density (United Nations population density report; United Nations,
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42 249 2013), and average, yearly temperature in a given study site (provided by respective
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44 250 coauthors), and the Human Development Index (HDI; UNDP, 2013)

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50 252 *Statistical Analyses*

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53 253 As individuals were nested within countries, we analyzed data using multilevel regression
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55 254 models (aka hierarchical linear models). We started with a baseline (empty) model to estimate

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3 255 the variability of the social olfactory awareness in the social context across countries. In the
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5 256 next model, we included individual-level variables: gender, age, the level of education, self-
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7 257 reported material situation and preferred interpersonal distance. In the third and final model,
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9 258 we added country-level predictors: HDI, population density (log-transformed) and average
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11 259 temperature. We compared the models using -2 log likelihood (-2LL) statistics and Akaike
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13 260 Information Criterion (AIC), with lower values in both cases indicating better models. In all
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15 261 models, we controlled for nesting participants within countries and estimated fixed effects of
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17 262 Level-1 (Individuals) and Level-2 (Countries) variables using a maximum likelihood
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19 263 estimator.
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265 **Results**

266 Table 1 summarizes the main characteristics of each site. Our main analyses were conducted
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28 267 by means of a series of multilevel regression models. As illustrated in Table 2, the baseline
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30 268 model showed that there was substantial variability in self-reported sense of smell in the
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32 269 social context at both individual and country levels. Intra-class correlation coefficient (ICC)
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34 270 demonstrated that 29% of the sense of smell's variability was associated with country-level,
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36 271 while 71% of the variance was located at the level of individuals.
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39 272 In Model 2, we included individual-level predictors. As illustrated by -2LL and AIC
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41 273 parameters, this model was characterized by better fit than the initial model (Δ -2LL =
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43 274 3589.05, Δ AIC = 3579.05, both $ps < .001$) and explained 3% of Level-1 variance. Consistent
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45 275 with our predictions, women had higher social olfactory awareness than men ($B = 0.90$, $SE =$
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47 276 0.09 , $p < .001$), and olfactory awareness decreased with age ($B = -0.02$, $SE = 0.004$, $p < .001$)
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49 277 and increased with educational level obtained ($B = 0.23$, $SE = 0.05$, $p < .001$). It was not
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51 278 related, however, to reported material conditions of participants ($B = -0.08$, $SE = 0.05$, $p =$
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53 279 $.15$) and their preferred interpersonal distance ($B = -0.0003$, $SE = 0.001$, $p = .82$).
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3 280 In Model 3 we included country-level predictors: HDI, average temperature and log-
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5 281 transformed population density. None of these variables, however, were statistically
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7 282 significant predictors of self-reported social olfactory awareness. Similarly, adding these
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9 283 predictors into the model did not improve it as compared to Model 2 and illustrated by higher
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11 284 value of AIC.

13 285 **Discussion**

15 286 The current study examined social olfactory awareness in 44 countries, taking into account
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17 287 both country- and individual-level predictors of this variable. Our results revealed that
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19 288 participants from different countries indeed differ in terms of odor awareness; however, a
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21 289 much smaller variability of the odor awareness was due to country-level than to individual-
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23 290 level factors (29% and 71%, respectively). A statistical model including individual-level
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25 291 predictors (gender, age, material situation, education and preferred social distance) provided a
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27 292 relatively good fit to the data, but adding country-level predictors (Human Development
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29 293 Index, population density and average temperature) did not improve model parameters. None
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31 294 of the examined country-level predictors proved statistically significant.

33 295 The results suggest that individual differences play an important role in social odor
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35 296 awareness, i.e., in aspects of odor awareness that are related to non-verbal communication
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37 297 between humans. We found three statistically significant predictors of odor awareness –
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39 298 gender, age and education in the largest international sample to date. Our findings on gender
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41 299 concur with previous research on the attitudes towards the sense of smell. Women consider
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43 300 olfaction more important than men in self-report questionnaires related both to sexual (Herz
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45 301 & Cahill, 1997; Herz & Inzlicht, 2002; Havlicek et al., 2008) and to non-sexual contexts
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47 302 (Havlicek et al., 2008). Further, Croy et al. (2010) showed that female respondents judged the
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49 303 sense of smell as being more important in their lives than male respondents. As mentioned in
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51 304 the Introduction, also in a previous cross-cultural study conducted in four countries, women
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3 305 indicated a higher interest in the sense of smell than men (Seo et al., 2011). Our study extends
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5 306 all these findings by showing that female olfactory awareness in the social context was higher
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7 307 than male across 44 countries. The predictive value of education is less obvious, yet also
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9 308 consistent with our hypothesis. Education could be associated with higher expenses on
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11 309 personal hygiene and, therefore, more attention paid to pleasantness of body odors. Further,
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13 310 more educated people might be more aware of their sense of smell and its importance and be
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15 311 more aware of different olfactory cues. The case of age is, however, more complicated. Croy
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17 312 et al. (2010) found that the importance of the sense of smell remains relatively unchanged
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19 313 throughout the life-span, and we observed a slight, albeit statistically significant decrease in
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21 314 social olfactory awareness associated with aging. It is possible that either the previous results
22
23 315 were specific to one culture, or that olfactory awareness in the social context is somewhat
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25 316 different from general odor awareness, as measured by Croy et al. (2010).

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27
28 317 It should be highlighted that our findings on social olfactory awareness in 44 countries
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30 318 are consistent with well characterized age- and gender-related differences in olfactory
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32 319 abilities. Studies on various aspects of olfactory perception show that women outperform men
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34 320 in tasks like odor memory and identification, and in the social context, they rely on body odor
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36 321 to a greater extent while evaluating a potential partner (Brand and Millot, 2001; Doty and
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38 322 Cameron, 2009; Ferdenzi et al., 2012). Our results revealed the same pattern. Further, we
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40 323 observed that social olfactory awareness decreases with age, and it is known that so does
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42 324 olfactory performance (Doty, 2009; Sorokowska et al., 2015). Lower olfactory abilities in
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44 325 older people might result from, among others, cumulative damage to the olfactory epithelium
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46 326 from repeated infections, or a variety of neurodegenerative diseases (Doty, 2009). The
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48 327 findings on age- and gender-dependent olfactory abilities and our data seem to suggest that
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50 328 people with a better sense of smell use it in more ways and are more aware of odors than
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52 329 those with lesser smell ability (Smeets et al., 2008), especially in the social context. Still, it

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3 330 needs to be highlighted that studies regarding odor awareness in relation to olfactory
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5 331 performance produce mixed results (see Smeets et al., 2008; Dematte et al., 2011). Odor
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7 332 awareness, a metacognitive measure, and various aspects of odor perception (assessed by
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9 333 various psychophysical tests) are not equivalent. Nevertheless, our data suggest that, at least
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11 334 in the social context, odor awareness could be subject to influence of biological factors, like it
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13 335 is in the case of olfactory sensitivity (Gross-Isseroff et al., 1992). Further, preference for
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15 336 certain odors, especially those of other people, can be genetically determined (Havlicek &
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17 337 Roberts, 2009; Janeš, Klun, Vidan-Jeras, Jeras, & Kreft, 2010, Havlicek & Roberts, 2009;
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19 338 Janeš et al., 2010; Milinski & Wedekind, 2001). Therefore, it is possible that subjective
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21 339 importance of social odors is also dependent on some innate, genetic factors (like HLA –
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23 340 human leukocyte antigen).

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26 341 Understanding the interplay between genetic and environmental factors is, however,
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28 342 really complicated in all studies involving human subjects. In addition to genetics, olfactory
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30 343 sensitivity is impacted in complex ways by environment (Calderón-Garcidueñas et al., 2010;
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32 344 Doty et al., 2011; Guarneros et al., 2009; Hudson et al., 2006; Knaapila et al., 2008), and odor
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34 345 awareness, however defined, must take this into account. Additionally, there are experience-
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36 346 and learning-mediated effects on different aspects of odor perception (e.g., Distel et al. 1999;
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38 347 Schaal et al. 1997; Schaal, 2012). This potential influence of personal history is particularly
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40 348 interesting, as studies show that learning and experience can shape also olfactory awareness.
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42 349 Parental reports of the children's odor exposure predicted their offspring's odor awareness, in
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44 350 preschool children (Martinec Nováková and Vojtušová Mrzilková, 2016) and in young adults
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46 351 (Nováková et al., 2014). Despite difficulties in determining whether the sources of such
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48 352 findings are biologically- or environmentally-driven, these data further strengthen our
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50 353 conclusion that individual-level factors (including personal history) might modulate odor
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52 354 awareness more than culture-level variables.
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3 355 In our global study, we examined three country-level predictors, but we did not find
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5 356 any of them statistically significant. However, 30% of the variability in social odor awareness
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7 357 was assigned to the level of country. If national wealth, temperature, and population density
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9 358 do not account for the variability in social odor awareness, the question as to which country-
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11 359 level factors are related to importance of odors in social contexts remains unanswered. There
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13 360 are several cultural factors not addressed in this study that could be taken into account while
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15 361 considering odor awareness. Some of them, for example cultural values, might be difficult to
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17 362 quantify, and therefore it seems challenging to measure them in survey research. As discussed
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19 363 above, apart from culture, there are also climate-related indices (e.g. humidity or air pollution)
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21 364 that may be related to olfactory performance and hence odor awareness (Calderón-
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23 365 Garcidueñas et al., 2010). In the light of the current research, the issue of culture- and climate-
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25 366 related predictors of attention paid to odors remains an open question to be addressed in
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27 367 future investigations, that could include also, e.g., less industrialized societies.

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29
30 368 There are certain limitations of the current study. The sample sizes were generally too
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32 369 small to be fully representative for participating cultures, and they were often samples of
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34 370 convenience – snowball sampling was frequently used as a method of recruitment. However,
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36 371 all coauthors were instructed to recruit participants from as diverse socioeconomical
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38 372 backgrounds as possible, and the samples were to be balanced in terms of age, gender, and
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40 373 education level. However, we used different methods of recruitment in different locations –
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42 374 we had no standard recruitment procedure. Nevertheless, this is the first study on odor
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44 375 awareness that involves such a large number of diverse cultures and despite certain
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46 376 limitations, our findings expand the knowledge on predictors of odor awareness in social
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48 377 interactions.

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51 378 In summary, our study revealed that individual characteristics are more strongly
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53 379 related than country-level factors to self-reported odor awareness in social contexts. Although
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3 380 people from different countries differ from one another substantially in social odor awareness,
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5 381 the main differentiating role is played by individual differences. This suggests that people
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7 382 living in different cultures and different climate conditions may still share some similar
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9 383 patterns of odor awareness if they share other individual-level characteristics.
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For Review Only

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3 384 **Conflict of interest**

4
5 385 The authors declare no conflict of interest. Andero Teras is a Founder, CEO and Event
6
7 386 Marketing Manager of Möttemaru OÜ but that there are no conflicts of interests with this
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9 387 study.
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2
3 397 **References**

- 4
5 398 Baron RA. 1997. The sweet smell of... helping: Effects of pleasant ambient fragrance on
6
7 399 prosocial behavior in shopping malls. *Personal Soc Psychol Bull.* 23:498–503.
8
9 400 Brand G, Millot J-L. 2001. Sex differences in human olfaction: Between evidence and
10
11 401 enigma. *Q J Exp Psychol B.* 54:259–270.
12
13 402 Brislin, RW, 1970. Back-translation for cross-cultural research. *J Cross Cult Psychol.* 1:185–
14
15 403 216.
16
17 404 Calderón-Garcidueñas L, Franco-Lira M, Henríquez-Roldán C, Osnaya N, González-Maciel
18
19 405 A, Reynoso-Roble, R, Villarreal-Calderon R, Herritt L, Brooks D, Keefe S, et al. 2010.
20
21 406 Urban air pollution: Influences on olfactory function and pathology in exposed children
22
23 407 and young adults. *Exp Toxicol Pathol.* 62:91–102.
24
25 408 Cleaveland S, Laurenson MK, Taylor LH. 2001. Diseases of humans and their domestic
26
27 409 mammals: pathogen characteristics, host range and the risk of emergence. *Philos Trans*
28
29 410 *R Soc B Biol Sci.* 356:991–999.
30
31 411 Cleland JG, and Ginneken JK van. 1988. Maternal education and child survival in developing
32
33 412 countries: The search for pathways of influence. *Soc Sci Med.* 27:1357–1368.
34
35 413 Croy I, Buschhüter D, Seo HS, Negoias S, Hummel T. 2010. Individual significance of
36
37 414 olfaction: Development of a questionnaire. *Eur Arch Oto-Rhino-Laryngology.* 267:67–
38
39 415 71.
40
41 416 Cupchik GC, Phillips K. 2005. Sensitivity to the cognitive and affective qualities of odours.
42
43 417 *Cognit Emot.* 19:121-131.
44
45 418 Dematte ML, Endrizzi I, Biasioli F, Corollaro ML, Zampini M, Gasperi F. 2011. Individual
46
47 419 variability in the awareness of odors: Demographic parameters and odor identification
48
49 420 ability. *Chemosens Percept.* 4:175–185.
50
51
52
53
54
55
56
57
58
59
60

- 1
2
3 421 Distel H, Ayabe-Kanamura S, Martínez-Gómez M, Schicker I, Kobayakawa T, Saito S,
4
5 422 Hudson R. 1999. Perception of everyday odors—correlation between intensity,
6
7 423 familiarity and strength of hedonic judgement. *Chem Senses*, 24:191-199.
8
9 424 Doty RL, Cameron EL. 2009. Sex differences and reproductive hormone influences on human
10
11 425 odor perception. *Physiol Behav.* 97:213–228.
12
13 426 Doty RL, Kamath V. 2014. The influences of age on olfaction: A review. *Front Psychol.* 5:1–
14
15 427 20.
16
17 428 Doty RL, Petersen I, Mensah N, & Christensen K. 2011. Genetic and environmental
18
19 429 influences on odor identification ability in the very old. *Psychol Aging*, 26:864-871.
20
21 430 Ferdenzi C, Mustonen S, Tuorila H, Schaal B. 2008. Children’s Awareness and Uses of Odor
22
23 431 Cues in Everyday Life: A Finland–France Comparison. *Chemosens Percept.* 1:190–198.
24
25 432 Ferdenzi C, Roberts SC, Schirmer A, Delplanque S, Cekic S, Porcherot C, Cayeux I, Sander
26
27 433 D, Grandjean D. 2012. Variability of affective responses to odors: culture, gender, and
28
29 434 olfactory knowledge. *Chem Senses.* 38:175–186.
30
31 435 Ferdenzi C, Schirmer A, Roberts SC, Delplanque S, Porcherot C, Cayeux I, Velazco MI,
32
33 436 Sander D, Scherer KR, Grandjean D. 2011. Affective dimensions of odor perception: A
34
35 437 comparison between Swiss, British, and Singaporean populations. *Emotion.* 11:1168–
36
37 438 1181.
38
39 439 Gross-Isseroff R, Ophir D, Bartana A, Voet H, Lancet D. 1992. Evidence for genetic
40
41 440 determination in human twins of olfactory thresholds for a standard odorant. *Neurosci*
42
43 441 *Lett.* 141:115–118.
44
45 442 Guarneros M, Hummel T, Martinez-Gomez M, Hudson R. 2009. Mexico City Air Pollution
46
47 443 Adversely Affects Olfactory Function and Intranasal Trigeminal Sensitivity. *Chem*
48
49 444 *Senses.* 34:819-826.
50
51 445 Hall ET. 1966. *The hidden dimension.* New York: Doubleday.
52
53
54
55
56
57
58
59
60

- 1
2
3 446 Havlicek J, Roberts SC. 2009. MHC-correlated mate choice in humans : A review.
4
5 447 Psychoneuroendocrinol. 34:497-512.
6
7 448 Havlicek J, Saxton TK, Roberts SC, Jozifkova E, Lhota S, Valentova J, Flegr J. 2008. He
8
9 449 sees, she smells? Male and female reports of sensory reliance in mate choice and non-
10
11 450 mate choice contexts. *Pers Individ Dif*. 45:565–570.
12
13 451 Herz RS, Cahill ED. 1997. Differential use of sensory information in sexual behavior as a
14
15 452 function of gender. *Hum Nat*, 8:275-286.
16
17 453 Herz RS, Inzlicht M. 2002. Sex differences in response to physical and social factors involved
18
19 454 in human mate selection: The importance of smell for women. *Evol Hum*
20
21 455 *Behav*, 23:359-364.
22
23 456 Hilpert P, Randall AK, Sorokowski P, Atkins DC, Sorokowska A, Ahmadi K, Alghraibeh
24
25 457 AM, Aryeetey R, Bertoni A, Bettache K, et al. 2016. The associations of dyadic coping
26
27 458 and relationship satisfaction vary between and within nations: A 35-nation study. *Front*
28
29 459 *Psychol*. 7:1106.
30
31 460 Hudson R, Arriola A, Martínez-Gómez M, Distel H. 2006. Effect of air pollution on olfactory
32
33 461 function in residents of Mexico City. *Chem Senses* 31:79-85.
34
35 462 IJzerman H, Semin GR. 2010. Temperature perceptions as a ground for social proximity. *J*
36
37 463 *Exp Soc Psychol*. 46:867–873.
38
39 464 Ilika AL, Obionu CO. 2002. Personal hygiene practice and school-based health education of
40
41 465 children in Anambra State, Nigeria. *Niger Postgrad Med J*. 9:79–82.
42
43 466 Janeš D, Klun I, Vidan-Jeras B, Jeras M, and Kreft S. 2010. Influence of MHC on odour
44
45 467 perception of 43 chemicals and body odour. *Open Life Sci*. 5:324-330.
46
47 468 Jones KE, Patel NG, Levy MA, Storeygard A, Balk D, Gittleman JL, Daszak, P. 2008. Global
48
49 469 trends in emerging infectious diseases. *Nature*. 451:990–993.
50
51 470 Knaapila A, Tuorila H, Kyvik KO, Wright MJ, Keskitalo K, Hansen J, Kaprio J, Perola M,
52
53
54
55
56
57
58
59
60

- 1
2
3 471 Silventoinen, K. 2008. Self-Ratings of Olfactory Function Reflect Odor Annoyance
4
5 472 Rather than Olfactory Acuity. *Laryngoscope*. 118:2212–2217.
6
7 473 Kuusela S, Honkala E, Kannas L, Tynjälä J, Wold, B. 1997. Oral hygiene habits of 11-year-
8
9 474 old schoolchildren in 22 European countries and Canada in 1993/1994. *J Dent Res*.
10
11 475 76:1602–9.
12
13 476 Larsson M, Nilsson LG, Olofsson JK, & Nordin S. 2004. Demographic and cognitive
14
15 477 predictors of cued odor identification: evidence from a population-based study. *Chem*
16
17 478 *Senses*. 29:547-554.
18
19
20 479 Larsson M, Öberg C, Bäckman, L. 2005. Odor Identification in Old Age: Demographic,
21
22 480 Sensory and Cognitive Correlates. *Aging, Neuropsychol Cogn*. 12:231–244.
23
24 481 Lenochová P, Vohnoutova P, Roberts SC, Oberzaucher E, Grammer K, Havlíček J. 2012.
25
26 482 Psychology of fragrance use: perception of individual odor and perfume blends reveals
27
28 483 a mechanism for idiosyncratic effects on fragrance choice. *PLoS One*. 7:e33810.
29
30
31 484 Liu HC, Wang SJ, Lin KP, Lin KN, Fuh JL, & Teng EL. 1995. Performance on a smell
32
33 485 screening test (the MODSIT): A study of 510 predominantly illiterate Chinese subjects.
34
35 486 *Physiol Behav*, 58:1251-1255.
36
37 487 Lundström JN, Jones-Gotman M. 2009. Romantic love modulates women’s identification of
38
39 488 men’s body odors. *Horm Behav*. 55:280–284.
40
41 489 Majid, A., & Kruspe, N. 2018. Hunter-Gatherer Olfaction Is Special. *Curr Biol*. 28:409-413.
42
43
44 490 Martinec Nováková L, Fialová J & Havlíček J. 2018. Effects of diversity in olfactory
45
46 491 environment on children’s sense of smell. *Sci Rep*. 8:2937.
47
48 492 Martinec Nováková L, Varella Valentova J, Havlíček J. 2014. Engagement in olfaction-
49
50 493 related activities is associated with the ability of odor identification and odor awareness.
51
52 494 *Chemosens Percept*. 7:56–67.
53
54
55 495 Nováková L & Vojtušová Mrzílková R. 2016. Children’s exposure to odors in everyday
56
57
58
59
60

- 1
2
3 496 contexts predicts their odor awareness. *Chemos Percept.* 9:56-68.
- 4
5 497 Mazur A. 1977. Interpersonal Spacing on Public Benches in “Contact” *Vs.* “Noncontact”
6
7 498 Cultures. *J Soc Psychol.* 101:53–58.
- 8
9 499 Milinski M, Wedekind C. 2001. Evidence for MHC-correlated perfume preferences in
10
11 500 humans. *Behav Ecol.* 12:140–149.
- 12
13 501 Nováková L & Vojtušová Mrzilková R. 2016. Children’s exposure to odors in everyday
14
15 502 contexts predicts their odor awareness. *Chemos Percept.* 9:56-68.
- 16
17 503 Regenbogen C, Axelsson J, Lasselin J, Porada DK, Sundelin T, Peter MG, Lekander M,
18
19 504 Lundström JN, Olsson MJ. 2017. Behavioral and neural correlates to multisensory
20
21 505 detection of sick humans. *Proc Natl Acad Sci.* 114:6400–6405.
- 22
23 506 Roberts SC, Kralevich A, Ferdenzi C, Saxton TK, Jones BC, DeBruine LM, Little AC,
24
25 507 Havlicek J. 2011. Body Odor Quality Predicts Behavioral Attractiveness in Humans.
26
27 508 *Arch Sex Behav.* 40:1111–1117.
- 28
29 509 Saxton, T. K., Nováková, L. M., Jash, R., Šandová, A., Plotěná, D., & Havlíček, J. 2014. Sex
30
31 510 differences in olfactory behavior in Namibian and Czech children. *Chemos Percept,*
32
33 511 7:117-125.
- 34
35 512 Schaal, B. Emerging chemosensory preferences: another playground for the innate-acquired
36
37 513 dichotomy in human cognition. In: Zucco GM, Herz B, Schaal B.(Eds.) 2012.
38
39 514 Olfactory cognition: from perception and memory to environmentan odours and
40
41 515 neuroscience. Amsterdam: John Benjamins, p. 237-268.
- 42
43 516 Schaal B. 1997. Variability and invariants in early odour preferences: comparative data from
44
45 517 children belonging to three cultures. *Chem Senses.* 22:212.
- 46
47 518 Schleidt M, Hold B, Attili G. 1981. A cross-cultural study on the attitude towards personal
48
49 519 odors. *J Chem Ecol.* 7:19–31.
- 50
51 520 Seo HS, Guarneros M, Hudson R, Distel H, Min BC, Kang JK, Croy I, Vodicka J, Hummel T.

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41
42
43
44
45
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48
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50
51
52
53
54
55
56
57
58
59
60

- 521 2011. Attitudes toward olfaction: A cross-regional study. *Chem Senses*. 36:177–187.
- 522 Smeets MAM, Schifferstein HNJ, Boelema SR, Lensvelt-Mulders G. 2008. The Odor
523 Awareness Scale: A New Scale for Measuring Positive and Negative Odor Awareness.
524 *Chem Senses*. 33:725–734.
- 525 Sorokowska A, Schriever VA, Gudziol V, Hummel C, Hähner A, Iannilli E, Sinding C, Aziz
526 M, Seo HS, Negoias S. 2015. Changes of olfactory abilities in relation to age: odor
527 identification in more than 1400 people aged 4 to 80 years. *Eur Arch Oto-Rhino-
528 Laryngology*. 272:1937–1944.
- 529 Sorokowska A, Sorokowski P, Havlíček J. 2016. Body odor based personality judgments: the
530 effect of fragranced cosmetics. *Front Psychol*. 7:530.
- 531 Sorokowska A, Sorokowski P, Hilpert P, Cantarero K, Frackowiak T, Ahmadi K, Alghraibeh
532 AM, Aryeetey R, Bertoni A, Bettache K, et al. 2017. Preferred Interpersonal Distances:
533 A Global Comparison. *J Cross Cult Psychol*. 48:577–592.
- 534 Sorokowska A, Sorokowski P, Hummel T, Huanca T. 2013. Olfaction and Environment:
535 Tsimane' of Bolivian Rainforest Have Lower Threshold of Odor Detection Than
536 Industrialized German People. *PLoS One*. 8:1–6.
- 537 Sorokowska A, Sorokowski P, Szmajke, A. 2012. Does Personality Smell? Accuracy of
538 Personality Assessments Based on Body Odour: Does personality smell? *Eur J Pers*.
539 26:496–503.
- 540 Sorokowski P, Randall AK, Groyecka A, Frackowiak T, Cantarero K, Hilpert P, Ahmadi K,
541 Alghraibeh AM, Aryeetey R, Bertoni A, et al. 2017. Marital satisfaction, sex, age,
542 marriage duration, religion, number of children, economic status, education, and
543 collectivistic values: Data from 33 countries. *Front Psychol*. 8:1199.
- 544 Stevenson RJ. 2010. An Initial Evaluation of the Functions of Human Olfaction. *Chem
545 Senses*. 35:3–20.

- 1
2
3 546 Sussman NM, Rosenfeld HM. 1982. Influence of culture, language, and sex on conversational
4
5 547 distance. *J Pers Soc Psychol.* 42:66–74.
6
7 548 UNDP, 2013. Human Development Report 2013. URL: <http://hdr.undp.org>
8
9 549 United Nations, Department of Economic and Social Affairs, Population Division. 2013.
10
11 550 World Population Prospects: The 2012 Revision, DVD Edition.
12
13 551 Winternitz J, Abbate JL, Huchard, E, Havlíček J, Garamszegi LZ. 2017. Patterns of MHC
14
15 552 dependent mate selection in humans and nonhuman primates: a meta-analysis. *Mol*
16
17 553 *Ecol.* 26:668–688.
18
19
20 554 Zhong C-B, Leonardelli GJ. 2008. Cold and lonely does social exclusion literally feel cold?
21
22 555 *Psychol Sci.* 19:838–842.
23
24
25
26
27
28
29
30
31
32
33
34
35
36
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Table 1. *Summary of descriptive statistics*

Country / Study Site	City / study sites	Sample size	% Females	Age		Education		Material situation		Mean preferred distance		HDI	Population density	Average temperature
				M	SD	M	SD	M	SD	M	SD			
Argentina	Parana	201	65%	32.31	11.16	3.91	0.96	2.74	0.49	58.64	22.80	0.81	14.52	19.00
Austria	Vienna	200	43%	26.59	9.73	4.12	0.61	2.73	0.66	68.93	23.77	0.90	100.19	11.50
Brazil	Natal	240	42%	35.58	9.59	4.44	0.82	2.51	0.69	81.42	36.74	0.73	22.93	26.00
Brazil	Porto Alegre	140	26%	33.34	8.39	4.86	0.37	2.26	0.60	73.00	32.34	0.73	22.93	20.00
Brazil	Rio de Janeiro	100	42%	43.16	11.74	4.62	0.72	2.27	0.63	75.60	23.84	0.73	22.93	24.00
Bulgaria	Blagoevgrad	102	38%	38.35	8.95	4.65	0.77	3.04	0.20	62.81	8.72	0.78	66.62	10.00
Canada	Halifax	68	63%	38.43	10.15	4.66	0.48	2.79	1.04	87.75	40.40	0.91	3.42	7.60
China	Shanghai, Beijing	365	53%	37.00	6.06	4.19	1.03	2.47	0.74	63.36	43.92	0.70	141.69	15.09
Colombia	Santa Maria	100	59%	41.10	11.81	3.83	1.07	2.77	0.74	87.93	28.66	0.72	40.78	26.00
Croatia	Zagreb	614	51%	44.75	11.65	3.97	0.98	2.67	0.75	91.54	22.15	0.81	76.73	11.00
Czech Republic	Prague	167	52%	36.48	15.93	4.19	0.71	2.86	0.79	82.95	23.05	0.87	133.82	8.00
Estonia	Tartu	146	66%	42.93	12.30	4.48	0.78	2.89	0.74	94.41	26.16	0.85	28.80	5.00
Germany	Dresden	154	60%	31.59	13.39	4.26	0.71	3.41	0.99	69.18	31.21	0.92	232.53	9.40
Ghana	Legon, Accra	103	50%	40.42	9.53	4.24	1.06	2.03	0.75	81.36	28.26	0.56	101.72	26.00
Greece	Thessaloniki	91	54%	38.77	9.07	4.22	0.76	2.96	0.61	68.09	22.18	0.86	84.19	15.10
Hong Kong	Hong Kong	94	43%	47.09	9.98	3.88	0.96	2.60	0.80	91.00	31.17	0.91	6414.48	23.00
Hungary	Pecs	237	68%	37.80	9.56	4.09	0.93	3.08	0.64	107.62	29.53	0.83	107.60	10.00
India	Chennai	206	50%	42.21	5.17	4.03	0.70	2.19	0.84	53.53	60.93	0.55	366.76	27.67
India	Bangalore	96	64%	40.48	9.28	4.96	0.29	1.76	0.76	76.39	30.36	0.55	366.76	24.00
India	Guwahati	203	51%	31.03	5.02	4.93	0.25	1.89	0.82	89.46	32.46	0.55	366.76	24.00
Indonesia	Bandung	92	73%	41.74	9.90	4.51	0.93	2.69	0.65	87.03	24.95	0.63	126.37	24.40
Iran	Tehran	606	57%	38.81	10.88	3.69	1.14	2.93	0.74	85.25	38.49	0.74	45.18	17.00
Italy	Milan	322	61%	48.39	11.06	4.00	0.85	2.65	0.64	67.66	26.12	0.88	200.81	12.00
Kazakhstan	Kokshetau	120	50%	37.03	8.18	4.30	0.96	2.69	0.63	69.56	33.96	0.75	5.80	4.00
Kenya	Nairobi	294	50%	37.38	8.22	3.77	1.20	2.85	0.91	74.22	36.18	0.52	70.49	21.63

1	Malaysia	Sintok	99	51%	40.03	8.92	4.45	0.72	2.91	0.52	77.78	21.57	0.77	85.72	27.00
2	Mexico	Mexico City	157	51%	38.81	11.24	4.18	1.08	2.62	0.63	82.78	39.77	0.78	60.20	16.00
3	Nigeria	Benin	97	54%	39.04	7.44	4.48	0.75	2.18	0.97	82.89	35.25	0.47	172.90	26.00
4	Nigeria	Enugu	214	39%	42.33	9.00	4.33	0.93	2.31	0.97	78.66	21.36	0.47	172.90	27.00
5	Nigeria	Ondo	285	56%	36.45	8.82	4.27	1.01	1.84	0.96	84.38	36.73	0.47	172.90	27.00
6	Norway	Trondheim	100	28%	41.29	13.51	4.75	0.58	2.57	0.73	70.47	24.84	0.96	12.70	5.00
7	Pakistan	Karachi	121	55%	36.17	10.33	4.78	0.61	1.79	0.81	88.91	31.78	0.52	217.50	26.00
8	Peru	Lima	102	52%	31.66	10.49	4.22	0.85	2.42	0.74	61.96	25.41	0.74	22.80	19.40
9	Poland	Wroclaw, Brzeg	425	62%	40.65	11.68	4.37	0.71	2.80	0.72	70.56	24.25	0.82	118.17	8.00
10	Portugal	Coimbra	280	65%	46.04	11.17	3.80	1.02	3.11	0.63	77.91	30.94	0.82	115.10	15.00
11	Romania	Cluj-Napoca	181	85%	35.68	6.65	4.93	0.52	3.48	0.76	94.00	35.54	0.79	91.70	8.00
12	Russia	Moscow	224	46%	38.61	13.86	4.52	0.91	2.79	0.75	69.55	23.01	0.79	8.41	5.00
13	Saudi Arabia	Riyadh	198	56%	36.16	8.31	4.60	0.79	2.44	0.83	109.83	42.04	0.78	12.68	26.00
14	Serbia	Belgrade	105	82%	24.96	7.01	4.15	0.52	2.99	0.58	66.98	29.28	0.77	109.18	11.80
15	Slovakia	Nitra, Bratislava	233	67%	42.76	11.74	4.49	0.57	2.89	0.71	66.09	27.33	0.84	110.81	10.00
16	South Korea	Seoul	100	50%	41.76	7.74	4.36	0.56	3.15	0.63	85.40	37.11	0.91	486.80	12.00
17	Spain	Valencia, Grenada	199	53%	47.14	9.39	3.81	1.11	2.90	0.54	73.63	30.64	0.89	91.27	15.98
18	Sweden	Trollhättan	212	50%	43.52	4.55	4.16	0.69	2.44	0.63	36.38	38.36	0.92	20.85	6.64
19	Switzerland	Zurich	179	39%	48.77	12.87	4.38	0.58	2.35	0.82	92.55	24.47	0.91	189.68	9.00
20	Thailand	Chiang Mai	240	50%	44.53	7.22	3.82	1.38	2.48	0.85	61.22	46.95	0.69	129.41	26.92
21	Turkey	Ankara	104	27%	48.09	14.25	4.13	1.04	2.40	0.99	67.95	29.77	0.72	92.06	12.00
22	Turkey	Antalya	187	57%	44.12	12.75	4.31	0.91	2.63	0.73	94.47	33.23	0.72	92.06	18.00
23	Turkey	Sivas	100	18%	34.61	10.59	3.52	1.22	2.02	0.88	109.87	29.70	0.72	92.06	9.00
24	Uganda	Kampala	91	38%	34.89	10.55	4.13	0.97	2.62	0.86	96.49	42.81	0.46	141.00	21.50
25	Ukraine	Lviv	311	79%	29.22	8.75	4.80	0.49	2.88	0.79	63.37	23.90	0.74	76.28	8.08
26	United Kingdom	Cardiff	100	58%	45.04	11.57	4.31	0.72	2.42	0.73	78.73	26.10	0.88	255.52	9.00
27	USA	Philadelphia, Washington, Durham	424	64%	41.74	15.62	4.75	0.50	2.43	0.81	70.61	29.33	0.94	32.43	12.00
28	Total		10751	54%	39.62	11.71	4.25	0.95	2.63	0.84	77.52	35.13	0.77	163.63	15.55
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Table 2. Means and Standard Deviations of the Results obtained by Men and Women across Participating Sites

Country	Men			Women			Overall		
	<i>M</i>	<i>N</i>	<i>SD</i>	<i>M</i>	<i>N</i>	<i>SD</i>	<i>M</i>	<i>N</i>	<i>SD</i>
Argentina	21.39	71	4.39	23.72	130	4.15	22.90	201	4.37
Austria	22.69	115	3.82	21.76	85	3.46	22.30	200	3.69
Brazil (Natal)	21.71	137	3.36	22.41	100	4.33	22.00	237	3.80
Brazil (Porto Alegre)	24.46	103	3.04	21.62	37	3.44	23.71	140	3.38
Brazil (Rio de Janeiro)	24.26	58	3.58	21.55	42	4.23	23.12	100	4.08
Bulgaria	24.52	63	2.01	26.00	39	2.58	25.09	102	2.34
Canada	14.64	25	3.11	14.25	43	3.30	14.40	68	3.22
China	18.63	131	4.38	18.37	153	4.11	18.49	284	4.23
Colombia	24.05	41	3.60	25.12	59	3.29	24.68	100	3.44
Croatia	20.09	299	4.10	22.71	313	3.74	21.43	612	4.13
Czech Republic	22.13	80	3.57	24.57	87	3.11	23.40	167	3.54
Estonia	21.46	50	4.30	23.46	96	3.72	22.77	146	4.03
Germany	21.37	49	4.35	23.55	76	3.42	22.70	125	3.94
Ghana	24.71	52	3.11	22.47	51	4.29	23.60	103	3.89
Greece	22.10	42	4.11	24.08	49	4.56	23.16	91	4.45
Hong Kong	18.74	54	4.30	17.78	40	3.69	18.33	94	4.06
Hungary	23.29	76	4.03	24.70	161	3.67	24.25	237	3.84
India	17.03	75	5.23	17.14	29	4.45	17.06	104	5.01
India (Bangalore)	21.54	35	4.88	20.02	61	4.36	20.57	96	4.59
India (Guwahati)	18.24	100	4.72	18.40	103	5.13	18.32	203	4.92
Indonesia	21.76	25	4.27	22.64	67	3.45	22.40	92	3.69
Iran	21.26	261	5.17	22.41	344	4.92	21.91	605	5.06
Italy	21.70	127	3.98	23.59	195	3.83	22.84	322	3.99
Kazakhstan	24.35	60	3.55	24.98	60	3.33	24.67	120	3.44
Kenya	23.36	136	4.44	21.78	126	5.10	22.60	262	4.83
Malaysia	24.86	49	3.95	22.40	50	3.51	23.62	99	3.91
Mexico	22.25	77	4.73	23.80	79	4.78	23.03	156	4.80
Nigeria (Benin)	23.14	44	4.58	24.94	52	3.37	24.11	96	4.05
Nigeria (Enugu)	22.78	130	4.85	21.61	84	5.64	22.32	214	5.19
Nigeria (Ondo)	22.10	124	4.29	21.81	161	4.87	21.94	285	4.62
Norway	22.17	72	3.18	22.04	28	2.65	22.13	100	3.02
Pakistan	23.11	55	4.04	23.42	66	4.50	23.28	121	4.28
Peru	14.82	49	4.32	11.19	53	3.30	12.93	102	4.22
Poland	22.36	160	3.88	24.30	263	3.74	23.57	423	3.90
Portugal	21.11	99	3.85	23.42	178	3.39	22.60	277	3.72
Romania	22.07	28	2.16	24.09	153	4.46	23.77	181	4.25
Russia	21.23	120	4.27	24.49	104	3.98	22.75	224	4.43
Saudi Arabia	23.06	87	4.29	24.58	111	3.34	23.91	198	3.85
Serbia	22.84	19	4.19	23.97	86	3.38	23.76	105	3.55
Slovakia	21.99	76	4.30	24.24	157	3.83	23.51	233	4.12
South Korea	18.20	50	4.92	19.58	50	4.51	18.89	100	4.75
Spain	21.88	93	4.32	24.07	106	3.26	23.05	199	3.94
Sweden	22.16	69	3.64	19.08	53	3.95	20.82	122	4.06
Switzerland	11.85	109	4.04	13.87	67	3.83	12.62	176	4.07
Thailand	18.77	91	4.02	18.04	76	4.29	18.44	167	4.15
Turkey (Ankara)	21.36	76	4.82	23.29	28	3.92	21.88	104	4.66

Turkey (Antalya)	22.76	80	4.05	24.25	107	3.76	23.62	187	3.95
Turkey (Sivas)	22.13	82	4.59	19.17	18	4.49	21.60	100	4.69
Uganda	21.86	56	4.73	19.23	35	6.08	20.85	91	5.41
Ukraine	20.91	66	4.75	24.13	245	3.40	23.45	311	3.95
United Kingdom	21.79	42	4.03	23.10	58	3.55	22.55	100	3.80
USA (Durham, North Carolina)	20.61	174	4.76	19.62	138	4.54	20.17	312	4.68
USA (Philadelphia)	21.19	153	4.27	23.34	271	3.64	22.57	424	4.01
Total	21.30	4595	4.81	22.49	5423	4.73	21.94	10018	4.80

Table 3. A Summary of Multilevel Models Regressing Social Olfactory Awareness on Individual- and Country-Level Predictors.

Predictors	Model 1 (Baseline) <i>B (SE)</i>	Model 2 (Level-1 Predictors) <i>B (SE)</i>	Model 3 (Level-1 & Level-2 Predictors) <i>B (SE)</i>
Fixed Effects			
Individual-Level Predictors			
Intercept	21.78 (0.36)***	20.51 (0.53)***	24.79 (3.59)***
Gender (<i>1=M, 2=F</i>)		0.90 (0.09)***	0.90 (0.09)***
Age		-0.02 (0.004)***	-0.02 (0.004)***
Education		0.23 (0.05)***	0.23 (0.05)***
Material situation		-0.08 (0.06)	-0.08 (0.06)
Preferred distance		-0.0003 (0.001)	-0.0003 (0.001)
Country-Level Predictors			
HDI			-3.02 (3.48)
Density (log-transformed)			-0.31 (0.31)
Average Temperature			-0.04 (0.06)
Random Effects			
Individual Level Variance	17.70 (0.25)***	17.19 (0.25)***	17.19 (0.25)***
Country Level Variance	7.21 (1.39)***	7.06 (1.38)***	6.81 (1.33)***
Model Properties			
-2LL	57693.8	54104.75	54102.86
AIC	57699.8	54120.75	54124.86

Note. Coefficient are unstandardized regression weights with their standard errors in parentheses.

*** $p < .001$