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The Virtual Atoll Task:

A spatial language elicitation tool

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Abstract. This paper describes and evaluates the Virtual Atoll Task (VAT), a new elicitation tool for research on spatial language. The task, which elicits spatial descriptions as participants direct each other through a simulated landscape, provides a more realistic, first-person perspective in comparison with previous tabletop space games (e.g., Levinson et al. 1992; Senft 1994; Wilkins 1993), and aims to prompt large scale spatial descriptions that may be uncommon in tabletop space. We discuss the methodology of the task then comment on its strengths and limitations as an elicitation tool, reporting on pilot studies in Jaluit Atoll (Marshall Islands) and Laamu Atoll (Maldives). We conclude by discussing the potential for the VAT to be modified for use in other topographic environments, as well as for the task to be employed for the investigation of other domains.

Keywords: virtual environments, spatial language, elicitation, linguistic fieldwork, frames of reference

1. Introduction

Conventional linguistic fieldwork has tended to prioritise the collection of texts produced naturally within the community, such as conversations or traditional stories. However, it has been recognised that research into specific linguistic domains can often benefit from a more targeted approach to elicitation, through the use of elicitation tasks or games with specially designed stimuli. One domain for which this has particularly been the case is the domain of spatial language. Researchers from the Language and Cognition Group at the Max Planck Institute for Psycholinguistics, Nijmegen, have developed a suite of elicitation tasks for exploring various aspects of spatial language.[1] These include 'route description' games (Wilkins, 1993), photo-photo matching games (Levinson et al., 1992), photo-object matching games (Senft, 1994), and others. Despite certain shortcomings (see below), such tools are a convenient way of eliciting language rich in spatial terms, and when supplemented by more naturalistic texts, can help to provide valuable insights into the dominant systems of spatial reference in a language.

In this paper we report on the 'Virtual Atoll Task' (VAT), a newly developed tool for the elicitation of spatial language. The VAT is a computer game set in a virtual atoll environment (see Fig. 1 below). The game and the virtual environment in which it takes place were designed by the authors using Unity, a program for computer game development. The VAT is played by two native speaker consultants who cooperate to search for a number of hidden treasure chests around the atoll. It aims to elicit highly precise spatial descriptions as one player – to whom the locations of the treasure chests have already been revealed – verbally guides his partner through the game.

The VAT provides a controlled way to observe how speakers give directions and locative descriptions in a large scale environment (albeit a virtual one), and thereby gets around many of the difficulties associated with the use of pre-existing tabletop games, as well as the challenges associated with directly observing speakers as they move through actual large scale space. Although it is not

[1] See http://fieldmanuals.mpi.nl.

intended to replace more established stimuli, we submit that the VAT is a useful addition to the suite of elicitation tools already developed for investigating spatial language.[2]

Figure 1. *Screenshot from the Virtual Atoll Task.*

This paper is divided into five sections. Section 2 provides some background to the cross-linguistic study of spatial language and to some of the existing elicitation methodologies in this domain. Palmer's (2015) 'Topographic Correspondence Hypothesis' is also introduced in order to explain the particular interest in atolls. Section 3 describes the methodology of the VAT as well as the design of the virtual environment in the game. Section 4 discusses some of the linguistic findings from the use of the VAT at our field sites in Laamu Atoll (Maldives) and Jaluit Atoll (Marshall Islands), and evaluates the strengths and weaknesses of the VAT as an elicitation tool, in comparison to other spatial language elicitation tasks. Finally, Section 5 concludes by summarising the features of the VAT and by discussing other potential applications for the task. In particular, we note that while few researchers are likely to employ the task in atoll-based communities, a

[2] Readers wishing to use the VAT in their own research are encouraged to contact the authors.

larger number may be interested in modifying the virtual environment to alternative topographies, or may wish to use the game for different purposes entirely.

2. Spatial language and its elicitation

2.1 Background

Talking about space is a fundamental part of speaking a language. Every day, we find ourselves in situations where we must describe the locations of objects or people, or talk about which way they are facing or where they are going. Naturally, linguists have wished to study how languages encode spatial descriptions, and to discover the level of cross-linguistic variation or uniformity that exists in terms of both grammatical structures and semantic categories. Several subdomains of spatial language have been found to vary across languages, including deixis, topological relations, motion descriptions, and frames of reference (Levinson & Wilkins, 2006). In addition, linguistic variation in the spatial domain correlates with and may even be a cause of variation in non-linguistic spatial cognition, as reflected in spatial memory and reasoning (Levinson, 2003; e.g., Levinson, Kita, Haun, & Rasch, 2002; Majid, Bowerman, Kita, Haun, & Levinson, 2004; etc.). The study of spatial language is therefore important not only to linguistics, but to our understanding of how different cultures conceptualise physical space.

2.2 Eliciting spatial language

Most grammars of languages include some information on structures that express spatial concepts, and many linguists have published more detailed accounts of the spatial systems in particular languages, based on extensive fieldwork (e.g., Levinson & Wilkins, 2006; Senft, 1997). How is such information obtained when in the field? To some extent, researchers have relied on direct observation, immersion in the language and culture, and the collection and close analysis of texts such as narratives and conversations. However, some have also used more targeted elicitation tasks involving carefully developed stimuli. Although somewhat less naturalistic, the use of such tools has a number of important advantages: (i) the controlled nature of the tasks allows for cross-linguistic comparisons to be made more soundly; (ii) researchers can easily manipulate variables of interest, such as the size, shape or layout of the stimuli, or the direction the participants are facing; and (iii) tasks can be designed to elicit texts rich in highly precise spatial terms, whereas more naturalistic texts might feature such terms only occasionally.

For certain areas of spatial language, many researchers have found it beneficial to elicit instructional texts produced by pairs of native speaker consultants. This was the approach favoured by the MPI's Language and Cognition Group during their 'space' project in the 1990s and early 2000s, and the basic methodology has subsequently been taken up by others including Bennardo (2000), Li and Gleitman (2002) and Dasen and Mishra (2010).[3] The methodology generally involves sitting two consultants side by side but separated by a screen.[4] One consultant acts as 'director' and must describe the stimuli in front of her to the 'matcher', who must try to select or manipulate the corresponding stimuli on her own side. The matcher is usually allowed to ask questions.

Stimuli are carefully designed to maximise the need for consultants to employ highly precise spatial language during the task. For example, in the 'Man and Tree' game (Levinson et al., 1992), the director cannot simply say, 'in this photo there is a man and a tree', since the stimuli include many photos showing a man and a tree in various configurations. Therefore, the game is useful for eliciting more precise spatial descriptions such as 'the man is *in front of* the tree' or 'the man is *north* of the tree'. Man and Tree is an example of a 'photo-photo' matching game;[5] other games involve 'photo-object' matching (e.g., Senft, 1994) or 'object-object' matching, which includes 'route description' games (e.g., Wilkins, 1993).

[3] The MPI's methodology was inspired by earlier experiments in psychology of language, such as the Human Communication Research Centre Map Task (Anderson et al., 1991; http://groups.inf.ed.ac.uk/maptask/maptask-description.html).

[4] Other configurations may be used as variants.

[5] Later variants have used photos of a different (toy) man and tree (e.g., Terrill & Burenhult, 2008), or have used photos of different objects entirely, such as a girl and an umbrella (Li & Gleitman, 2002) or a ball and chair (Bohnemeyer, 2011; Polian & Bohnemeyer, 2011).

Despite the ability of these games to elicit precise spatial relations, there are certain limitations and shortcomings. For one thing, the particular design of the task affects the results. For example, if a set of photos includes a lot of symmetrical objects, one would expect to see fewer tokens of intrinsic frame of reference (e.g., 'the tree is *left* of the man', i.e., at the man's own left side) than if the stimuli included mostly faceted objects. Another issue is that because of the nature of the task, consultants might resort to strategies that are linguistically available but not common in their language. Claims about the prevalence of certain spatial strategies in a language should therefore not be based on director-matcher style tasks alone. And of course, there are typically a range of practical challenges associated with running such tasks in the field, including consultants being unfamiliar with certain stimuli or not understanding what to do in the game. To an extent, however, these difficulties can be mitigated by collecting data from multiple elicitation tasks in combination with more naturalistic texts, so that one's findings do not depend too much on the design of any particular task.

A different limitation (and one that is of special interest to this paper) is the small scale, tabletop nature of most director-matcher games. In many languages, the linguistic strategies preferred in small scale, manipulable space are not the same as those used when referring to the wider world. English, for example, tends to reserve cardinal directions like *north* and *south* for large scale space, such as when describing regions of countries or long distance voyages. Tabletop director-matcher games like Man and Tree are poorly suited to eliciting vocabulary that is largely restricted to those kinds of contexts.

On the other hand, it can be problematic to observe people using spatial language as they navigate through large scale space – aside from the logistical challenge of getting quality recordings when exposed to the elements and noisy vehicle engines, one may well find that speakers use precise spatial language infrequently. This may be because their communicative needs are adequately served by pointing gestures and the use of place names (e.g., for the destination), or because they are travelling along a route they have taken many times before and so spatial descriptions are unnecessary. The VAT was specifically designed to provide a method for eliciting large scale spatial descriptions while avoiding some of the issues associated with existing director-matcher tasks and also those associated with direct observation of real world way-finding.

2.3 Spatial language and the environment: the case of atolls

Before describing the methodology of the VAT in Section 3, it is first necessary to introduce the theoretical background and hypotheses which inspired the task. This will also address why the VAT was designed specifically for atoll environments (though as we explain in Section 5, it has the potential to be modified for other topographies).

Palmer (2015) proposes a 'Topographic Correspondence Hypothesis', predicting that languages spoken in similar topographic environments should exhibit similar subtypes of the absolute frame of reference in accordance with local topography, while languages spoken in different topographic environments should be expected to have diverse systems of absolute frame of reference. Although other researchers have discussed the relationship between frames of reference and the environment, Palmer's hypothesis relates specifically to the topography of the language locus, rather than to an indoors/outdoors variable (e.g., Levinson et al., 2002; Li & Gleitman, 2002) or to the 'ecological zones' (temperate, tropical, etc.) or 'subsistence modes' (hunter-gatherer, stable agriculture, etc.) considered by Majid et al. (2004). It is also more fine-grained in that it makes predictions as to particular subtypes of the absolute frame of reference (e.g., cardinal systems, landward-seaward systems, uphill-downhill systems, etc.), rather than claiming that absolute frame of reference as a whole correlates with some environmental feature or other.

Palmer (2015) observes that the spatial systems in a number of languages appear to support the Topographic Correspondence Hypothesis (see also: Palmer, 2002, 2004, 2007). For example, Aralle-Tabulahan (Austronesian), Samo (Papuan), Dyirbal (Australian) and Florutz German (Indo-European) are all spoken in environments featuring mountains and rivers, and all four languages possess similar absolute directional systems that include terms for 'uphill', 'downhill', 'upriver', 'downriver' and 'across river/valley'. However, to test the hypothesis in a wider range of languages and topographic environments, Palmer (2015) proposes an 'Environment Variable Method' with two dimensions of comparison: first, the language is held constant and the environment varied (i.e., observe speakers of a single language or of closely related languages that are spoken in different topographic environments); and second, the environment is held constant and the language is varied (i.e., observe speakers of unrelated languages that are spoken in similar topographic environments).

Palmer identifies atoll environments as a useful test case for the Topographic Correspondence Hypothesis and Environment Variable Method. An atoll is a ring of coral reef and flat, narrow strips of land surrounding a central lagoon (see Fig 2 below).

Figure 2. *Satellite photograph of Atafu Atoll, Tokelau.*[6]

The lagoon on the inside of the atoll and the ocean on the outside play very different roles in the lives of atoll dwellers, and both are visible from many points on land. The locations of the two bodies of water are therefore highly salient features of this rather unusual environment. The Topographic Correspondence

[6] Source: http://eoimages.gsfc.nasa.gov/images/imagerecords/37000/37753/ISS018-E-018129_lrg.jpg

Hypothesis predicts that the spatial systems of atoll-based languages should attend to this distinction between ocean and lagoon, and indeed the atoll-based languages of the Pacific do employ 'lagoonward-oceanward' axes (Palmer, 2007; 2015). However, as Palmer observes, these languages are all members of the Oceanic branch of Austronesian, and so are not ideal candidates for comparison. Dhivehi, an Indo-European language spoken throughout the atolls of the Maldives in the Indian Ocean, is a more suitable language for the second dimension of the Environment Variable Method. As for the first dimension, Marshallese migrant communities in the United States provide a useful comparison to their relatives still living on atolls in the Marshall Islands.

In order to test the Topographic Correspondence Hypothesis on atoll-based languages, we have collected spatial language data from both Dhivehi and Marshallese, with the latter subdivided into atoll-based Marshallese and US Marshallese. To this end, we have employed a range of spatial language elicitation tools in tandem with more conventional language documentation techniques. The VAT is but one of these tools, though it is one that has a special place because it requires participants to navigate through a version of their environment. It thereby provides a window on how different atoll communities speak about and conceptualize the topography around them, which has important implications for the Topographic Correspondence Hypothesis and for our more general understanding of the interaction between language, culture, cognition and the environment.

3. Methodology and game design

3.1 Procedure

The VAT is a cooperative computer game played by two consultants, a 'director' and a 'matcher'.[7] The role of the director is to guide the matcher to a number of treasure chests which are hidden in various locations around the virtual atoll. The

[7] We use the terms 'director' and 'matcher' as these are in keeping with earlier space games (see §2.2), even though the methodology is somewhat different.

director does not interact with the controls in any way. The role of the matcher is to operate the controls and follow the director's instructions in order to discover and open the chests. Both players are encouraged to speak to each other throughout the task, but are asked not to point at the screen. The basic procedure is as follows, and a photograph of two Marshallese men playing the VAT is provided in Figure 3:

1. The director watches a short video showing the locations of the treasure chests while the matcher waits outside the room. The video is actually a screen capture recording of the first author playing the game without any director and accompanied by some background music.

2. The director is invited to watch the video again and to play the game himself, until familiar with the locations of the chests. During this process, the researcher may intervene to assist with any issues relating to the controls, but should not prime the director by using any spatial vocabulary or by offering strategies for remembering the locations of the chests.

3. The matcher is invited into the room and given a small amount of practice with the controls.

4. When both players are ready, the researcher loads the game scene and turns on any recording equipment (ideally, a good quality audio recorder connected to two lapel microphones, as well as a screen capture program for recording gameplay).

5. The game begins, with the director verbally guiding the matcher through the virtual atoll environment until all treasure chests have been discovered, or until the researcher or participants decide to stop (for example, if the game has become too time-consuming).

6. If time permits, the players may swap roles and steps 1-5 may be repeated with a second game scene. This scene has identical geography to the first, but the treasure chests are hidden in different locations (accordingly, there is a different demonstration video for this iteration).

Figure 3. *Participants playing the VAT in Jaluit, Marshall Islands.*

3.2 Appearance and gameplay

In order to maximise immersion in the virtual environment, the VAT employs a first person perspective (as opposed to, for example, the third person view or the 'over the shoulder' perspective found in many video games); therefore, the players' experience of the virtual environment is as similar as possible to the way they experience their real environment. The scenes in the VAT were created by an 'Island Generator' program designed using the Unity platform for computer game design.[8] With minimal training, it is possible to use the Island Generator to create and terraform one's own virtual atoll and/or island environments.

The environment generated for the VAT consists of an atoll at some distance from a large non-atoll island. The latter was included so that players do not travel only within the confines of the lagoon, but have the chance to leave the atoll and

[8] Unity is available for free download from www.unity.com and is required to run the Island Generator program.

engage in long-distance 'ocean-voyaging', a practice which in some languages requires different navigational strategies (see Palmer, 2007 for Marshallese; François, 2004 for Oceanic in general). In order to help the players differentiate between the lagoon and the ocean, the game's ocean water is a deeper blue than the lagoon water, the ocean side of islands is considerably rockier, and piers – of which there are three around the virtual atoll – are always on the lagoon side of islands. These features parallel the geography of real-world atolls. While many of the game's islands are similar in appearance to one another, none are actually identical, and a number of features including vegetation, rocks, buildings, vehicles, shape, size and location may be used to tell them apart. The game also features a prominent sunset to allow participants to derive cardinal directions from the position of the sun, should this occur to them.[9]

Across both scenes, the treasure chests are hidden inside houses, on balconies, underneath piers, in the back of a van, or on the ground (either concealed by other objects or out in the open). The chests were deliberately placed in a wide variety of locations in order to facilitate participants' memory of them. The game includes a counter at the top left of screen which indicates how many chests are yet to be opened.

The controls for the VAT were designed to be as simple as possible, under the assumption that most players would be unfamiliar with computer games, if not computers in general. Therefore, while most modern games use either the arrow keys or the 'wasd' keys for movement, the VAT only requires one keyboard key (the space bar), which moves players forward in the direction they are currently facing. The view is controlled by moving the mouse, and objects (i.e., treasure chests and speedboats) are engaged by pressing the left mouse button. In addition to the relative simplicity of having the mouse control orientation, it is also advantageous in that the mouse is presumably less likely than the arrow keys to bias participants towards using egocentric spatial terminology such as 'left' and 'right'. A disadvantage, however, is that players are unable to move backwards, and instead must rotate the view 180 degrees before again pressing the space bar.

[9] If desired, the sunset sky can be switched to a daytime one in the Island Generator program.

4. Results and discussion

4.1 The data

To date, we have employed the VAT as an elicitation game with 12 Dhivehi-speaking pairs from Laamu (Haddummati) Atoll, Maldives, and seven Marshallese-speaking pairs from Jabor, Jaluit Atoll, Marshall Islands. In Laamu Atoll it was possible to administer the VAT in six different islands, though most pairs were recorded in the capital island of Fonadhoo (five pairs) or the fishing/farming island of Dhan'bidhoo (three pairs). Owing to the need to recruit participants who had some basic familiarity with computers, most participants from both language communities were young men. A version of the task with five treasure chests was used for most pairs, though a newer version with only four chests was used for four of the Dhivehi pairs in order to reduce the duration of the task.[10] The combined Dhivehi data is approximately six hours in total, of which a sample of one hour and 11 minutes was transcribed and translated for analysis. The Marshallese data amounts to approximately two hours and 10 minutes, all of which is fully transcribed and translated. In addition, a second field trip to the Marshall Islands is planned for 2015/2016 during which more VAT data may be collected.

4.2 Linguistic results

On the basis of the data collected, it appears that the VAT was partly successful in eliciting the kinds of spatial descriptions for which it was designed, though the nature of the task appeared to favour certain spatial strategies over others. For both languages, the VAT succeeded in eliciting some spatial vocabulary that was not observed in small scale spatial tasks such as the Man and Tree game. For example, the distal locative demonstrative *ijuweo* 'over there, yonder' was

[10] The newer version also has a number of small improvements, including a more obvious contrast between the lagoon and ocean, and smoother interaction with in-game objects.

produced by several Marshallese speakers, as were topographically-based motion verbs such as ***buñlik*** 'sail out into the ocean'. In Dhivehi, the motion verbs ***arān*** 'ascend', ***erēn*** and ***faibān*** 'descend' were commonly used to describe getting on and off islands, even when the participants were well inland and the ground was flat. The use of such terms suggests that participants were indeed identifying the virtual atoll environment with real atoll environments, which had been an important aim in designing the task. Further evidence of this is in some of the jokes and comments made by participants during the task, explicitly identifying virtual islands with real-world ones, as in the following example from Marshallese:

(1)	*jitōñ*	*aḷ.*	*Kajju.*	*Kōj*	*-ro*	*tal*	*ñan*	*Mājro.*
	face	sun	go.straight	1PL.INCL	-two	go	to	Majuro

'Face the sun. Go straight. We are going to Majuro.

ewi	*Jaluit,*	*ḷe?*	*E-*	*nañin*	*to*	*an*	*jāde?*	...	*Eñņe!*
where	Jaluit	man	3SG	almost	long.time	3SG.POSS	appear		there.it.is

Where is Jaluit, man? How long until its appearance? … There it is!' [11]

MAR_VAT_JAB_20140307_PB1_DG1_W: 04.40

In addition, the Marshallese data has a few instances of players employing the directionals *iar* 'lagoonward' and *lik* 'oceanward', though it is not always clear if the terms refer to an axis in the virtual environment or to the lagoonward-oceanward axis in the external world. Despite our best efforts to make the virtual lagoon and ocean as visually distinct as possible, in some cases participants felt

[11] Majuro is the capital of the Marshall Islands, an atoll some 200km away from Jaluit Atoll, the participants' home atoll where the task was recorded.

unable to extrapolate a lagoonward-oceanward axis within the game, as the following exchange demonstrates:

(2)	YM1	*e-*	*pād*	*ilo*	*jekā*	*kaṇe.*		
		3SG-	be.located	at	some.place	those		
		'It is somewhere around there.'						
	TP1	*lik*	*ke*	*iar ?*				
		ocean.side	or	lagoon.side				
		'Ocean side or lagoon side?'						
	YM1	[…] *bwe*	*je-ñak*	*ewi*	*iar*	*im*	*lik.*	
		so	1PL.INCL-not.know	where	lagoon.side	and	ocean.side	
		[…] 'So we don't know where the lagoon side and the ocean side are.'						

MAR_VAT_JAB_20141129_YM1_TP1_W: 06.52

Perhaps due to perceived ambiguities in using topographically-based directionals for such a task, the participants often deferred to other strategies. The Marshallese participants primarily relied on left-right terms, real-world cardinal directions, or somewhat vague uses of locative demonstratives. Dhivehi speakers also relied very heavily on left-right terms and demonstratives, and many descriptions lacked frame of reference information altogether, as in the following example:

(3)	*goho-bala*	*ēnū*	*fālam-ek*	*lā-fa*	*raş-ek*
	go-IMP	sit.there.PST.FOC	pier-INDF	put-PTCP	island-INDF
	'Go, there is an island with a pier.'				

DIV_VAT_LF_20140129_1_1_AZ2_IS3_SW: 04:47

However, a smaller number of Dhivehi descriptions invoked topographical or cardinal directions. Topographical terms included *eggamu* 'inland', *atiri* 'beach', and *fuṭṭaru* 'reef'; these were used exclusively to refer to features of the virtual environment and to directions within that environment. Interestingly, there was no clear evidence of a lagoonward-oceanward axis in the Dhivehi data, in contrast to Marshallese where such a directional system was represented, even if it was not a dominant strategy. Dhivehi cardinal terms were occasionally used for virtual cardinal axes (typically 'east' or 'west' when facing the setting sun), but more often for real-world directions, with 'north' corresponding to the screen's left if the players were facing east, for example.

There are a number of possible explanations for the preference in both samples for egocentric strategies such as left-right terms and demonstratives. Firstly, the participants recruited were predominantly young adults who had some level of computer literacy, and other experiments such as the Man and Tree game revealed that this group was more likely to use egocentric spatial terms in other tasks too. But one might also suppose that the very use of a computer encourages egocentric frames, because even if the controls and interface for the VAT do not have left-right asymmetries, participants may nonetheless associate computers with left-right systems. This is because other computer-based activities require the use of such systems (e.g., text directionality, left vs. right clicking, arrow keys, etc.). Finally, although participants were familiar with the type of environment represented in the VAT, they were unfamiliar with the geographic details of the atoll in the game (e.g., which islands contained houses, etc., as well as the locations of the islands themselves). Since participants could only have developed a fairly rudimentary and inaccurate mental map of the virtual atoll from their exposure to it in the brief training phase, it would have been challenging for them to relate their current position in the game to other in-game locations that were out of view. This may have fostered strategies that focused on the participants' immediate movements, without any reliance on more distant features such as the virtual lagoon or sun. It would be interesting to observe how participants play a version of the game after they have acquired much more experience and familiarity with the geography of the virtual atoll, and this may be a future application of the task.

4.3 The VAT as an elicitation tool: strengths and weaknesses

When trialling the VAT, several limitations emerged. Firstly, despite our efforts to make the controls as simple as possible, many participants still found them challenging, particularly in parts of the game which required finer control, such as climbing up the staircases of houses. These were generally participants who did not have much experience operating computers. Because of this, we mostly recruited participants who were young and sometimes more highly educated than other members of the community. Thus the data elicited was not necessarily representative of the wider speech community, but only of a subgroup, and it may fail to capture more traditional patterns of usage as favoured by older speakers of Dhivehi and Marshallese. For some languages or at some field sites, presumably, it would not be possible to recruit any suitable participants at all, if nobody in the community has a sufficient level of computer literacy.

A further issue was the duration of the task, which was often over an hour (including instructions, training, and two games). While this did not cause too many problems at our field sites, it could potentially be problematic if participants are busy or have limited attention spans. It would be possible to mitigate this by running the task across two sessions, with the participants swapping roles for the second session.

Finally, when participants got lost in the virtual world or forgot the location of the treasure chests, the game sometimes descended into a relatively quiet and/or uninteresting phase, with participants meandering around silently as they attempted to find the chests by trial and error. As mentioned earlier, this can be remedied to an extent by reducing the number of chests to four, but occasionally one may nonetheless finish with a paucity of meaningful data, at least for some parts of the game. In contrast, the design of previous tabletop space games precludes the use of a trial-and-error strategy, since the split field of view prevents players from knowing if they have made a correct 'match' until the end of the task.

On the other hand, the VAT has a number of advantages over earlier spatial language elicitation tasks, avoiding many of the shortcomings outlined in §2.2. In addition to the task's ability to elicit larger scale spatial descriptions (as demonstrated in the previous section), the VAT is in many ways a more realistic task in comparison with other space games, despite the fact that it takes place on a computer screen. This is partly because of the first-person perspective experienced by participants in the game, which is the perspective one would ordinarily have when giving or receiving spatial descriptions in real life. Previous space games involving a bird's-eye view of small objects within reach provide a somewhat less naturalistic context for precise spatial language. Such games are also artificial in that they divide participants with a screen, bringing about a split field of view. Although this is fundamental to making certain games succeed as elicitation tasks, a divided field of view of identical objects is highly unusual in real life, and can easily lead to misunderstandings that would never occur in normal conversation (for example, in the Man and Tree game, if a director says the equivalent of 'The toy man is facing me', the matcher will often be confused as to whether this means towards the screen – i.e., perpendicular to the participants – or towards herself).

5. Conclusions

We submit that the VAT is a valuable tool for eliciting spatial language, and in particular for testing Palmer's (2015) Topographic Correspondence Hypothesis. At our field sites in the Maldives and the Marshall Islands, it successfully elicited certain large scale spatial descriptions that were not prompted by more conventional tasks, and provided meaningful data that will go some way to evaluating the Topographic Correspondence Hypothesis, as well as to answering more general research questions on the relationship between spatial language and the environment (though we cannot hope to resolve those questions here).

The VAT overcomes many of the shortcomings of more established spatial language elicitation tasks, though it has certain limitations of its own. However, many of these can be mitigated, or will become less problematic over time (e.g., in the case of difficulties with operating the controls, it is likely that the pool of potential participants for the task will grow as computer literacy continues to spread into even the remotest of communities). In any case, we regard the VAT as a useful addition to other space games, rather than as a replacement. Table 1 below summarises the ways in which the VAT differs from previous tabletop space games:

Table 1: *Comparison of the VAT to previous spatial language elicitation tasks*

	Previous space games	**VAT**
Scale	Small, tabletop	Medium-large (simulated)
Field of view	Divided	Shared
Perspective	Bird's-eye view	First person
Stimulus materials	Artificial, abstract	Less artificial or abstract
Accessibility	Objects easy to manipulate	Controls somewhat difficult
Specificity of descriptions	Highly specific	Less specific (trial-and-error strategy possible)
Source of director's knowledge	Separate but identical stimuli	Memory

Finally, although the VAT is currently limited to atoll and island environments, it would be possible to use Unity or other software to build alternative virtual worlds. It would be intriguing, for example, to trial a riverine version with speakers of a language spoken in that environment, or an alpine map in a mountain-based community. Additionally, the VAT, along with the Island Generator program used to create the virtual environment, has the potential to be adapted to the needs of the researcher and could foreseeably be used for a variety of purposes, such as studying the development of cooperative communication strategies,[12] or for more general linguistic elicitation. Since relatively few researchers are likely to take the VAT to atoll-based communities, we anticipate that the immediate future of the task lies in these other applications of it, as well as in non-atoll island communities for which the Island Generator program can already build suitable virtual environments.

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