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Creativity is a Toaster: Experimental Evidence on How Multilinguals Process Novel Metaphors

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Creativity is a toaster: Experimental evidence on how multilinguals process novel metaphors

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The study was conceived and designed by AWH, MB and KK, the data was collected and analyzed by AWH, the results were discussed and interpreted by AWH and MB. Finally, the paper was drafted by AWH (The Experiment, Results and analysis) and MB (Introduction, Theoretical Background, Discussion, Conclusion) and then edited by KK.

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Abstract

This paper investigates the connection between multilingual experience and creative metaphoric competence. Since multilingualism has been shown to bring cognitive advantages in creative thinking, this paper explores whether the ability to interpret creative metaphors differs in participants with less vs. more multilingual experience. The results of a self-paced reading study combined with a sensicality judgment showed that people with less vs. more multilingual experience process metaphors evaluated as being (1) less or (2) more creative quite similarly in terms of reading times; however, the groups differ significantly in their judgments of semantic sensicality for the (2) more creative metaphors. While in the case of less creative metaphors groups do not differ, in the case of more creative metaphors people with more multilingual experience are more likely to say that the metaphor makes sense. We interpret these findings as showing that people with more multilingual experience access the non-salient semantic features of the concepts compared in the metaphor with less effort and can employ richer semantic representations, which complements previous research on multilingualism and cognitive flexibility.

Introduction

Being a fluent bilingual or an eager foreign language learner brings many benefits (Diamond 2010), including the potential to create a wider network of social interactions, business opportunities and employment options, improve appreciation of other cultures and sensitivity towards them, and access services abroad that are not accessible to monolingual speakers (Antoniou 2019). In the past few decades, researchers have investigated behavioral and neurological factors relevant to the interaction between multilingualism and cognition, showing that multilingualism brings a range of cognitive advantages.

These cognitive advantages are mainly related to the simultaneous activation of both languages in the mind of a bilingual (Kroll et al. 2006; Bialystok 2011). The concurrent activation of both languages engages cognitive and neural systems that keep the brain of the bilingual speaker constantly active and well-trained throughout the life stages. Previous research suggests that bilinguals have increased activation (compared to monolinguals) in the brain region associated with cognitive skills like attention and inhibition (Del Maschio and Abutalebi 2019). The cognitive benefits of bi-/multilingualism are supported by empirical evidence collected in experiments with speakers of all ages, from infants (Antoniou et al. 2015) to elderly subjects (e.g. Bialystok et al. 2007). Empirical evidence shows that, when

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socio-cultural variables are controlled and cannot therefore confound the results (Bak 2016), bilingual advantages can be found in young children for executive functions (such as planning and decision-making), metalinguistic awareness, phonetic perception, cognitive flexibility, and creative thinking (see Antoniou (2019) for a literature review). Among the many cognitive benefits that correlate positively with bi-/multilingualism, it has been observed that speaking more than one language positively affects the ability to think creatively (Lee and Kim 2011). Creative thinking, in turn, is associated with cognitive flexibility, that is, the mental ability to activate different (and potentially distant) concepts at the same time and establish meaningful relations between them (see Khalil et al. (2019) for a review).

In the present study, we focus on a specific form of creative thinking: metaphorical thinking and the ability to judge novel metaphoric expressions to be sensible. Since any metaphor comprehension requires creating connections between two less or more distant concepts, the process is very similar to creative thinking in general, as it is often assumed that creativity is the act of creating new connections between existing ideas and concepts (Simonton 2008). According to Birdsell (2018b), interpretation of conventional and creative metaphors relies on different mechanisms and requires different knowledge. In interpretation of novel metaphors, creativity plays a very important role, while in case of conventional metaphors, vocabulary knowledge seems to be more important. Since creativity and flexible thinking are instrumental in understanding creative language, in this paper we investigate whether people with more multilingual experience are more flexible than people with less multilingual experience and therefore more capable of making sense of novel metaphoric expressions. This type of study can have important applications in the real world. In education, for example, eliciting interpretations of metaphors from multilingual speakers may be used as an entertaining task to practice the foreign language and train the creative thinking processes. Similarly, in language teaching, constructing and interpreting novel metaphors can be an engaging classroom activity to stimulate creative thinking in the target language while also developing the contingent cognitive flexibility.

Theoretical background

Multilingualism and creativity

Research on monolingual and bi-/multilingual speakers suggests that speaking more than one language enhances creativity, which can be broadly defined as the ability to come up with novel, yet appropriate solutions to a given problem, often diverging from conventional

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thought patterns (Kharkhurin 2009: 60, for a discussion on the definition of creativity see Runco and Jaeger (2012)). According to classic studies in creativity research, the new connections involved in the creative process may be established through cycles of divergent and convergent thinking processes (e.g. Guilford 1967). In particular, in the first phase of each cycle, creative thinkers generate as many responses as possible to a particular stimulus or problem, thus setting up a network of loose connections, commonly defined as divergent thinking. In the second phase, they constrain the range of options and eventually select a single solution, which represents the creative outcome of the convergent thinking process (Cropley 2006). Of these two processes, the first one (divergent thinking) is considered to vary greatly among speakers.¹

Among the theories concerning individual differences with respect to creative thinking, a consensus seems to be emerging that creative skills develop in response to social interactions and therefore exposure to a varied and rich environment may enhance creative potential within the individual (Glăveanu 2013; Dijk et al. 2019). This scenario naturally suggests that bilinguals who are exposed to a wider range of social, cultural, and linguistic experiences than monolinguals are on average more creative, a hypothesis that is indeed supported by empirical evidence (Leung and Chiu 2008; Lee and Kim 2011). In particular, Leung and Chiu investigated to what degree the extensiveness of multicultural experiences and openness to new experiences predicted undergraduates' performance on two measures of creative potential: (a) the generation of unusual uses of garbage bags and (b) the retrieval of non-prototypical or normatively inaccessible exemplars in the conceptual domain of occupation. Leung and Chiu tested sixty-five European American undergraduate students and found that having extensive multicultural experiences predicted better performance on both measures of creative potential. This result, however, was found only for participants who, based on the Openness to Experience scale used in their study, proved to be open to new experiences. Among those who scored low on the Openness scale, having more extensive multicultural experiences, a variable assessed through a Multicultural Experience Survey implemented by the authors, was associated with a lower level of creative potential. Since among low Openness participants having more exposure to other cultures was related to a lower level of creative potential, one might interpret these results as meaning that a rich multicultural environment is not a contributing factor to creative potential. The authors suggest that these results imply that people who do not live in a rich multicultural environment might be psychologically less accepting of new experiences, and therefore might be overwhelmed by new experiences and foreign cultures and actively resist them.

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Finally, the authors also acknowledge that the results of this study need to be complemented by further research to better understand the relationship between Openness and multicultural experiences and the impact they have on one's creative potential. In another study, Lee and Kim tested a sample of 116 Korean American students, who were preliminarily assessed in their language skills, and found that their creative potential was positively correlated with their degree of bilingualism.

Overall, as Dijk et al. (2019) describe in a detailed literature review on the interplay between bilingualism and creativity, in the empirical research in this field there seems to be a consensus that bilingualism boosts and develops creative thinking, which, according to several studies, is related to the role of executive functioning in creativity, a cognitive process that seems to be better developed in multilinguals in comparison to monolinguals (Hommel et al. 2011; Kharkhurin 2009; Lee and Kim 2011; Leikin and Tovli 2014).

Metaphor comprehension and creativity

Metaphoric competence is broadly defined as the ability to understand and use metaphors in a given language (Littlemore and Low 2006) and it is subject to considerable individual variability. A specific type of metaphoric competence is the ability to use and interpret creative metaphors (Birdsell 2018a). Distinguishing between conventional metaphoric competence and creative metaphoric competence is crucial since a large body of empirical literature shows that conventional and creative metaphors are processed in different ways. Conventional metaphors have been the main topic of research among scholars in cognitive linguistics, who embed their research within the Conceptual Metaphor Theory framework (Lakoff and Johnson 1980). According to this theoretical framework, metaphors are entrenched in the conceptual structures of the mind and their linguistic manifestations, commonly found in language, are processed subconsciously. For example, the English preposition *in* is often used metaphorically to indicate relations that are not strictly spatial: while a person can be literally *in a car*, where *in* indicates a spatial relation of containment, she can be metaphorically *in a difficult situation*, where *in* is used metaphorically to convey the idea that states of mind are physical locations.ⁱⁱ The study of such conventionalized metaphoric expressions is not very poignant for research on creativity. Nevertheless, it should be mentioned that even in the early work of Lakoff and Johnson (1980) and later Lakoff and Turner (1989), the authors develop a discussion on how creative metaphors may emerge, starting from conventional metaphoric expressions. This could be achieved by extending the boundaries of conventional conceptual metaphors to construct new mappings, by

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imaginatively implementing unused parts of conventional metaphors or even by combining conventional metaphors in new ways. For example, starting from the conventional metaphor to which we conceptualize states of mind as physical locations, one could create creative extensions such as in *she was in a difficult situation, but eventually she managed to climb out of it*.

Within a framework of classic Conceptual Metaphor Theory, metaphors are processed by means of comparison, that is, through the conceptual alignment and comparison of the two conceptual domains involved. However, Glucksberg and colleagues (Glucksberg and Keysar 1993; Glucksberg 2003) challenged this comparison view, suggesting that metaphors are typically processed by means of semantic categorization. In their view, metaphors establish class-inclusion relations between two distant concepts, and are interpreted when listeners identify a higher (i.e. more generic) conceptual category to which both metaphor terms belong. The categorization view of metaphor comprehension is traditionally seen at odds with the comparison view proposed by the Conceptual Metaphor Theory.

To reconcile the two views, the Career of Metaphor Theory (Bowdle and Gentner 2005) suggested that the life of metaphors tends to progress along a continuum that goes from novel to increasingly conventionalized in language use. This career is characterized by a change in the way such expressions are processed in the mind. While novel metaphors tend to be processed by means of cross-domain comparisons, as they lose their novelty and become increasingly more frequent and common in language, they tend to be processed by categorization. These two different processing strategies have also been correlated with different reaction times reported for the processing of (respectively) novel and conventional metaphors, with the latter being processed faster than the former. In other words, creative metaphors take more time and effort to be interpreted, compared to conventional metaphors. For example, Gentner and Wolff (1997) compared two types of processing strategies, that is by abstraction (or categorization) and by alignment (or comparison). The empirical results show a pattern that the authors interpret as suggesting a shift in processing, related to metaphor conventionalization: while novel metaphors may be understood by alignment, which is a more cognitively demanding strategy, conventional metaphors may be understood by abstraction, a less cognitively demanding strategy. This shows how creative metaphors require more effort than conventional metaphors, as well as an entirely different strategy of interpretation. Other experimental studies, using more complex methodologies like EEG, confirm these results, showing that processing creative metaphors involves different neural mechanisms than conventional metaphor processing. For instance, Lai et. al (2009) compared

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processing of anomalous, novel metaphorical, conventional metaphorical and literal sentences. Their results show that at an earlier processing stage anomalous, novel and conventional metaphorical sentences are more effortful than literal sentences; however, at a later processing window, conventional metaphorical sentences resemble the processing of literal sentences, while novel, i.e. creative metaphors, resemble the processing of anomalous sentences. This suggests, similarly to what was shown above, that processes required to interpret creative metaphors differ from the processes involved in interpretation of conventional metaphorical expressions.

Birdsell (2018b) agrees that interpretation of conventional and creative metaphors differs and suggests that conventional metaphor interpretation requires vocabulary knowledge in addition to sociolinguistic and cultural knowledge in a given language, while interpreting creative metaphors requires skills that are often associated with creativity in general, such as combinatorial ability (Ward et al. 1999) or analogical reasoning (Paivio and Walsh 1993; Gentner et al. 2001; Kintsch 2008). Birdsell further suggests that production of creative metaphors involves an ability that includes different creative strategies: conceptual wandering, that is, the ability to conceptually deviate from usual standard associations, and novelty seeking, that is, a desire to discover the unique and unfamiliar. While Birdsell focuses on the production of creative metaphors, one might expect similar creative abilities to possibly play an important role in comprehension of creative metaphors as well.

The current study

The current study aims to investigate the interplay between multilingualism and creative metaphoric competence. In particular, we hypothesize that if speaking more than one language has been shown to bring cognitive advantages, including an increase in creative thinking potential and the ability to construct new creative associations, then people with more multilingual experience can be expected to outperform people with less multilingual experience in their ability to interpret and judge highly creative metaphors to be sensible.

We aim to investigate:

1. Are there differences in reading times for novel metaphors between speakers with less vs. more multilingual experience?
2. Are there differences in judgments of sensibility in novel metaphors of varying degrees of comprehensibility/ease of interpretation between speakers with less vs. more multilingual experience?

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We hypothesize that people with less multilingual experience will exhibit more difficulties (slower reaction times and negative judgement of sensicality) with novel metaphors in general, particularly with the ones that are hard to interpret.

Previous research has typically focused on the production of novel metaphors in native and non-native speakers (e.g. Nacey 2013; Littlemore et al. 2012; 2014; Wang and Cheng 2016) and on the ability of language learners to comprehend conventional metaphoric expressions in the target language (Hoang (2014) for a literature review), but not on the degree of flexibility in people with varying degrees of multilingual experience that allows them to judge novel metaphoric expressions to be sensible.

The results of our investigation shed light on an original form of cognitive flexibility that characterizes the widely-acknowledged multilingualism advantage: the ability to judge highly creative metaphors to be sensible.

The experiment

This experiment investigates whether low comprehensibility and ease of interpretation affect comprehension and acceptability of novel metaphorical expressions in people with less vs. more multilingual experience. The experiment was a self-paced reading study combined with a sensicality judgment. Reading times at different regions and answers to the sensicality judgment were recorded.

Stimuli

The stimuli used were 32 A is B metaphors (see Table 1) from Katz et al. (1988). This set was used because it includes already normed data and the norming results were recently successfully replicated (Campbell and Raney 2016). The metaphors were chosen from the nonliterary set of metaphors provided by Katz et al. Their nonliterary set of metaphors consists mainly of novel metaphors constructed by two of the authors (Katz and Marschark). All metaphors were judged interpretable by the same two authors and metaphors that were common and possibly familiar to participants were avoided.

The aim of this experiment was to compare processing difficulty for two conditions: metaphors that are easy and metaphors that are difficult to interpret. Therefore, in the easy condition (N=16) we used metaphors with values for comprehensibility (*How easily are you able to comprehend the sentence?*) and ease of interpretation (*How easily can you interpret the meaning of the sentence?*) that are above 5 (out of 7), and in the hard condition we used metaphors (N=16) with values below 4. In the easy condition, the mean value for

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comprehensibility was 5.87, while the ease of interpretation was 5.95. In the hard condition the mean value for comprehensibility was 3.47, while the ease of interpretation was 3.47. The difference for both comprehensibility ($t=14.23$, $p < .001$) and ease of interpretation ($t=15.21$, $p < .001$) was significant between the conditions.ⁱⁱⁱ

[TABLE 1 NEAR HERE]

Since the methodology used in this experiment was self-paced reading, we wanted to be able to record reading times both at the end of the metaphor and at the words following it. For this reason, after the metaphors created by Katz et al., we have added an additional *and* phrase right after the metaphor, which consists of two adjectives that explain the metaphor. The adjectives we added were controlled for length, frequency (CELEX, Francis Kučera, BNC) and imageability. There were no significant differences for any of the measures between the two conditions (see Table 2).

[TABLE 2 NEAR HERE]

Even though we used Katz et al.'s metaphors, we considered lexical measures for single words from these metaphors to check whether some other lexical factors, other than difficulty of comprehensibility and interpretation might interfere with the processing times. There were no significant differences in any of the lexical measures between the conditions for the word A and word B from the A is B metaphors (see Table 3).

[TABLE 3 NEAR HERE]

The stimuli included filler sentences as well. There were 94 filler sentences, half of the filler sentences made sense and half did not. Altogether, each participant saw 126 sentences. See Table 4 for examples of filler sentences.

[TABLE 4 NEAR HERE]

Participants

General characteristics

All 48 participants were native speakers of English, aged 18 to 55, recruited in Oxford, UK, right-handed, with normal to corrected-to-normal vision, and no known language,

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neurological and hearing disorders. The participants were divided into two groups: native speakers of English with less multilingual experience (N=24), and native speakers of English with more multilingual experience (N=24).

Classifying bilinguals and multilinguals

Here we want to briefly acknowledge the rationale behind our classification of the experimental groups. The literature on who qualifies as a bi-/multilingual is vast and confounding. For instance, Wei (2000: 4-5) shows that there exists a variety of terms that have been used to describe bilinguals, such as, *achieved bilingual*, *consecutive bilingual*, *maximal bilingual*, *subtractive bilingual* etc. which implies that it is difficult to cover all the defining characteristics of bilinguals in a single term. Furthermore, Baker and Prys Jones (1998: 2) emphasize that there are several questions one needs to address when defining a bilingual, among which are: *should bilingualism be measured by how fluent people are in two languages*, *should bilinguals be only those people who have equal competence in both languages*, *is language proficiency the only criterion for assessing bilingualism*, or *should the use of two languages also be considered* etc. These and other questions are usually at issue in the literature discussing the definition of bilingualism. Even though these particular proposals investigate bilingualism, these issues and questions are also pertinent to the study of multilingualism.

Edwards (2013) notes that approaches to bilingualism/multilingualism used to be more restrictive, as in the case of Bloomfield (1933) and Weinreich (1953), who consider the term bilingual to refer to individuals who achieved native fluency in two languages. Edwards points out that both restrictive and less restrictive definitions have their flaws and that any classification must be definable. However, he also acknowledges many confounding factors in determining bilingualism, such as attitude, age, gender, intelligence, memory, inter-linguistic distance, and context of testing. Butler (2013) also acknowledges complexities of defining monolingualism, bilingualism and multilingualism. Butler points out that nowadays most researchers use broad definitions, such as Grosjean (2010: 4) who classifies bilinguals as ‘those people who need and use two or more languages (or dialects) in their everyday lives’, or Valdés and Figueroa (1994: 8), who define a bilingual as ‘an individual [who] possesses more than one language competence’. Butler claims that while these broad definitions have their advantages, especially with respect to studying SLA within the scope of bilingualism, the problem lies in the fact that these definitions usually consider multilingualism and bilingualism to be the same, while it has been shown in research that

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there are both differences and similarities between bilingual and multilingual acquisition (Aronin and Hufeisen 2009; De Angelis 2007; Hoffmann 2001; Jessner 2008). Baker (2001) says that these more restrictive traditional definitions of bilingualism could fall under the label of *maximalist bilingualism* (Baker 2001: 11), while *minimalist bilingualism* would allow anyone with minimal competence in two languages to be labeled a bilingual. However, Baker claims that the different definitions might have to differ with respect to their purpose, but one must be careful to form them along the competence dimensions.

Therefore, based on these discussions, we would like to acknowledge here that forming two groups of experimental participants is a highly complex task and has many challenges. One of the big challenges in European countries is finding a true minimalist monolingual person who has only ever been exposed to one language. In the environment where we recruited our participants, who were mainly Oxford University undergraduate and graduate students, it is very difficult to find anyone who has not been exposed to at least one other language, in addition to English, in their pre-university education. For this reason, the minimalist view of a bilingual/multilingual person was not possible in our case. Through the language questionnaires that our participants filled in, it was evident that the language biographies of our participants were complex and vary greatly. While the participants self-reported to be either monolingual or multilingual, from the language questionnaires it was visible that the monolingual group consists mainly of monocultural participants with minimal exposure to another language other than English, and that the multilingual group consists largely (though not entirely) of multicultural participants with high and often continuous exposure to another language other than English. Taking all this into account, it was difficult to assume either a minimalist or a maximalist point of view, since a second language seemed to be present in most participants' language biographies. Therefore, we employ a broader and less strict classification of the two experimental groups and label our experimental groups as groups with less vs. more multilingual experience.

Language questionnaires

To collect information about participants' language biographies, we administered a language questionnaire before the self-reading experiment. The questionnaire was constructed and adapted according to the questionnaire used in Laura Sabourin's ERPLing Lab at the University of Ottawa (Sabourin et al. 2016). The following information was collected for the two groups.

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All 24 participants from the group with less multilingual experience self-identified as monolingual native speakers of English. In this group the average age was 22 (min 18, max 46), and there were 5 male and 19 female participants. All participants identified English as their only native language, and all the participants reported that their parents' native language was also English. Four participants identified their strongest L2 to be at an intermediate level, while all the others claimed that their strongest L2 was at a very low or low level. Average age of acquisition of their strongest L2 was 10.5 years old, and average daily use of their strongest L2 was 0.2 hours a day. The average number of languages that this group reported having knowledge of in addition to English was 1.9.

All 24 participants from group with more multilingual experience self-identified as being native speakers of English and being able to speak another language fluently. The average age of was 28 (min 19, max 52), and there were 5 male and 19 female participants. All participants identified English as one of their native languages, while 10 participants identified another language in addition to English to also be their native language. In this group, 14 participants reported having either one or both parents whose native language was not English or who were multilingual. All participants except one identified their strongest L2 (or in some cases their second L1) as currently being at either advanced, near-native or native level. One participant identified as having two native languages while marking one of their native languages as currently being at an intermediate level. Average age of acquisition of their strongest L2 was 5.5 years old, and average daily use of their strongest L2 was 2.1 hours a day. The average number of languages this group reported having knowledge of in addition to English was 3.1.

Procedure

The experiment was conducted in a soundproof room using the Presentation® software, and the sentences were shown on the screen of a Dell Latitude 7480 laptop. The participants used a Logitech Gamepad F310 joystick to read through the sentences, with the A button to move from the word they read, and with the LB button for NO and RB button for YES.

The self-paced reading experiment lasted about 10 - 15 minutes, depending on the participants' speed. The participants were given the following instructions: *The words will appear one by one, as you press the button A. This means that you are controlling the reading pace. After every read word, press A to see the next word. Continue with this until the end of the sentence. After that, a question will appear on the screen: Does this sentence*

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make sense? You will have to say YES or NO. The participants' task was to read the sentences word by word at their own pace and answer the sensicality judgment at the end.

All participants saw the same stimuli. Before the experimental trials, participants performed a practice test which consisted of 1 block of 12 trials. The experimental trial consisted of 9 blocks of 14 trials. In between blocks, the participants saw a countdown (from 5 to 1) followed by a fixation cross on the screen where they could take a break if they needed to.

Results and analysis

Analysis methods

The analysis was done on self-paced reading times of the two groups of participants: native English speakers with less vs. more multilingual experience. There were two critical conditions, that we here call hard and easy, meaning novel metaphorical expressions that are more difficult to comprehend and interpret (hard), and less difficult to comprehend and interpret (easy).

There were six sentence regions (Table 5). In our analysis, we report on Region Met (end of metaphorical expression), Region SO (spill over from the end of metaphorical expression), Region End (end of sentence). We also analysed the time (Answer RT) it took to answer the question *Does this sentence make sense?*, as well as the answers to the question (YES/NO). Regions 1, 2 and 5 were not analysed.

[TABLE 5 NEAR HERE]

Reading times outside ± 2 standard deviations from the mean were excluded as outliers, as well as reading times below 200 ms and above 2000 ms. We also excluded responses where no answer button was pressed (for Answer RT). This resulted in 6.12% data exclusion in Region Met, 4.82% in Region SO, 9.44% in region End and 10.09% in Answer RT. We used the statistical software JMP (SAS, 2012) to do a two-way factorial analysis of variance (ANOVA), with main effects of Condition and Group, and interaction between Condition and Group. All fillers were also excluded from the analysis.

Results

In Region Met, there was a significant main effect of Group ($F=7.15$, $p=.008^*$), such that the group with less multilingual experience took more time to read the region. The main effect of

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Condition and the interaction between Group and Condition were not significant. In Region SO there were no significant main effects, and the interaction between the Group and Condition was not significant. In Region End, there was a significant main effect for both Condition ($F=6.99$, $p=.008^*$) and Group ($F=7.7$, $p=.006^*$), such that the group with more multilingual experience took more time to read the word, and such that the hard condition took more time. The interaction between Group and Condition was not significant. In Answer RT region, there was a significant main effect for both Condition ($F=8.07$, $p<.0001^*$) and Group ($F=16.67$, $p<.0001^*$), such that the group with less multilingual experience took more time to press the button YES/NO, and such that it took more time to press the button in the hard condition. The interaction between Group and Condition was not significant.^{iv} For the summary of reaction times across regions see Table 6 and Figure 1, and for the summary of analysis see Table 7.

[TABLE 6 NEAR HERE]

[FIGURE 1 NEAR HERE]

[TABLE 7 NEAR HERE]

We also conducted a Pearson Chi Square test to examine the answers (yes/no responses) to the sensicality question. The test was done by group and by condition. The by group test gives insight into the relationship between the condition and the answer for the two groups, i.e. with less vs. more multilingual experience. On the other hand, the by the condition test gives insight into the relationship between the group and the answer for the two conditions, i.e. easy and hard.

In the group with less multilingual experience, the Pearson Chi Square test shows that there is a significant relationship between the condition and the answer. In the hard condition, it was significantly more likely that the answer would be NO, than in the easy condition, with $\chi^2(1, N=752) = 45.23$, $p <.0001$. In the group with more multilingual experience, the Pearson Chi Square test shows that there is a significant relationship between the condition and the answer. In the hard condition, it was significantly more likely that the answer would be NO than in the easy condition, with $\chi^2(1, N=754) = 10.94$, $p = .0009$. For the summary of results across groups see Figure 2.

[FIGURE 2A NEAR HERE]

[FIGURE 2B NEAR HERE]

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In the easy condition, the Pearson Chi Square test shows that there is no significant relationship between the group and the answer. This means that the probability of answer NO is not different across groups in the easy condition, with $\chi^2(1, N=752) = 2.81, p = .09$. In the hard condition, the Pearson Chi Square test shows that there is a significant relationship between the group and the answer. For the group with less multilingual experience, it was significantly more likely that the answer will be NO in the hard condition than for the group with more multilingual experience, with $\chi^2(1, N=754) = 26.63, p < .0001^*$. For the summary of results across conditions see Figure 3.

[FIGURE 3A NEAR HERE]

[FIGURE 3B NEAR HERE]

Discussion

In this study we investigated comprehension of novel metaphors in populations with less vs. more multilingual experience. We also examined whether people with more multilingual experience are more capable than people with less multilingual experience of making sense of highly novel and creative metaphors. To test our hypothesis, we performed a self-paced reading experiment combined with a sensicality judgment. Participants had to skip words using a computer keyboard, to read a series of creative metaphors that varied in their levels of creativity (defined as 'easy' and 'hard' metaphors, respectively). Reading times at different regions and answers to the sensicality judgment were recorded.

Our results showed that on average, both groups process easy and hard metaphors quite similarly in terms of reading times, with no significant interaction between Group and Condition in any of the regions. This result suggests that there is no evidence that having less or more multilingual experience affects reading times across the two conditions: easy and hard metaphors are processed alike by people with less vs. more multilingual experience. However, we found a significant main effect of Group and Condition in some specific critical regions, which indicate some interesting differences between how people with less vs. more multilingual experience process novel metaphors. In Region Met, it takes significantly more time for the group with less multilingual experience to read the end of the metaphor, compared to the group with more multilingual experience. This indicates that the group with less multilingual experience takes more time to think about unfamiliar metaphors, suggesting that they behave differently to the group with more multilingual experience when confronted

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with more creative forms of language. Moreover, we observed processing differences in the two final critical regions, in both of which the hard condition takes longer to read. This is in line with offline measures collected by Katz et al. (1988) since all the metaphors used in the hard condition had very low comprehension and interpretability measures, and it is therefore to be expected that they will take longer to read. When it comes to the main effect of Group, it seems that both groups pause at the end, but while the group with more multilingual experience does so at the final word, the group with less multilingual experience takes more time to press the button.

The answers to the sensicality judgment '*Does this sentence make sense?*' show that in both groups there is a greater probability that they will answer NO in the hard than in the easy condition. In particular, however, while both groups tend to respond that easy metaphors make sense, the group with less multilingual experience is more likely to respond that hard metaphors are meaningless compared to the group with more multilingual experience. It is therefore on the hard condition (i.e. on those metaphors that are perceived to be more difficult to comprehend, according to the norming values collected by Katz et al.) that people with more multilingual experience tend to be more flexible than people with less multilingual experience.

The results show that groups with less vs. more multilingual experience differ significantly in the way they perceive hard metaphors to be loaded with meaning. The difference between hard and easy metaphors that we used to operationalize the two conditions is based on ratings elicited from speakers and collected by Katz and colleagues (1988). Such difference is therefore data-driven, based on speakers' judgments and derived in a bottom-up manner, rather than being motivated by a theory in a top-down manner. The bottom-up approach adopted in the present study does not allow us to easily distinguish between semantically different types of expressions, but nonetheless some differences can be observed between the two conditions operationalized in this study. Easy metaphors, in particular, appear to be statements in which the two compared terms designate concepts that share salient properties. For example, when we think about beaches and grills, properties such as high temperature and heat immediately come to mind even when each of these concepts is taken in isolation. The construction of a metaphorical equivalence between the two, as in *beaches are grills* (which is one of the stimuli examples in the easy condition) is therefore easily interpretable because the metaphorical similarity between the two terms is constructed on the basis of semantic features that are highly salient for both concepts. Similarly, in *a kangaroo is a yo-yo*, arguably the vertical movement associated with each of

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these two referents (the jumping kangaroo and the rolling yo-yo) is a very salient property of both concepts, on which the metaphor is constructed and on the basis of which it is perceived to be easy because the shared properties are easily accessible to the reader. The same applies to the two referents in *the mind is a sponge* (which share the salient property of absorbing and retaining) and in *anger is a blizzard* (which are both difficult to control and can have violent outbursts). Conversely, metaphors in the hard condition are based on equivalences between entities that do not share salient properties. For instance, in *silence is an apron* there is no shared salient property between the two concepts: silence may be associated with quiet time, relaxation, or emptiness and isolation and so on, while apron may be typically associated with cooking or cleaning and with clothing in general. The salient properties of each of the two concepts do not overlap, and therefore the metaphor is perceived to be hard to comprehend and hard to interpret. Similarly, in *money is penicillin*, the first entity is typically associated with spending, buying, and other concepts related to financial transactions, while penicillin is associated with entities within the medical domain. In *creativity is a toaster*, the divergent thinking that generates creative ideas shares no salient properties with a toaster, used to make bread warm, crispy and brown. Nonetheless, the more these equivalences sink in, the more likely it is that a viable metaphorical interpretation will emerge as the reader starts to navigate not only the salient properties associated with each concept, but also the less salient and more latent ones. For example, creativity may be seen as a process thanks to which an idea is processed and, as a result, becomes crispier, tastier and overall better, like toasted bread. Similarly, money can be seen as something that ‘heals’ some types of diseases, and thus be compared to penicillin. Finally, silence can be used to protect, cover and not disclose important information, much as aprons are used to protect clothes from dirt. This interpretation of what makes a metaphor easy or hard to comprehend, based on the salience of the features of each of the two metaphor terms, is in line with the *aptness view* of metaphor processing, in which *aptness* can be defined as the perception of how well can a source (metaphor vehicle) cover salient features of the target. Apt metaphors cover well salient features, and therefore are easier to process, compared to less apt metaphors (Glucksberg and Haught 2006a, 2006b; Jones and Estes 2006).

However, there might be limitations in interpreting these results and distinguishing between qualitatively different types of metaphors that can be found in the sample of ‘easy’ metaphors and in the sample of ‘hard’ metaphors, respectively. In other words, it is difficult to describe with greater detail and in relation to existing theories of metaphor, what types of metaphors are perceived to be different in terms of meaningfulness, when processed by

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people with less or more multilingual experience. A different experimental design, implemented in a top-down manner, where stimuli are drafted ad-hoc to fit into specific classifications of metaphor types, can in this sense complement our findings. In a very recent study, Authors et al. (in prep.) took a top-down approach to investigate research questions similar to those that are addressed in this article. In the study conducted by Authors et al., we preliminarily distinguished between literal expressions (e.g. *a simple idea*), familiar and frequently-used expressions based on conventional metaphors (e.g. *a bright idea*), creative extensions of conventional metaphors (e.g. *a grey idea*), and finally, creative expressions based on novel conceptual metaphors (e.g. *a damp idea*). In general, it was found that the people with more multilingual experience took more time to read the last word in the sentences, compared to people with less multilingual experience, suggesting that they use more effort to find an interpretation of the given metaphors, rather than quickly dismissing them. Finally, looking at the sensicality judgment provided at the end of the task, there was a significant difference in the degree to which people with less vs. more multilingual experience perceive creative extensions and novel metaphors to be meaningful, with people with more multilingual experience being more open toward perceiving these statements as meaningful than people with less multilingual experience. The results of Authors et al., in line with the findings of the present study, suggests that people with more multilingual experience are more tolerant in allowing unusual metaphors to be meaningful.

Finally, being multilingual is often tightly connected to being multicultural. Interestingly, research shows that like multilingualism, multiculturalism enhances cognitive flexibility (Antonio et al. 2004; Cheng et al. 2008; Leung et al. 2008; Maddux and Galinsky 2009; Storme et al. 2017; Çelik et al. 2016, etc.). For instance, Maddux and Galinsky (2009) show, through a series of studies, that living abroad correlates positively with creativity, while Çelik et al. (2016) show that being exposed to value diversity and cultural thinking had a positive effect on divergent thinking. In case of our participants, in the group of participants with more multilingual experience 10 participants reported as having another native language in addition to English, and 14 participants reported having one or both parents whose native language was not English. This means that the majority of this group grew up in a multicultural environment, and therefore, their multicultural background could also have an effect on their creativity and cognitive flexibility. While multiculturalism and multilingualism are strongly correlated, they cannot be equated, as a person who is multilingual does not have to be exposed to a multicultural experience. Some researchers, such as Leung et al. (2008), view bilingualism as one of the aspects of interactions with foreign cultures. Therefore, since

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it is the case that the group with more multilingual experience is also the group with more multicultural experience, we acknowledge that participants' cultural identity and experience might also have affected the participants' creativity, but it is not our intention to explore deeper the possible differences between these two effects in this paper.

When speaking of different multilingual/multicultural experiences, it is important to mention the literature focusing on English as Lingua Franca (ELF) which bears additional support to the results of this study. For instance, Leung and Jenkins (2020) state that ELF communication is considerably more flexible than monolingual communication: speakers use the language with respect to their needs, often using different languages for different purposes, and therefore, exhibiting creativity and flexibility that is not usually found in a monolingual/monocultural environment. Interestingly, while speakers do not intend to be innovative, they do so in context, to fulfil their communicative needs (Pitzl 2012). In particular, Pitzl (2012; 2016) shows that when it comes to figurative language use, ELF speakers regularly use metaphorical language in both conventional and non-conventional ways, and that their novel use of non-conforming figurative language might even bring about linguistic change. Pitzl emphasizes that, in case of ELF speakers, creative use of metaphoric language has a real communicational value and purpose.

To sum up, the difference observed between groups with less vs. more multilingual experience in processing hard metaphors could be explained in terms of different degrees of ability to access non-salient features of specific concepts. Within the limited time that participants dedicated to answering the sensibility judgment, it appears that people with more multilingual experience were more capable than people with less multilingual experience of accessing the non-salient features of the entities compared in the metaphor thereby making sense of the metaphor. The cognitive advantage of multilingualism that is usually interpreted in terms of general cognitive flexibility could be further explained as the ability to quickly and easily retrieve more information (compared to the group with less multilingual experience) about given concepts, and therefore being able to draw on richer semantic representations. If this is the case, the advantage people with more multilingual experience have over people with less multilingual experience could be applied in various fields, to address real-world issues. For example, being able to rely on richer semantic representations of word meaning may enable people with more multilingual experience to be better than people with less multilingual experience at performing tasks such as devising creative campaigns to promote products, ideas, social measures and political messaging, generating creative solutions to architectural problems in urban planning, and imagining products in

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industrial design settings. Whether or not these tasks involve sophisticated linguistic skills, they all draw creatively on conceptual combinations and integrations. Further research is necessary to establish to what extent the richer representations multilinguals have access to also offer an advantage in solving extra-linguistic tasks.

Conclusion

The empirical literature on cognitive and pragmatic benefits of multilingualism supports the view that multilingual speakers show enhanced cognitive flexibility by comparison with monolinguals. In the study presented in this paper, we focused on a specific application of this flexibility, that is, the ability of people with less vs. more multilingual experience to judge highly creative metaphoric expressions to be sensible.

A further conclusion that may be drawn from the findings presented in this paper is that multilingualism, and consequently the study of at least one language beyond the first language, has high value and should be a priority in policy making especially in societies that perceive themselves as monolingual. Empirical research suggests that multilingualism and multiculturalism, which is the norm rather than the exception in the world, knowledge and use of more than one language has benefits for the wealth, the health, and broadly speaking the intelligence of our societies.

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ⁱ The degree of divergent creative thinking is measured by means of ad-hoc designed tests, such as the Torrance Test of Creative Thinking (TTCT, Torrance, 1998) and the Abbreviated Torrance Test for Adults (ATTA, Goff and Torrance, 2002). In these tests participants are asked to establish as many connections as they can in a limited amount of time, in response to a given task, e.g. listing all possible creative uses of a brick. Results of divergent thinking tasks are usually evaluated on different criteria, which include the number of responses (fluency), the number of different categories being used (flexibility), the degree to which the responses differ from the standard (originality), and the amount of detail (elaboration).

ⁱⁱ Note that conceptual metaphors and conventional metaphorical expressions are different concepts. A conceptual metaphor refers to understanding one conceptual domain in terms of another on a conceptual level, e.g. MIND is a CONTAINER. A conventional metaphorical expression is a linguistic manifestation of a conceptual metaphor, e.g. *to keep something in the back of the mind*.

ⁱⁱⁱ Due to the nature of these sentences, other categories of measures that Katz et al. collected are also significantly different between conditions (e.g. Degree of Metaphoricity, Metaphor Goodness, Felt Familiarity, Number of Alternative Interpretations). This is due to the fact that none of these measures are independent of each other. We acknowledge this; however, we base our condition groups based on the criteria set out above.

^{iv} The raw results file is available at this link:

https://osf.io/8dsp7/?view_only=d8c7122f9ee047a6aa83685ed5c8fca2