

Short title: Effects of L2 on ToA

Full title: The Foreign Language Effect on Tolerance of Ambiguity

Silvia Purpuri¹, Nicola Vasta¹, Roberto Filippi², Li Wei², and Claudio Mulatti¹

¹ University of Trento (Italy)

² IOE, UCL's Faculty of Education and Society, London, UK

Acknowledgements:

Many thanks to all participants who took part in the study.

Address for correspondence:

Silvia Purpuri

University of Trento

Dipartimento di Psicologia e Scienze Cognitive

Corso Bettini, 84

38068 Rovereto (TN)

Email: silvia.purpuri@unt.n.it

Word count: 4255

Abstract

Previous research has shown that bilingual speakers may be more tolerant to ambiguity, they might perceive situations of ambiguity more interesting, challenging and desirable (e.g., Dewaele & Li, 2013). To our knowledge, no data is available addressing the question whether the language in use can have an effect on the personality trait of tolerance of ambiguity (ToA). This study investigated whether and how reading statements in a second language (L2), as opposed to the native language (L1), affects ToA. 387 Italian/English bilingual adults completed a questionnaire measuring levels of ToA either in English or Italian. Results revealed that processing information in L2 promoted higher scores of ToA overall and in sentences that were related to challenging perspectives and change. Age, gender and L2 proficiency were significant predictors of higher ToA scores. This study offers new evidence that processing information in a L2 can affect tolerance of ambiguous situations.

Keywords: Foreign Language Effect, Tolerance of Ambiguity, Decision-making, Bilingualism, L2, Second Language, Foreign Language.

Introduction

Research has shown that the use of a foreign language can have an effect on our moral judgement and decisions (e.g., Ciolletti, McFarlane & Weissglass, 2016; Costa et al., 2014, Geipel, Hadjichristidis & Surian, 2015a, 2015b, 2016). In a seminal study, Costa and colleagues (2014) administered the *trolley dilemma task*, where saving the life of five people actively involves sacrificing the life of one person. The authors showed that presenting the dilemma in a language that participants had learnt as a second language (L2), greatly increased their stated willingness to sacrifice that one person. In the domains of morals, judgements and decisions, it has been confirmed that the foreign language elicits less intense emotional reactions if compared to a native language and that using a foreign language seems to make people more rational and it increases utilitarian choices (Corey, Costa, 2015). The foreign language has been found to reduce risk aversion, making people more prone to opt for a sure outcome instead of taking the risk of a gamble with unsure outcomes (Hadjichristidis, Geipel, & Savadori, 2015; Keysar, Hayakawa, & An, 2012; Winkler & Bhatt, 2020; Xing, 2021). It has also been shown to reduce causality bias, the illusion of a relation of causality between two events when they are not causally related (Díaz-Lago & Matute, 2019) and to suppress superstition (Hadjichristidis, Geipel & Surian, 2019). Research has also shown that bilinguals perceive dishonesty as less inappropriate in their foreign language (Alempaki, Doğan, & Yang, 2017), and perceive crimes described in a foreign language as less severe (Woumans, Van der Cruyssen, & Duyck, 2020).

Tolerance of ambiguity is the ability of an individual to perceive, process, and respond to ambiguous or uncertain situations without experiencing undue stress or anxiety. (Budner, 1962). Furnham and Ribchester (1995) found that individuals who score high on measures of tolerance of ambiguity are more likely to engage in creative problem-solving and to embrace novel and unconventional ideas. On the contrary, individuals with low tolerance of ambiguity

may feel more anxious or stressed in ambiguous situations and may be more prone to rigid thinking, avoidance, or decision-making based on incomplete information (Furnham and Ribchester, 1995).

Measurements of tolerance of ambiguity have been used in various contexts and fields. For example, the ability to tolerate ambiguity has been shown to have an impact on medical doctors' level of perceiving work-related stress (Ianello, Mottini, Tirelli, Riva, Antonietti, 2017). Low tolerance for ambiguity has been seen to be associated with the tendency to order more diagnostic tests (Ianello et al., 2017) and it has been shown to interfere with medical decision making (Roets, Raman, Heytens, Avonts, 2013; Kruglanski, Webster, Klem, 1993). It has also been seen to be related to lower tolerance of uncertainty (Gärtner, Bußenius, Prediger et al., 2020). It has been assumed that measuring the ToA in medical school applicants could be interesting in the selection process in order to choose the best applicants for undergraduate medical schools (Gärtner et al., 2020).

Previous studies have pointed out how bilingual and multilingual individuals are more tolerant to ambiguity if compared to monolingual speakers (e.g. Dewaele and Li, 2013). In a subsequent study, Dewaele and Botes aimed to investigate the effect of multilingualism on five high-order personality traits and extended previous findings showing that knowing more languages provides positive traits to individuals (Dewaele and Botes, 2020). They found that knowing more languages was positively related to openness to experience and extraversion. The study suggests that the earlier someone learns additional languages and the more they use them, the greater the effect on personality traits. The findings contribute to the growing body of literature on the relationship between multilingualism and personality.

Research has seen the use of a second language implying a reduction in the emotional response in that language, leading to a certain degree of emotional distance (Iacozza, Costa, Duñabeitia, 2017, Costa, Foucart, Hayakawa, Aparici, Apesteguia, Heafner, et al., 2014). The less emotion is experienced in a situation, the more control it is possible to have in that situation and the use of a foreign language alters the emotion caused by the message (Keysar, Hayakawa & An, 2012, Gross, 2012). For this reason, people might be more rational and logical in a situation involving their second language (e.g., Costa et al., 2014). They might be more prone to invest in situations they are not used to and that are distant and unfamiliar from them. They might invest more easily in challenging or unfamiliar situations and might see change as an opportunity. Previous research also suggests that moral FLE appears to be stronger among bilinguals with lower self-reported foreign language proficiency (Stankovic, Biedermann, Hamamura, 2022).

The present study investigated whether there is a L2 effect on tolerance of ambiguity and whether presenting information in a foreign language (as opposed to the native language) makes people more tolerant to ambiguity. It consisted of a questionnaire that participants completed in either their first or second language. We predicted that participants who answered the questionnaire in their second language (L2=English) were more tolerant to ambiguity compared to participants who answered the same questionnaire in their first language (L1=Italian).

Methods

Participants

Sample size was determined a-priori using G*power with: between participants design, $d = .4$ (small/moderate size; c.f. Circi, Gatti, Russo, & Vecchi, 2021), $\alpha = .05$, and power = .8. Results indicated a minimum sample size of 156 (see pre-registration: <https://osf.io/7rn9z>)

Five hundred and twenty six participants volunteered to take part in the study and completed an online questionnaire measuring ToA. They also provided biographical and linguistic information. After eliminating incomplete answers, Three hundred and eighty seven participants were included in the analysis (251 female, 118 male, 10 non binary, 8 did not provide this information); mean age = 27.15 years (41 participants did not provide this information, age range: 18-76 years). 207 participants were randomly assigned to the Italian questionnaire (L1_Italian condition), and 180 to the questionnaire in English (L2_English condition).

All participants had studied English as a second language as part of their previous scholastic education. On average, participants in the L2_English condition have had English education since the age of 9.33, with speaking in L2: 9.42 (39 answers not given) - reading in L2: 9.13 (41 answers not given) - writing in L2: 9.44 (43 answers not given) and have studied English on average for 8 14.98 years (41 answers not given).

Participants were asked to self-assess their foreign language proficiency in terms of speaking, reading, writing and understanding levels on a 7-point Likert scale (1= no competence through

7= high/native competence). Across the 7 measures, participants in their foreign language condition rated their foreign language skills at 5.34 (between 5 and 6 of the Likert scale (L2_English: M = 5.34), with speaking at 5.02, reading at 5.68, writing at 4.97 and understanding at 5.71. Participants were also asked to self-rate their level of English according to the Common European Framework. They could choose between B1 (independent user), B2 (advanced independent user), C1 (proficient user) and C2 (advanced proficient user). Participants who answered the questionnaire in the foreign language condition reported, on average, a level between B2 and C1 (mean_CFR: 2.59 (between b2 and c1; see Table 1). Only 235 participants completed this particular section of the questionnaire. 152 participants did not report this information.

Average age (in years) at which participants started learning L2				
	General	Speaking	Reading	Writing
	9.33	9.42	9.13	9.44
Average L2 proficiency				
	Understanding	Speaking	Reading	Writing
	5.71	5.02	5.68	4.97
Self-rated level of L2 according to the Common European Framework, number of responses (15 missing)				
	B1	B2	C1	C2
	20	89	93	33

Table 1. L2 descriptives table. Only participants in the foreign language condition (L2) are considered.

Most of the participants were born in Italy, with the largest group (n=141) being born in Trentino Alto Adige, followed by Veneto (n=71), Piedmont (n=9), Friuli Venezia Giulia (n=18), Lombardy (n=41), Liguria (n=2), Emilia Romagna (n=15), Tuscany (n=11), Marche (n=2), Lazio (n=4), Campania (n=6), Apulia (n=13), Sicily (n=19), Abruzzo (n=2), Basilicata (n=3), Calabria (n=1), Umbria (n=1) and Sardinia (n=3). A map of Italy with the participants'

regions is provided in Appendix B. Fifteen participants were born outside Italy (n=2 in India, n=4 in the United Kingdom, n=2 in Romania, n=1 in Sri Lanka, n=1 in Germany, n=1 in Austria, n=1 in Mexico, n=1 in Albania, n=1 in Brazil and n=1 in Bangladesh) and ten participants did not report the place of birth. All our participants currently live in Italy.

The study protocol was approved by the Ethics Committee of the University of Trento according to the principles expressed in the Declaration of Helsinki. We obtained the participants' consent at the very first stage of our online questionnaire. The participants had to choose if they agreed or not by clicking on the chosen box before moving on to completing the questionnaire.

Materials

The participants were asked to complete the adapted version of the Tolerance for Ambiguity questionnaire (Herman et al., 2010 - see Appendix A for the full texts of the questionnaire in English and in Italian) that was used to investigate if multilingualism was linked to a higher tolerance of ambiguity (Dewaele & Li, 2013). Herman et al. (2010) had developed a psychometrically sound measure of ToA and presented the Tolerance for Ambiguity Scale (TAS), which they describe as a “conceptually clear, internally consistent assessment tool” (p. 60). Theirs was a 12-item questionnaire with five-point Likert scales. They found four distinct dimensions which were labelled as follows: 1) valuing diverse others; 2) change; 3) challenging perspectives; and 4) unfamiliarity. One question was removed by Dewaele and Li, who have worked with the 11-item questionnaire with five-point Likert scales. They also made some minor stylistic adaptations. We used the new version of the questionnaire (Dewaele & Li 2013) and analysed the results following Herman et al. 's categorization into four dimensions. The four dimensions together with the corresponding items are presented in Table 2 below.

DIMENSIONS	ITEMS
-------------------	--------------

Valuing diverse others	1. I avoid situations where people don't share my values. 5. I can be comfortable with nearly all kinds of people.
Change	4. The sooner we all acquire similar values and ideals the better. 8. A good job is one where what is to be done and how it is to be done are always clear. 9. A person who leads an even, regular life in which few surprises or unexpected happenings arise really has a lot to be grateful for. 10. What we are used to is always preferable to what is unfamiliar.
Challenging perspectives	2. I would like to live in a foreign country for a while. 6. If given a choice, I would visit a foreign country rather than vacation at home. 7. A good teacher is one who makes you think about/consider your way of looking at things.
Unfamiliarity	3. I like to surround myself with things that are familiar to me. 11. I like parties where I know most of the people more than ones where all or most of the people are complete strangers.

Table 2. List of items sorted by dimension.

In the current study, the original materials were in English and then translated into Italian by highly proficient bilingual speakers. One independent judge controlled the translated version for consistency with the English version. Some questions had already been reverse coded in Herman et al.'s (2010) original manuscript (see Appendix A). Their numerical scoring scale ran in the opposite direction in order to check if respondents were giving consistent answers. The language versions were also closely matched for word count (English questionnaire = 163 words, Italian questionnaire = 129 words).

Procedure

Participants had to judge to what extent they agreed with the items of the ToA questionnaire by selecting the appropriate box of a 5-point Likert scale (1=strongly disagree, 2=disagree, 3=neither agree nor disagree, 4=agree, 5= strongly agree). The presentation order of the 11 items of the Tolerance of Ambiguity questionnaire has been randomised. In each condition, participants received the questionnaire entirely written in one language: English or Italian. After completing the questionnaire, participants had to spend a few more minutes completing our informative questionnaire on their linguistic and cultural background. This final part was

in Italian for all participants, as only participants with Italian as their first language were recruited.

Results

ANOVAs and a MANOVA were carried out to test if there were any differences in the language in which the questions were presented. Analysis of covariance (ANCOVA) was also used to analyse whether age, the number of years of study of the second language, L2 proficiency and the distance from home had an effect on ToA scores.

In order to explore if there was an effect of the language of the questionnaire on ToA, an ANOVA was carried out, with ToA as a dependent variable and the language of the questionnaire as a fixed factor. This indicated a significant effect of the language of the questionnaire overall, $F(1, 385) = 5.239$, $p = 0.023$, $\eta_p^2 = .013$, with participants who completed the questionnaire in English (mean = 37.67, sd = 4.26) scoring higher than participants who completed the questionnaire in Italian (mean = 36.72, sd = 3.88).

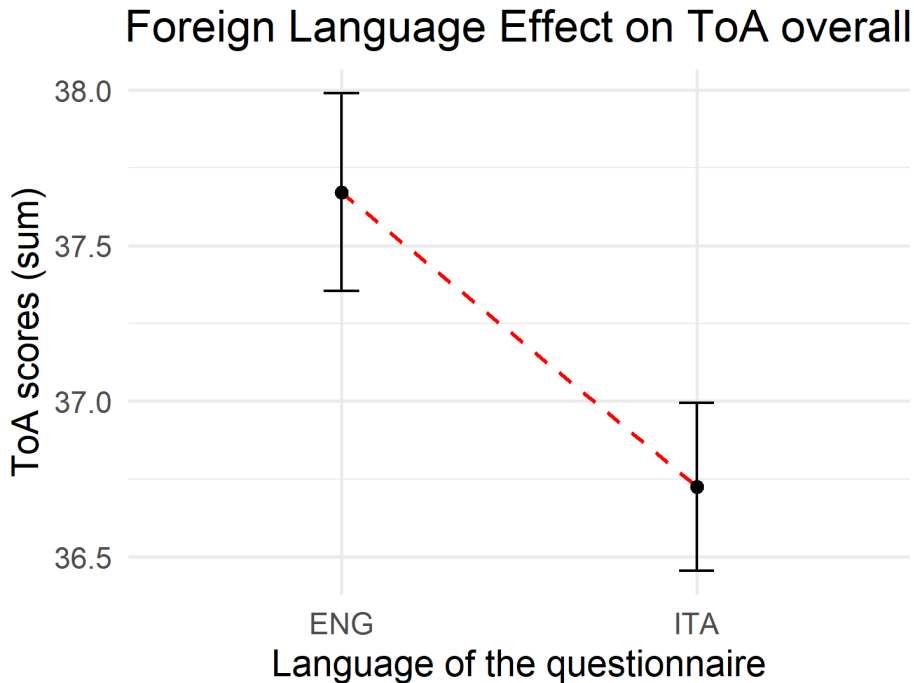


Figure 1. Sum of ToA scores, sorted by Language of the questionnaire. Vertical bars represent standard errors, while black dots represent the aggregated means.

To evaluate the effect of language on the four dimensions, that is, 1) valuing diverse others; 2) change; 3) challenging perspectives; and 4) unfamiliarity, a MANOVA was performed with questionnaire language as the between-subject factor and the four ToA dimensions as dependent variables.

MANOVA revealed a main effect of *questionnaire language*, $F(1,385) = 4.934, p < 0.001$. This indicates that language selectively influences the four different dimensions. In order to examine whether the foreign language effect is present throughout all dimensions, four one-way ANOVAs were carried out, one for each dimension. Whereas the main effect of the dimensions *valuing diverse others*, and *unfamiliarity* were not significant ($F_s < 1$), the effect of the dimension *challenging perspectives* was significant, $F(1,385) = 5.964, p = 0.015, \eta_p^2 = .015$, with participants who completed the English questionnaire scoring higher on ToA (mean = 4.25, sd = 0.62) than those who completed the questionnaire in Italian (mean = 4.1, sd =

0.61). *Change* was also significant, $F = 6.040$, $p = 0.014$, $\eta_p^2 = .015$, with participants who completed the English questionnaire scoring higher on ToA (mean = 2.93, $sd = 0.70$) than those who completed the questionnaire in Italian (mean = 2.72, $sd = 0.66$). This shows that participants who responded to the item of the dimension in English were more tolerant to ambiguity than those who responded to the Italian version.

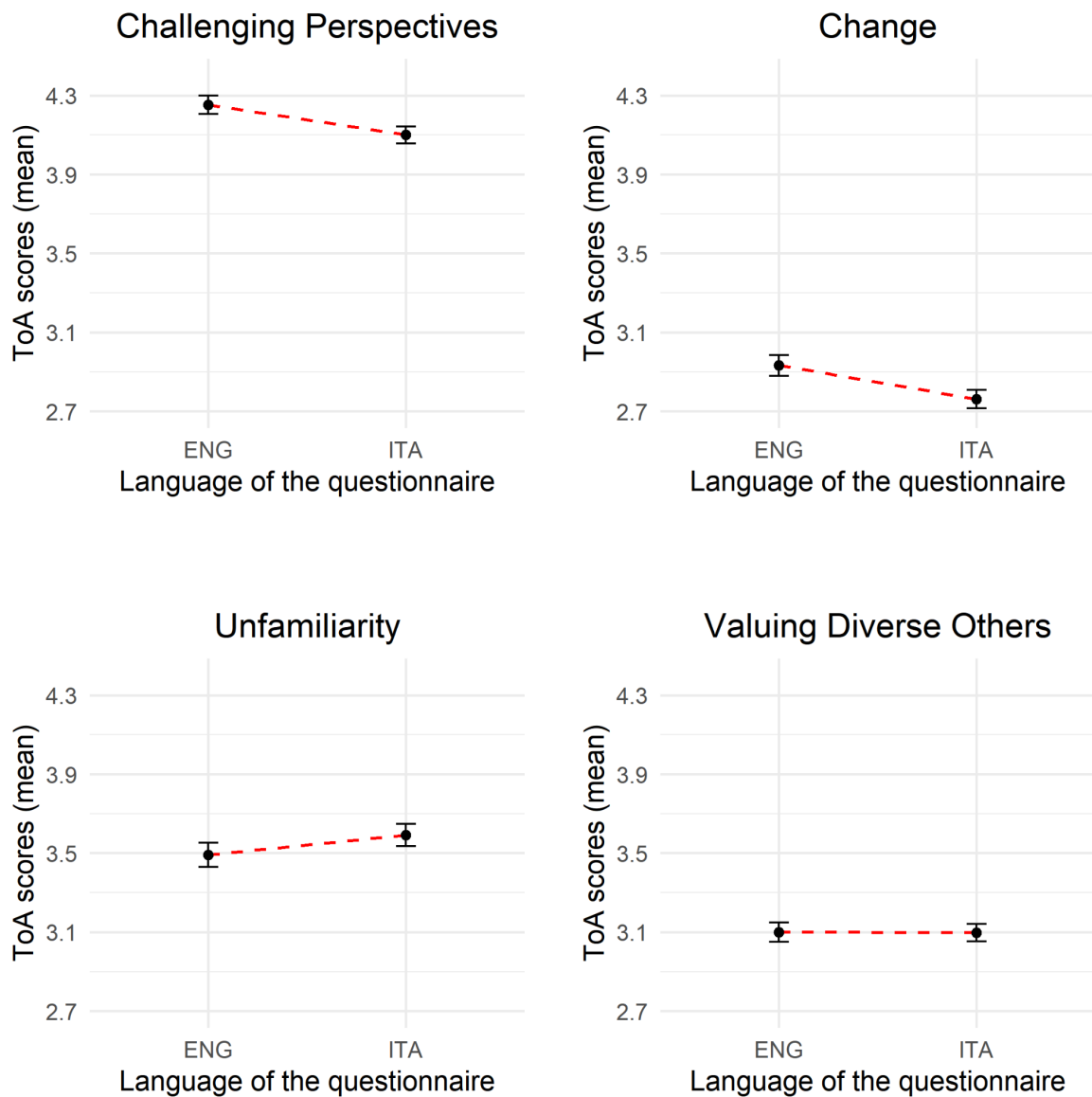


Figure 2. Mean of ToA scores for each one of the four dimensions, sorted by Language of questionnaires. Vertical bars represent standard errors, while black dots represent the aggregated means.

The role of age, gender, years of L2 acquisition/exposure, L2 proficiency and geographical distance.

In two ANCOVAs we have examined whether the years of L2 acquisition/exposure and L2 proficiency had an effect on ToA. 19 participants were excluded from these analyses because they did not provide the relevant linguistic information in the questionnaire.

A one-way ANCOVA was conducted with the language of the questionnaire (English vs Italian) as an independent variable, the participants' overall level of ToA as dependent variable and with L2 proficiency as a covariate. L2 Proficiency was rated based on the answers provided by the participants in the linguistic assessment section: the higher the score obtained in L2 Proficiency, the higher the participant's proficiency. This indicated a significant effect of the language of the questionnaire, $F(1,365) = 5.132$, $p = 0.024$, $\eta_p^2 = 0.014$, with L2 proficiency being a significant covariate, $F(1,365) = 5.018$, $p = 0.026$, $\eta_p^2 = 0.014$, showing that the more proficient participants were in the foreign language, the more tolerant to ambiguity they were.

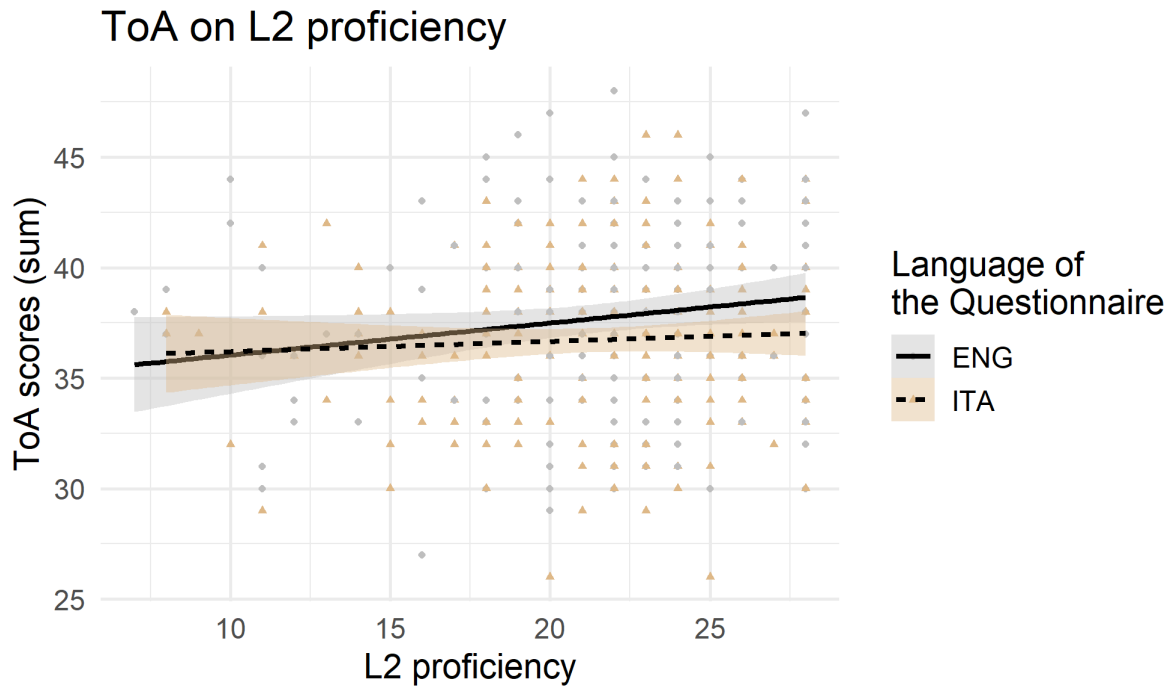


Figure 3. Sum of ToA scores sorted by L2 proficiency, in both the English (ENG) and Italian (ITA) condition. Each dot corresponds to the ToA score of at least one participant. Grey and brown regions indicate the confidence interval (95%).

However, from a different ANCOVA, the variable number years of L2 acquisition/ exposure did not reveal any significant effect ($F = 1.1$, $p = 0.3$).

In a third one-way ANCOVA, we have examined whether age had an effect on ToA. 41 participants were excluded because they did not report their age. We have set Language of questionnaire as an independent variable, ToA as dependent variable and Age as a covariate. There was a significant effect of the language of the questionnaire, $F(1,343) = .5.471$, $p = 0.020$, $\eta^2 = 0.016$. Age also resulted in a significant covariate, $F(1,343) = 5.577$, $p = 0.019$, $\eta^2 = 0.016$, showing that older participants were less tolerant to ambiguity if compared to younger participants. To further analyse this relation, linear regression analysis was conducted for each of the two questionnaire conditions (English and Italian). This revealed that Age was a reliable predictor of ToA ($\beta = -0.18$, $p = 0.22$), but only for the participants who completed the

questionnaire in their second language (English). No relation was found for participants who completed the questionnaire in their first language, Italian ($p = 0.26$).

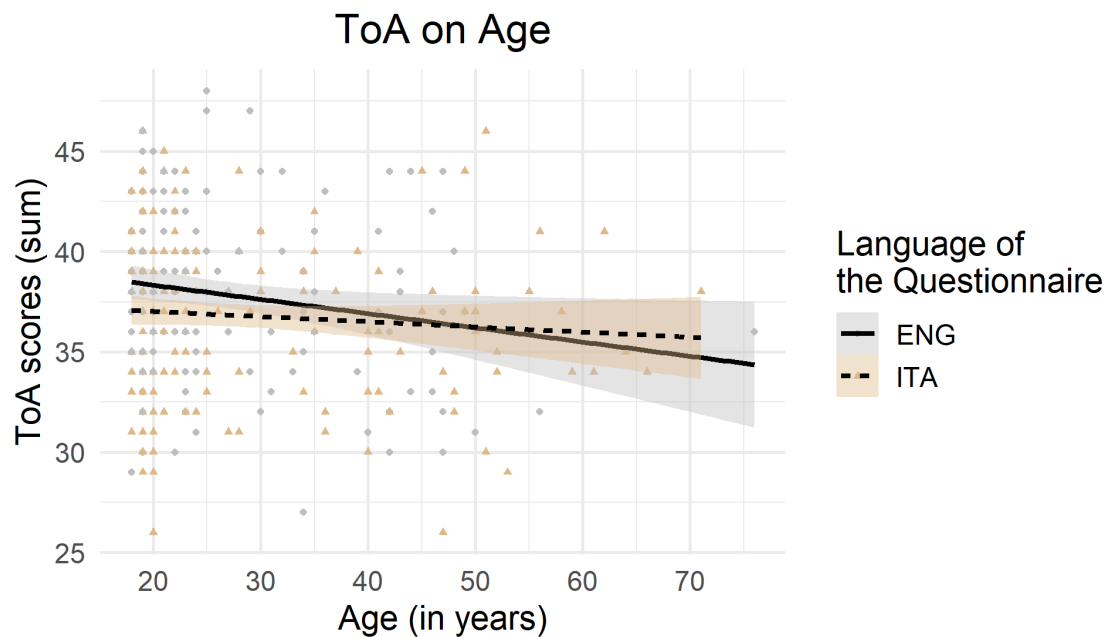


Figure 4. Sum of ToA scores sorted by Age, in both the English (ENG) and Italian (ITA) condition. Each dot corresponds to the ToA score of at least one participant. Grey and brown regions indicate the confidence interval (95%).

We then performed a two-way ANOVA in order to examine if there were any gender-related differences on ToA. 18 participants were excluded from this analysis (10=non binary, 1=other, 7 participants did not provide this information), as their number was too small to be consistent. We have set Gender and Language of the questionnaire as independent variables and ToA as dependent variable. The main effect of gender resulted to be significant, $F(1,365) = 5.013$, $p = 0.026$, $\eta^2 = 0.013$, with female participants being more tolerant to ambiguity (mean = 37.422, $sd = 4.088$) if compared to male participants (mean = 36.50, $sd = 3.92$). Moreover, Gender significantly interacted with Language of the questionnaire, $F(1,365) = 5.761$, $p = 0.017$, $\eta^2 = 0.015$. Bonferroni corrected post-hoc tests showed that female participants who answered the

English questionnaire displayed higher ToA scores than both female participants with an Italian questionnaire, $t = 3.059$, $p = 0.014$, and male participants with an English questionnaire, $t = 3.229$, $p = 0.008$.

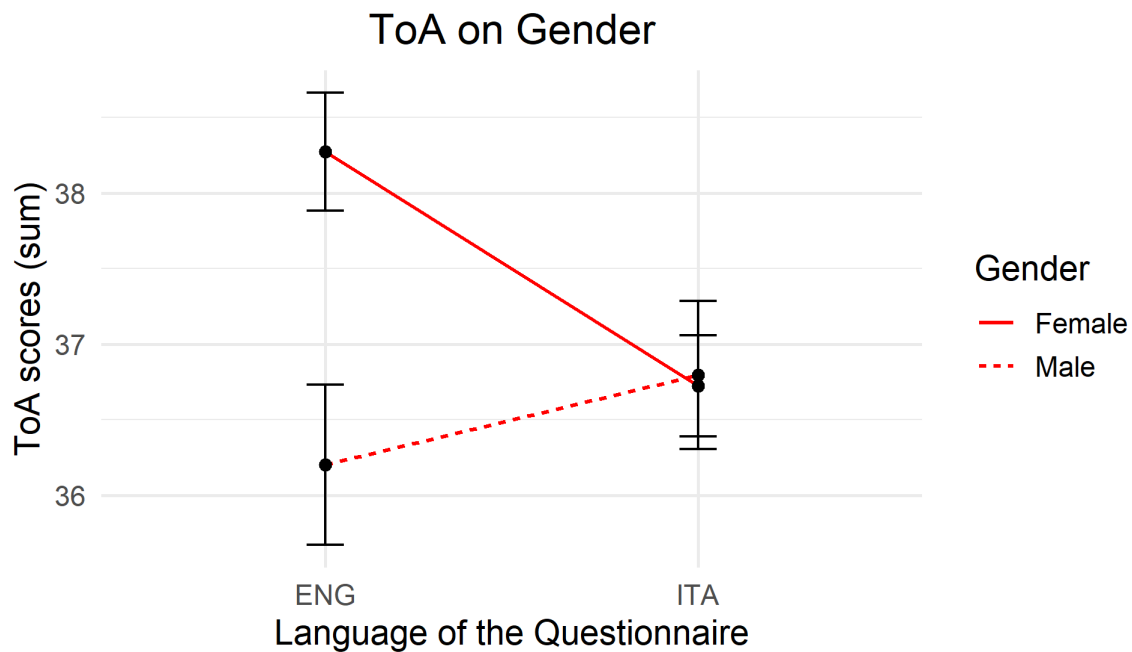


Figure 5. Sum of ToA scores, sorted by Language of the questionnaire and Gender. Vertical bars represent standard errors, while black dots represent the aggregated means.

We have also explored the role of geographical distance on tolerance of ambiguity, but this resulted to be non-significant ($F = 2.5$, $p = 0.1$).

Discussion

This study addressed the question whether the use of a second language (L2) has an effect on tolerance of ambiguity (ToA), a personality trait in which an individual perceives ambiguous situations or stimuli as desirable, challenging and interesting (Furnham and Ribchester, 1995). Specifically, it was hypothesised that processing information in L2 promotes higher levels of ToA in bilingual speakers. Three hundred and eighty seven speakers of Italian and English

completed an online questionnaire measuring ToA. The questionnaire, originally available in English (Herman et al., 2010), was translated into Italian as well. Two hundred and seven of them were randomly assigned to the Italian questionnaire and one hundred and eighty to the questionnaire in English. Participants had to judge to what extent they agreed with the items of the ToA questionnaire by selecting the appropriate box of a 5-point Likert scale. We analysed the data following Herman et al. 's (2010) categorization into four dimensions: 1) Valuing diverse others, 2) Change, 3) Challenging perspectives and 4) Unfamiliarity.

The results provided evidence that the use of a foreign language influences tolerance of ambiguity. In line with prior research and with our predictions, this study demonstrated that the use of a foreign language increases ToA overall.

When first categorising the four different factors that we ourselves have explored in the present article, Herman et al. have provided conceptualization in order to understand how and why each of the four factors might or might not be linked to bilingualism and multilingualism. Keeping in mind his analysis as a starting point, we have tried to think about why there could be a foreign language effect on our four factors. As to the factor labelled as *valuing diverse others*, this is consistent with interpersonal interaction, choosing situations where people share or don't share the same values and being comfortable with all kinds of people. It might reflect a person's inclination to appreciate and respect individuals from various backgrounds, cultures, and with different values or perspectives. A foreign language effect might be possible, as when using a second language participants are more likely to feel at ease with people who are different to them. As to the dimension labelled as *change*, it "reflects the dynamic nature of intercultural situations such as cross-cultural transitions and global management." (Herman et al, 2010). A FLE is likely to be present here, as people might be more prone to go out of their comfort zone and follow effective coping strategies in their foreign language, when following

their rationality. As to *unfamiliarity*, as new challenges “unfreeze and change prior mental models” (McCall and Hollenbeck, 2002; Oddou and Mendenhall, 2008), this could easily be more true in the foreign language, as part of the foreign language effect. Participants in their second language might be more prone to choose a situation that is not that familiar to them. This can be linked and be applied to the factor *challenging perspectives*, where people will tend to be more prone to engage in something that is different to them to a certain extent, if that perspective is presented in the foreign language.

When analysing the four different factors separately, our results provided evidence of increased ToA in the dimension of *challenging perspectives* and *change*. However, the effect was not statistically reliable when unfamiliarity and valuing diverse others were analysed. The foreign language effect was robust in the factors *challenging perspectives* and *change*. This confirms our hypothesis that participants who had had to answer the questionnaire in their foreign language would have been more likely to be tolerant to ambiguity if compared to the participants who had completed the questionnaire in their first language in situations where it is necessary to undertake effective coping strategies and engage in decisions that might lead to an evolution or a shift from the status quo. In the factors *valuing diverse others* and *unfamiliarity*, no significant effect of the foreign language on tolerance of ambiguity was found. One possible explanation could be that these items, that were very clear in Italian (L1), might have been more challenging to understand in L2, as the sentences were a bit longer or contained difficult constructions or double negatives, that might have created some confusion to our participants. This possible result may be affected by subtle differences in translation, that we have included among the possible limitations of our study (page 20).

Some evidence suggests that variables, such as language proficiency, may affect this reduction in emotionality associated with a foreign-language use (Caldwell-Harris, 2014). On this basis, we decided to set some variables as covariates and investigate any possible outcomes.

The current study found a significant relationship between age and ToA. Dewaele and Li (2013) reported a strong positive relationship between participants' age and their ToA scores (Dewaele & Li, 2013) and a similar correlation was found between multilinguals' age and scores on Trait Emotional Intelligence (Dewaele et al., 2008). From these studies, it seems that with age, people might become more tolerant to ambiguity. Contrary to this, the current study found an inverse correlation. It seemed that older participants were, the less tolerant to ambiguity they resulted to be, with younger participants being more tolerant to ambiguity. This was particularly true when the questionnaire was presented in the participants' foreign language. It needs to be said, as a possible limitation for this study, that participants who volunteered to take part in our experiment were on average quite young. Also, we unfortunately do not have any information about age for 41 participants. It may be useful to replicate this study with a higher number of older participants.

The relationship between ToA and the participants' self reported proficiency in the second language was also analysed and it showed that participants who were more proficient in their L2 were significantly more tolerant to ambiguity. This is not in line with previous research, where high self-rated language proficiency, a possible indicator of more frequent language use (as suggested by Luk and Bialystock, 2013) has been seen to facilitate stronger emotional experience in the foreign language (Caldwell-Harris et al., 2011; Dewaele, 2008), leading to more deontological choices. This finding is worth investigating at a deeper level in future studies, possibly having the participants complete a placement test in the foreign language in

order to objectively assess their actual level of proficiency in that language. As proficiency has been self reported, we cannot be sure of the participants' response.

When analysing the relationship between ToA and the participants' gender, we found that female participants were more tolerant to ambiguity if compared to male participants. Moreover, Gender significantly interacted with Language of the questionnaire, showing that female participants who answered the English questionnaire displayed higher ToA scores than both female participants with an Italian questionnaire and male participants with an English questionnaire. This is a very interesting result that should be explored in the future in more detail.

Although our study provides valuable insights into the relationship between FLE and ToA, it is important to acknowledge several limitations, that will need to be addressed in future studies. First, the ToA Questionnaire has not been validated in the sense of demonstrating that it can predict behavioural outcomes and not just correlate with other self-ratings of this trait or logically related other traits. Second, it would be useful to have more homogeneous groups of male and female participants. Third, as a recent study by Paap and al (2023) has shown, a scale's predictive validity and factor structure can be influenced by subtle changes in wording (e.g., translation). In the current study, participants who have completed the questionnaire in English have been presented with the same questionnaire that had been used in the previous study (Herman et al., 2010). For this reason, we have decided, in the Italian version, to conduct an analysis maintaining the same structure of the original paper (Herman et al, 2010). For future studies, it might be worth investigating whether translations may change the original factor loading structure.

Conclusions

The present research investigated for the first time the foreign language effect on tolerance of ambiguity. It offered new evidence that processing information in a foreign language does influence a personality trait like tolerance of ambiguity. We had the most significant results in sentences that were related to challenging perspectives and change, suggesting that people are more likely to be tolerant to ambiguity in situations that are linked to those two dimensions. Older participants resulted to be less tolerant to ambiguity if compared to younger participants, especially in the second language. Female participants were more tolerant to ambiguity if compared to male participants and the more proficient participants were in their second language, the more tolerant to ambiguity they were.

This study provided novel data of how processing information in L2 may change the perception of the world and affect decisions. This novel data is, in our opinion, very relevant today more than ever, given the amount of people who make decisions in a foreign language every day, often dealing with delicate subjects, where tolerance of ambiguity is desirable, if not required. This issue could have serious socioeconomic implications, especially in our globalised world, where decisions are taken on a daily basis in international, multilingual settings.

References

Alempaki, D., Dog̃an, G., & Yang, Y. (2017). Lying in a foreign language. Retrieved from SSRN: doi:10.2139/ ssn.2995506

Bakalis, S., & Joiner, T. A. (2004). Participation in tertiary study abroad programs: the role of personality. *International Journal of Educational Management*, 18(5), 286 - 291. <https://doi.org/10.1108/09513540410543420>

Bennis WM, Medin DL, Bartels DM (2010) The Costs and Benefits of Calculation and Moral Rules. *Perspect Psychol Sci* 5: 187–202

Budner, S. (1962). Intolerance of ambiguity as a personality variable. *Journal of Personality*, 30 (1), 29–50

Caldwell-Harris, C. L., Tong, J., Lung, W., & Poo, S. (2011). Physiological reactivity to emotional phrases in Mandarin—English bilinguals. *International Journal of Bilingualism*, 15(3), 329–352. <https://doi.org/10.1177/1367006910379262>

Caldwell-Harris, C. L. (2014). Emotionality differences between a native and foreign language: Theoretical implications. *Frontiers in psychology*, 5, 1055.

Cipolletti, H., McFarlane, S., & Weissglass, C. (2016). The moral foreign-language effect. *Philosophical Psychology*, 29(1), 23–40. <http://dx.doi.org/10.1080/09515089.2014.993063>.

Circi, R., Gatti, D., Russo, V., & Vecchi, T. (2021). The foreign language effect on decision-making: A meta-analysis. *Psychonomic Bulletin & Review*, 28(4), 1131-1141.

Costa A, Foucart A, Hayakawa S, Aparici M, Apesteguia J, Heafner J, et al. (2014) Your Morals Depend on Language. *PLoS ONE* 9(4): e94842. <https://doi.org/10.1371/journal.pone.0094842>

Corey, J. D., y Costa, A. (2015). El efecto de usar una lengua extranjera sobre las decisiones morales. *Ciencia Cognitiva*, 9:3, 53-56.

Dane, E. , & Pratt, M. G. (2007). Exploring intuition and its role in managerial decision making. *Academy of Management Review*, 32(1), 33–54.

Dewaele, J.-M., Petrides, K.V., & Furnham, A. (2008). The effects of trait emotional intelligence and socio biographical variables on communicative anxiety and foreign language anxiety among adult multilinguals: A review and empirical investigation. *Language Learning*, 58 (4), 911–960

Dewaele, Jean-Marc and Li, Wei (2013) Is multilingualism linked to a higher tolerance of ambiguity? *Bilingualism: Language and Cognition* 16 (2), pp. 231-240. ISSN 1366-7289.

Dewaele, J.-M., & Botes, E. (2020). Does multilingualism shape personality? An exploratory investigation. *International Journal of Bilingualism*, 24(4), 811–823. <https://doi.org/10.1177/1367006919888581>

Díaz-Lago, M., & Matute, H. (2019). Thinking in a Foreign language reduces the causality bias. *Quarterly Journal of Experimental Psychology*, 72(1), 41-51.

Furnham, A., & Ribchester, T. (1995). Tolerance of ambiguity: A review of the concept, its measurement and applications. *Current Psychology: A Journal for Diverse Perspectives on Diverse Psychological Issues*, 14(3), 179–199. <https://doi.org/10.1007/BF02686907>

Gärtner, J., Bußenius, L., Prediger, S. et al. Need for cognitive closure, tolerance for ambiguity, and perfectionism in medical school applicants. *BMC Med Educ* 20, 132 (2020). <https://doi.org/10.1186/s12909-020-02043-2>

Geipel, J., Hadjichristidis, C., & Surian, L. (2015a). The foreign language effect on moral judgment: The role of emotions and norms. *PLoS ONE*, 10(7), e0131529. <http://dx.doi.org/10.1371/journal.pone.0131529>.

Geipel, J., Hadjichristidis, C., & Surian, L. (2015b). How foreign language shapes moral judgment. *Journal of Experimental Social Psychology*, 59, 8–17. <http://dx.doi.org/10.1016/j.jesp.2015.02.001>.

Geipel, J., Hadjichristidis, C., & Surian, L. (2016). Foreign language affects the contribution of intentions and outcomes to moral judgment. *Cognition*, 154, 34–39. <https://doi.org/10.1016/j.cognition.2016.05.010>.

Greene J, Nystrom L, Engell A, Darley J, Cohen J (2004) The neural bases of cognitive conflict and control in moral judgment. *Neuron* 44: 389–400 [10.1016/j.neuron.2004.09.027](https://doi.org/10.1016/j.neuron.2004.09.027)

Gross, R. (2012). *Key studies in psychology* (6th ed.). Hodder Education Group.

Hadjichristidis, C., Geipel, J., & Savadori, L. (2015). The effect of foreign language in judgments of risk and benefit: The role of affect. *Journal of Experimental Psychology: Applied*, 21(2), 117–129. <https://doi.org/10.1037/xap0000044>

Hadjichristidis, C., Geipel, J., & Surian, L. (2019). Breaking magic: Foreign language suppresses superstition. *Quarterly Journal of Experimental Psychology*, 72(1), 18–28. <https://doi.org/10.1080/17470218.2017.1371780>

Herman, J. L., Stevens, M. J., Bird, A., Mendenhall, M., & Oddou, G. (2010). The Tolerance for Ambiguity Scale: Towards a more refined measure for international management research. *International Journal of Intercultural Relations*, 34, 58–65.

Iacozza S, Costa A, Duñabeitia JA (2017). What do your eyes reveal about your foreign language? Reading emotional sentences in a native and foreign language. *PLoS ONE* 12(10): e0186027. <https://doi.org/10.1371/journal.pone.0186027>

Ianello P, Mottini A, Tirelli S, Riva S, Antonietti A. (2017). Ambiguity and uncertainty tolerance, need for cognition, and their association with stress. A study among Italian practicing physicians. *Med Educ Online*. 2017;22(1):1270009.

Kahneman, D., & Tversky, A. (1979). Prospect theory: An analysis of decision under risk. *Econometrica*, 47(2), 263–292. doi: 10.2307/1914185

Kahneman, D. (2003). Maps of bounded rationality. *American Economic Review*, 93(5), 1449–1475.

Keysar, B., Hayakawa, S. L., & An, S. G. (2012). The Foreign-Language Effect: Thinking in a Foreign Tongue Reduces Decision Biases. *Psychological Science*, 23(6), 661–668. <https://doi.org/10.1177/0956797611432178>

Kossowska M, Jasko K, Bar-Tal Y. Need for closure and cognitive structuring among younger and older adults. *Pol Psychol Bull*. 2012;43(1):40–9.

Kruglanski AW, Webster DM, Klem A. (1993). Motivated resistance and openness to persuasion in the presence or absence of prior information. *JPSP*. 1993;65(5):861.

Luk, G., & Bialystok, E. (2013). Bilingualism is not a categorical variable: Interaction between language proficiency and usage. *Journal of cognitive psychology (Hove, England)*, 25(5), 605–621. <https://doi.org/10.1080/20445911.2013.795574>

- Pavlenko, A. (2012). Affective processing in bilingual speakers: Disembodied cognition? *International Journal of Psychology*, 47(6), 405–428. <https://doi.org/10.1080/00207594.2012.743665>.
- Roets A, Raman E, Heytens S, Avonts D. (2013). Effects of dispositional need for cognitive closure and training on medical decision making. *Med Decis Mak.* 2013;34(2):144–6.
- Sadler-Smith, E. (2008). *Inside intuition*. London: Routledge.
- Stanovich, K. E., & West, R. F. (2000). Individual differences in reasoning: Implications for the rationality debate? *Behavioral and Brain Sciences*, 23(5), 645–665. <https://doi.org/10.1017/s0140525x00003435>
- Stankovic M, Biedermann B, Hamamura T. Not all bilinguals are the same: A meta-analysis of the moral foreign language effect. *Brain Lang.* 2022 Apr;227:105082. doi: 10.1016/j.bandl.2022.105082. Epub 2022 Jan 28. PMID: 35093765.
- Strohminger, N., & Nichols, S. (2014). The essential moral self. *Cognition*, 131, 159–171. <http://dx.doi.org/10.1016/j.cognition.2013.12.005>.
- Strohminger, N., & Nichols, S. (2015). Neurodegeneration and identity. *Psychological Science*, 26, 1469–1479. <http://dx.doi.org/10.1177/0956797615592381>.
- Tversky, A., & Kahneman, D. (1974). Judgment under uncertainty: Heuristics and biases. *Science*, 185(4157), 1124–1131. <https://doi.org/10.1126/science.185.4157.1124>
- Winkel, H., Bhatt, D. (2020). The role of culture and language in moral decision-making. *Cult. Brain* 8, 207–225. <https://doi.org/10.1007/s40167-019-00085-y>
- Woumans, E., Van der Cruyssen, I., & Duyck, W. (2020). Crime and punishment: Morality judgment in a foreign language. *Journal of Experimental Psychology: General*, 149(8), 1597–1602. <https://doi.org/10.1037/xge0000736>
- Xing, A. (2021). Foreign Language Effect on Risk Preference: The Framing Effect, Loss Aversion, and Risk Aversion. *Journal of Behavioral and Experimental Economics*. 93. 101723. 10.1016/j.socec.2021.101723.

Zeelenberg, M. , Nelissen, R. , & Pieters, R. (2008). Emotion, motivation, and decision making: A feeling-is-for-doing approach In Plessner H., Betsch C., & Betsch T. (Eds.), *Intuition in judgment and decision making* (pp. 173–191). New York: Lawrence Erlbaum Associates.

Appendix A

Adapted version of the Tolerance for Ambiguity questionnaire (Herman et al., 2010, p. 64)

1. I avoid situations where people don't share my values. [Reverse Coded]
2. I would like to live in a foreign country for a while.
3. I like to surround myself with things that are familiar to me. [Reverse Coded]
4. The sooner we all acquire similar values and ideals the better. [Reverse Coded]
5. I can be comfortable with nearly all kinds of people.
6. If given a choice, I would visit a foreign country rather than vacation at home.
7. A good teacher is one who makes you think about/consider your way of looking at things.
8. A good job is one where what is to be done and how it is to be done are always clear. [Reverse Coded]
9. A person who leads an even, regular life in which few surprises or unexpected happenings arise really has a lot to be grateful for. [Reverse Coded]
10. What we are used to is always preferable to what is unfamiliar. [Reverse Coded]
11. I like parties where I know most of the people more than ones where all or most of the people are complete strangers. [Reverse Coded]

(1-strongly disagree, 2-disagree, 3-neither agree nor disagree, 4-agree, 5-strongly agree)

Questionnaire - Italian translation

1. Evito le situazioni in cui le persone non condividono i miei stessi valori. [Reverse Coded]
2. Vorrei vivere in un paese straniero per un po'.
3. Mi piace circondarmi di cose che mi sono familiari. [Reverse Coded]
4. Prima noi tutti acquisiamo valori e ideali simili, meglio è. [Reverse Coded]
5. Mi sento a mio agio praticamente con tutti, indipendentemente dalle loro idee, culture e religioni.
6. Potendo scegliere, farei le vacanze in un paese straniero piuttosto che nel mio.
7. Un buon insegnante è quello che ti fa riflettere sul modo di vedere le cose.
8. Un buon lavoro è quello in cui è sempre chiaro cosa va fatto e come va fatto. [Reverse Coded]
9. Una persona deve essere grata di avere una vita regolare, con poche sorprese e pochi avvenimenti inaspettati. [Reverse Coded]
10. Ciò che è conosciuto è preferibile a ciò che è sconosciuto. [Reverse Coded]
11. Mi piacciono le feste dove conosco già molte gente rispetto a quelle in cui non conosco nessuno. [Reverse Coded]

(1-molto in disaccordo, 2-in disaccordo, 3-indeciso, 4-d'accordo, 5-molto d'accordo)

Appendix B

Map of Italy with regions of interest highlighted in grey.

