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Absolute Spatial Frames of Reference in Bilingual Speakers of Endangered Ryukyuan Languages: An Assessment via a Novel Gesture Elicitation Paradigm

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Abstract

We experimentally investigate, by means of a novel gesture-elicitation paradigm, the spontaneous spatial frames of reference (FoRs) used by bilingual individuals who speak Japanese (which has been labeled as a “relative” language) and one of the endangered Ryukyuan languages (Miyako or Shiraho) whose speakers have been reported to routinely use absolute FoRs. How would these last elderly bilingual speakers spontaneously resolve the clashing FoRs the two languages they speak bring forth? We find that despite the fact that Japanese and these Ryukyuan languages have full corresponding grammatical and lexical resources for expressing both, relative and absolute FoR, Ryukyuan speakers tend to markedly prefer the latter gesturally. Methodologically, the results, which are consistent with data obtained with standard FoRs methods, corroborate the reliability of the novel gesture elicitation task, which adds to the battery of techniques for studying FoRs a method that assesses effortless spontaneous real-time cognition with high ecologically validity.

Keywords: spatial construals; gesture; absolute frames of reference; linguistic relativity hypothesis, bilingual; endangered languages; Miyako, Shiraho, Japanese, Japonic languages; Ryukyu islands; elderly participants

Introduction

The study of spatial frames of reference (FoRs) (Levinson, 2003) has received significant attention in the last 20 years. While speakers of some languages have been found to prefer relative FoRs (i.e., egocentric; e.g. ‘left’ and ‘right’) to describe or reason about spatial relations among tabletop objects, speakers of others prefer absolute FoRs (i.e., allocentric; e.g. ‘north’, ‘south’) (Gumperz & Levinson, 1996; Levinson and Wilkins, 2006). A common interpretation of these results has been that it is language that plays a significant role in structuring the cognition of fundamental domains like space (Majid, Bowerman, Kita, Haun, and Levinson, 2004) —the core of the linguistic relativity hypothesis (Gumperz and Levinson, 1991; Lucy, 1992). This proposal, however, is largely based on the implicit assumption that the human mind is fundamentally

monolingual, an assumption that doesn’t seem to hold as bi- and multi-linguism have been ubiquitous throughout the history of humanity (Evans, 2011; Pavlenko, 2014). In fact, scholars investigating the linguistic relativity hypothesis have explicitly asked themselves “What are the cognitive consequences of being a bilingual in languages that rely on different frames of reference?” (Majid et al., 2004, p. 113), but no clear answer has been proposed so far, and no significant efforts seem to have been spent in order to address the question properly. Indeed, following the linguistic relativity hypothesis, bilingual individuals who fluently speak languages from the same linguistic family, and which are equipped with exactly the same relevant linguistic resources should not exhibit any marked preference in using relative or absolute FoRs. Here we ask, do fully bilingual individuals who speak such languages spontaneously exhibit any preferences when the linguistic practices of these languages elicit clashing absolute-relative frames of reference?

The last bilingual speakers of endangered languages spoken in the Ryukyus (the chain of islands stretching between Taiwan to Kyushu, Japan) provide a particularly interesting population for addressing this question. The Ryukyuan languages Miyako and Shiraho, are, for instance structurally equivalent to Japanese with respect to lexical spatial encodings. The three languages—all members of the Japonic family—have precise words for left and right, front and back, north and south, etc. (see Table 1), often even sharing cognate words (i.e., sharing the same original root, like “left” and “right” from proto-Japonic **pidari* and **migiri*, respectively). However, while speakers of Japanese have been reported to clearly prefer relative FoRs (Pederson, Danziger, Wilkins, Levinson, Kita, and Senft, 1998), ethnographic descriptions (Suzuki, 1978) as well as empirical psycho-linguistic studies (Celik, Takubo, and Núñez, 2019) have reported that speakers of Ryukyuan languages commonly rely on absolute FoRs. Interestingly, the preference of absolute FoRs of these individuals takes place despite being themselves fluent Japanese-bilinguals, and having been schooled and enculturated into the

mainland Japanese culture for most, if not all of their long lives (Japanese elementary school has been implemented in the Ryukyu islands since the end of 19th century, and there has been an overwhelming presence of mainland Japanese culture in TV and radio for decades).

Table 1: Spatial terms in Japanese, Miyako, and Shiraho

FoR	Translation	Japanese	Miyako	Shiraho
Absolute	east	higashi	agan	anta
	west	nishi	in	inta
	south	minami	pai	penta
	north	kita	nisi	nifanta
Relative	right	migi	ngi	neeri
	left	hidari	pidan	pitare
Intrinsic/ Relative	side	yoko	juku	jagata/aza
	front	mae	mavkjaa	menta
	behind/back	ushiro	teibi, kusi	finta
	straight	massugu	massigu	menga
Intrinsic	be aligned	narab-	narab-	narab-

In this study, we experimentally investigate the spatial FoRs used spontaneously by bilingual Ryukyuan speakers (Miyako-Japanese or Shiraho-Japanese) and by monolingual speakers of standard Japanese from Tokyo. Endangered languages such as the Ryukyuan languages, however, are primarily spoken by elderly people, who are often challenged by problem-solving, reasoning, and memory tasks (Brinley, Jovick, and McLaughlin, 1974) such as the ones used in standard FoRs studies (e.g., “Animals-in-a-row” task (Pederson et al., 1998) or complex arrays of toys (Haun, Rapold, Janzen, and Levinson, 2011)). For this reason, we focus here on spontaneous cognition by means of a novel gesture elicitation paradigm that, while being ecologically valid, adequately assesses effortless spontaneous cognition (McNeill, 1992; Bates and Dick, 2002; Kendon, 2004; Goldin-Meadow, 2005) and can readily be implemented in cross-cultural field studies (Núñez and Sweetser, 2006; Le Guen, 2011; Núñez and Cornejo, 2012; Núñez, Cooperrider, Doan, and Wassmann, 2012; Cooperrider, Slotta, and Núñez, 2018).

Method

Fieldwork locations

The fieldwork took place in the southern part of the Ryukyu islands, where the languages we investigate in this study (Miyako and Shiraho) are spoken. The southern Ryukyus are approximately 1,900 kms southwest from Tokyo, located on the western end of nowadays Okinawa prefecture, Japan. Two sites were involved. The Miyako site was primarily situated in the main island of the Miyako archipelago (total population 54,863 in 2005, Miyakojima shishi hensan iinkai, 2012), which are composed of 7 inhabited islands: Ikema, Irabu, Miyako, Ogami, Kurima,

grouped into the city of Miyako, and Tarama, Minna, grouped into the village of Tarama. The Shiraho site was located in the village of Shiraho (population 1,602 in 2010, Ishigakishi kikaku-bu kikaku seisaku-ka, 2013), along the southwestern shores of the Ishigaki island, one of the many islands belonging to the Yaeyama archipelago. This village is the only place where the Shiraho language is spoken. Both Miyako and Yaeyama islands got integrated into the Ryukyu kingdom at the beginning of the 16th century and were ruled and administered by the Ryukyu Kingdom until the Meiji era (1868-1912), before becoming part of Okinawa prefecture (Miyagi, 1968). Both fieldwork sites are located in rural areas that have agriculture (e.g. sugar cane), and, more recently, tourism as main economic activities.

Languages

Ryukyuan languages are traditionally spoken in the Ryukyuan islands and stand in sister relationship with Japanese, with which they form the Japonic family. They all share a common ancestor —proto-Japonic— thought to have been spoken before the 7th century (Pellard, 2015). They are divided into two branches, Northern Ryukyuan spoken in Amami and Okinawa islands, and Southern Ryukyuan, spoken in Miyako and Yaeyama islands. While not mutually intelligible as a consequence of the independent development of each language, both Miyako and Shiraho belong to the Southern Ryukyuan branch. The Ryukyuan languages are virtually entirely unintelligible to speakers of standard Japanese from the mainland, a fact that has been attested empirically (Yamada et al., in press). Ryukyuan speakers, on the other hand, are completely fluent in Japanese due to the fact their entire scholastic, administrative and civic lives are conducted in Japanese. As in the rest of the Ryukyus, there is an on-going language shift to Japanese, resulting in the elderly generations being bilingual in the traditional language and Japanese, and the younger generations monolingual in Japanese, with almost no knowledge of the local language. Miyako and Shiraho are thus reported to be definitely, and severely endangered, respectively (Moseley, 2010). The exact number of fluent speakers is difficult to assess due to the complex sociolinguistic situation induced by the language shift, but coarse estimates have given the figure of 12,000 to 22,000 speakers for Miyako (Jarosz 2015), and only 147 for Shiraho (Nakagawa, Lau, and Takubo, 2016). Miyako, Shiraho and modern Standard Japanese share many broad morpho-syntactic features. Among others, they are characterized by an agglutinative morphology, a SOV word order, the use of postpositions and suffixes, and a nominative/accusative case system.

Participants

Thirty-eight individuals participated in the study, 15 Miyako inhabitants-speakers (5 men, 10 women) tested in the Miyako islands, 8 Shiraho inhabitants-speakers (3 men, 5 women) tested in Shiraho, Ishigaki island, and 15 monolingual speakers of Standard Japanese (8 men, 7

women) all born and raised in Tokyo as the control group, tested in Tokyo. Given that Miyako and Shiraho are endangered languages (like all other Ryukyuan languages), the population of speakers is essentially constituted by senior citizens. As a result, the Ryukyuan samples in this study, as well as the matching control group, were formed by elderly men and women (mean age of the Miyako group was 83.2 and SD 8.13; for Shiraho was 83.63 years and SD 2.62; for the Japanese group was 73.47 years, SD 4.49). Miyako and Tokyo participants were recruited through elderly and rehabilitation centers. Shiraho speakers, being considerably less in number and living in a relatively small village, were recruited through the network of one of the authors (NN). As compensation Ryukyu participants received a small gift, and Tokyo controls a small amount of money. Three Miyako speakers and four Japanese speakers were excluded from the analysis because they failed to produce directional gestures with a clear trajectory in two or more of the four trials. One female Miyako participant was excluded because during the experiment she spoke in Japanese (not in Miyako, as instructed). In total, the data from 30 participants (11, 8, and 11, from the Miyako, Shiraho, and Japanese groups, respectively) were included in the analysis.

Materials

The set of stimuli consisted of eight simple live dynamic events made up of a combination of tabletop objects. These objects were: two ping-pong balls (one white, one black), two book-size boards (one white, one black), and one transparent small box used as a support for reclining the boards. In four of the eight events the experimenter releases a black/white ball to roll down a contrasting reclined white/black board and on the other four events s/he releases the ball (with corresponding color schemes) to bounce down the reclined board (see Figure 1).

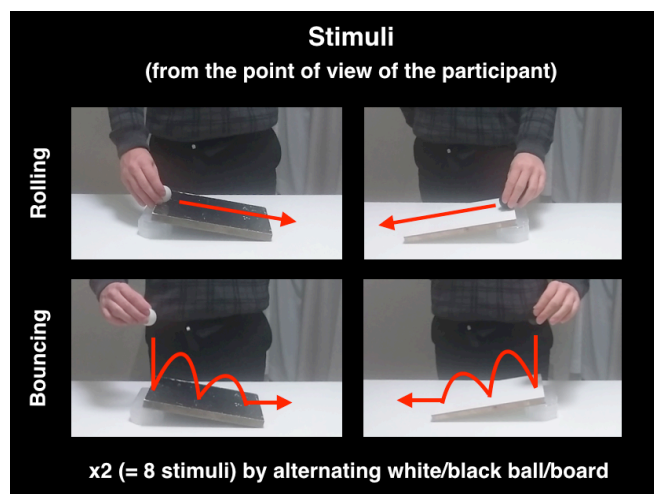


Figure 1: Gesture elicitation stimuli.

From these, four events had the action unfolding towards the left of the participant and four towards the right of him/her. Figure 1 shows four of the eight stimuli (the other four stimuli correspond to the ones shown but with alternated black/white colors of the ball/board).

Procedure

The experimental procedure consisted of four trials, in which participants were tested individually. In each trial the participant was placed in front of a table facing either north or south (the direction was selected randomly).

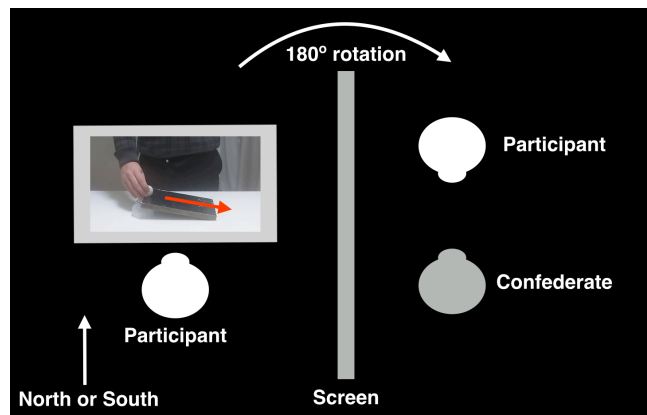


Figure 2: Schema of the gesture elicitation procedure.

Across the table there was an experimenter, who enacted for the participant one of the eight dynamic stimuli (events) described in the “Materials” section. The mode of movement (rolling/bouncing ball) and direction of the movement (eastward/westward) implemented in each of the four trials were selected randomly so that each participant experienced in the 4 trials all possible combinations of mode and direction of movement, namely ball rolling east, ball rolling west, ball bouncing east and ball bouncing west (the color scheme for each trial in the sequence was fixed, alternating the black ball over the white board with the white ball over the black board, beginning with the former configuration¹). When the brief presentation of the event ended (with the experimenter catching the ball), the participant was invited to go to a section of the room located a few meters away on the other side of a screen that blocked the view of the table where the stimulus had been shown (see Figure 2), and was instructed to sit on an armrest-less chair that placed him/her with a 180° rotation with respect to his/her original orientation (i.e., if s/he observed the dynamic stimulus facing north, s/he was then sat facing south). At this point, sitting in front of the participant there

¹ Since the Ryukyuan languages are endangered, the number of (elderly) speakers available is reduced (especially in Shiraho). This made a full counterbalanced design (manner of movement, direction of movement, and color scheme) not viable.

was a confederate fluent in the participant’s language² and who, being on this side of the screen, had not observed the dynamic stimulus. The participant was then invited to describe (in the relevant language: Miyako, Shiraho, or Standard Japanese) to the confederate sitting in front of him/her the scene that had been shown to him/her on the table on the other side of the screen. The presence of the confederate was meant to ensure that the participant would have a genuine real-world interlocutor who de facto had not observed the stimulus. The confederate’s participation was primarily limited to listening to the descriptions given by the participant (and, occasionally, to nodding to signal comprehension of the participant utterances). Once the description was completed, the participant was invited to go back to the original table on the other side of the screen in order to begin the next trial. There was no mention of the possibility or necessity of gesturing during the instructions. All participants’ descriptions were video-recorded.

Results

The directionality of the gestures was easily assessed as they primarily exhibited transversal hand (and sometimes head) movements indexing ball trajectories (often co-produced with utterances that referred to the motion of the ball itself: e.g. “it rolled away”, or with vocalizations that characterized the manner of the ball’s motion: e.g., “bom, bom, bom” for the bouncing ball). Only gestures that unambiguously unfolded either to the left or to the right of the participant while describing the trajectory of the ball were considered for analysis³.



Figure 3: Example of a gesture produced by a Miyako speaker exhibiting an absolute frame of reference

Figure 3 shows an example of a Miyako participant describing the trajectory of a westward bouncing ball, which she had observed facing south on the other side of the white screen (i.e., as the ball moved to her right). Her description, as she now faces north, involves a right-handed swiping gesture towards her left (i.e., westwards) reflecting an absolute FoR.

² A native speaker for the cases of Miyako and the Standard Japanese controls. For Shiraho, the confederate was the third author (NN), who has done extensive fieldwork on the language.

³ In this report we ignore gestures co-produced with non-targeted descriptions such as the size of the table or the texture of its surface.

Based on these gestural properties, the gestures depicting the trajectory of the dynamic stimuli of each of the four trials was classified as either “relative” or “absolute”, depending on whether it followed an egocentric or an allocentric pattern, respectively⁴. The classification yielded a mean percentage of absolute gestures per participant.

In average both Ryukyuan groups produced a much higher percentage of absolute gestures (Miyako mean = 71.09%, SD = 23.7%; Shiraho mean 81.25%, SD = 34.72%) than the Japanese-only group (Mean = 40.9%, SD = 30.15%). Individual data show that only 1 of the 11 Miyako participants (9.1%), and 1 of the 8 Shiraho participants (12.5%) manifested absolute FoRs in less than 50% of the trials. In contrast, nearly half of the Japanese-only speakers did so (5 of the 11 participants; 45.5%). Besides, more than half of the Miyako participants (6 out of 11; 54.5%), and almost all Shiraho participants (7 out of 8; 87.5%) exhibited absolute FoRs at least in 75% of the trials. In contrast, only 2 of the 11 Japanese speakers (18.2%) did so. A One-Way ANOVA reveals that the difference between the three groups is statistically significant ($F(2,27) = 5.10, p = 0.013$), exhibiting a large effect size ($\eta^2 = 0.27$) (see Figure 4). Post-hoc Bonferroni and Holm simultaneous comparisons of the Ryukyu groups versus the Japanese controls yield statistically significant differences for both, Miyako (Bonferroni and Holm T -statistic = 2.42; Bonferroni p -value = 0.045; Holms p -value = 0.023) and Shiraho (Bonferroni and Holm T -statistic = 2.97; Bonferroni p -value = 0.013; Holms p -value = 0.013).

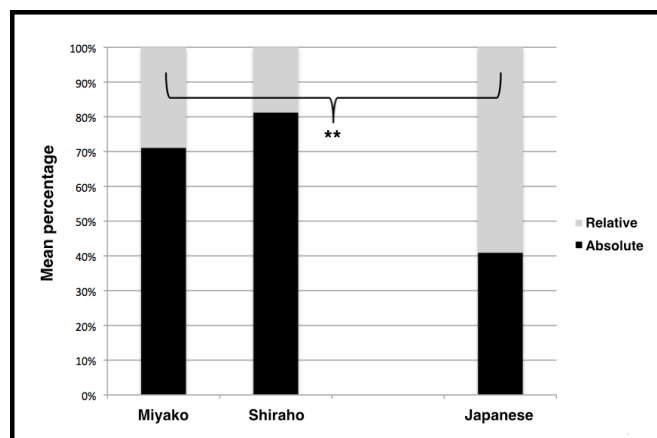


Figure 4: Mean percentage of absolute gestures (black) per participant.

Discussion

The study of FoRs has been an important area for the investigation of the linguistic relativity hypothesis (Gumperz & Levinson, 1996; Li & Gleitman, 2002; Majid et al., 2004; Haun et al. 2011). However, with rare

⁴ For the analysis presented here we do not analyze the details and extension of participants’ verbal production.

exceptions (e.g., Marghetis, McComsey, and Cooperrider, 2014; Meakins, Jones, and Algy, 2016), many of these studies have focused on monolingual populations. When bilingualism has been present, which is the case of many colonized regions around the world where individuals speak the indigenous language as well as that of the colonizer, more often than not the emphasis has been put only on one of the languages spoken (usually the indigenous one). This situation has left open questions involving the status of the linguistic relativity hypothesis when bilingual (or multilingual) cognition is concerned— an underestimated but ubiquitous condition in human history (Evans, 2011; Pavlenko, 2014). The linguistic relativity hypothesis makes clear predictions of FoRs preferences when the languages under investigation are not structurally equivalent, like when comparing those that do not have terms for “left” and “right” with languages that do, such as Mesoamerican Tzeltal and Dutch, respectively (e.g., Brown and Levinson, 1993; Levinson, 2003; Majid et al., 2004). Usually these predictions are about comparisons of speakers of languages that, differing substantially in the deployment of relative vs. absolute FoRs, belong to completely unrelated and radically different linguistic families, such as the one just mentioned (Tzeltal belongs to the Mayan family and Dutch to the Indo-European family) or ≠Akhoe Hai||om from the savannah of Northern Namibia (Central Khoisan language family) and Dutch (Indo-European family) (Haun et al, 2011).

Some studies with bilingual speakers of indigenous/Indo-European languages that exhibit clashing absolute-relative encoding have investigated extra-linguistic factors that appear to delimit the role of language in shaping thought (e.g., Spanish (Indo-European)-Juchitán Zapotec (Otomanguean family) from Oaxaca, Mexico (Marghetis, McComsey, and Cooperrider, 2014); English (Indo-European)-Gurindji (Pama-Nyungan family) from Northern Australia (Meakins, Jones, and Algy, 2016). These studies suggest that environmental and sociocultural factors such as schooling and writing practices affect the choice of FoRs in fundamental ways that are not strictly speaking linguistic.

To help evaluating the precise role that language might play in shaping thought—the essence of the linguistic relativity hypothesis—and further delineate the contribution of extra-linguistic factors, an important step is to investigate cases of bilingual populations of people that speak languages that: (1) in practice tend to elicit clashing FoRs (e.g., absolute vs. relative), (2) that belong to the *same* linguistic family (hopefully sharing cognate words), and, importantly, (3) that are structurally equivalent with respect to the relevant lexicon and grammatical resources. In this study we have done so by investigating the preference of FoRs of Japanese-bilingual speakers of two endangered Ryukyuan languages that belong to the same Japonic linguistic family as Japanese, and that, while being mutually unintelligible, share an important number of grammatical features and cognate words (e.g. Hattori (1959) reports 59% of shared cognates for Miyako and Tokyo Japanese). Importantly, while Japanese has been reported to

preferentially elicit the use of relative FoRs for characterizing small-scale spatial relations (Pederson et al., 1998; Kita, 2006) the Ryukyuan languages have been reported to do so primarily via absolute FoRs (Suzuki, 1978; Celik, Takubo, and Núñez, 2019).

The use of FoRs by (elderly) Miyako speakers had been previously studied experimentally via a referential communication task (Celik, Takubo, and Núñez, 2019) adapted from the standard “Man-and-tree” task (Pederson et al. 1998). In this task—of a director-matcher type (e.g., Le Guen, 2011)—speakers are asked to describe to a partner sitting on the other side of a screen simple scenes containing two toy animals that the latter could not see (Cooperrider, Slotta, and Núñez, 2017). The study on Miyako confirmed, as predicted, that (elderly) monolingual Japanese-speaker controls almost exclusively relied on relative terms to describe the stimuli to their partners. In stark contrast, Miyako speakers, when speaking in Miyako, exhibited a marked tendency to describe the spatial configurations of the figurines using absolute terms, such as ‘west’ and ‘east’, and this despite being fully bilingual in Japanese and having been massively exposed to mainland Japanese culture for decades. Surprisingly, in addition, speakers from the same Miyako bilingual population when doing the same task in Japanese relied extensively on relative terms, showing no significant difference from Standard Japanese speakers. These results suggest that, beyond the grammatical and lexical resources of languages, the referential communicative practices and conventions brought forth when a speaker is immersed in speaking a particular language may be an important factor influencing thought (and spatial construals, in this case). In order to test whether these results were triggered by the goal-oriented, performance-driven, explicit cooperation dimension that is demanded in this communicative task, in this study we investigated the spatial construals that would be spontaneously enacted gesturally in real-time without the demands of goal-oriented cooperation and performance that are present in the referential communication director-matcher task. Moreover, to gain a richer insight into the Ryukyuan mind, we extended this approach to investigate another Ryukyuan language— Shiraho, from the Ishikagi island.

This study shows that the investigation of spatial construals and FoRs preference can be enriched with the addition of observations of speech-gesture co-production. Spontaneous gesture production is largely effortless, which is an important factor when evaluating elderly speakers, and it is universal, so it is expected to be observed in all human groups (McNeill, 1992). Since, in general, spontaneous gesture production is less monitored than speech, it largely unfolds below the level of awareness, and therefore provides a remarkable backdoor to real-time cognition (McNeill, 1992). And being effortless and largely unconscious, gesture production does not provide the intimidating effect that challenging reasoning and memory tasks might bring for some individuals. This is especially relevant when

studying elderly speakers of endangered languages who often are unschooled (or poorly schooled) and are less exposed to testing and scholastic practices. Importantly, gesture production often provides content that is not observable through speech alone (Kendon, 2004) allowing for the observation of construals that are not accessible via purely linguistic means (Le Guen, 2011; Núñez et al., 2012). Finally, gestures are often co-produced with abstract analogical and metaphorical thinking that reveal important features of the underlying conceptual mappings and inferential affordances (McNeill, 1992), which often rely on spatial construals (e.g., see Núñez and Sweetser (2006) for spatial construals of time).

The novel gesture elicitation paradigm used in this study builds on these important properties of gesture-speech co-production. The results confirm, via a different, but complementary approach into cognition, the preference of absolute FoRs observed in Miyako speakers with a more traditional method such as that of referential communication director-matcher tasks (Celik, Takubo, and Núñez, 2019). These results help establish the reliability of this novel gesture elicitation method for investigating tabletop spatial construals. Moreover, the results of this study extend the findings to speakers of another Ryukyuan language — Shiraho— which being consistent with those obtained with Miyako speakers, confirm some of the socio-geographic observations (Suzuki, 1978) that Ryukyuan people exhibit a marked tendency to use absolute FoRs.

The fact that the elderly Ryukyuan individuals exhibit preference for absolute FoRs despite being fluent Japanese-bilinguals and being fully immersed in mainland Japanese culture for most of their extended lives is quite remarkable. In fact, other groups, such as the Gurindji people of Northern Australia who traditionally relied on absolute FoRs, have been shown to have shifted to relative patterns due to exposure to English and the associated cultural and literary practices that go with it (Meakins, Jones, and Algy, 2016). Similarly, regarding spatial construals of time, Mandarin-English bilinguals have been reported to exhibit chronic inter-language influences on patterns in thought, and this already by the time they are young adults (Lai and Boroditsky, 2013). But in stark contrast to these cases, the last speakers of the Ryukyuan languages we have studied, despite a life-long immersion in the dominant Japanese culture and language, manifest a preference for an absolute FoR that appears to be robust and long-lasting. How pervasive is this pattern among speakers of other languages of the Ryukyu islands? Why is it so resilient? We don't know. More research is needed for answering this and many other open questions. We are, however, running out of time, as the last speakers of these endangered languages may leave us taking with them their rich cultural heritage along with the precious answers.

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