Encouraging advanced second language speakers to recognise their language difficulties: a personalised computer-based approach

Xu, J; Bull, Susan

DOI:
10.1080/09588221003666206

Document Version
Peer reviewed version

Citation for published version (Harvard):
Xu, J & Bull, S 2010, 'Encouraging advanced second language speakers to recognise their language difficulties: a personalised computer-based approach', *Computer Assisted Language Learning*, vol. 23, no. 2, pp. 111-127. https://doi.org/10.1080/09588221003666206

Computer Assisted Language Learning
Vol. 23, No. 2, April 2010, 111–127

Encouraging Advanced Second Language Speakers to Recognise their Language Difficulties: A Personalised Computer-Based Approach

Jing Xu and Susan Bull

School of Electronic Electrical and Computer Engineering, University of Birmingham, Birmingham, UK

Abstract. Despite holding advanced language qualifications, many overseas students studying at English-speaking universities still have difficulties in formulating grammatically correct sentences. This article introduces an 'independent open learner model' for advanced second language speakers of English, which confronts students with the state of their knowledge in a personalised computer-based approach designed to prompt awareness of their own language rules and how these compare to the native speaker rules, for use in an independent learning context. As an illustration we present an example in the area of modal verbs, with advanced Chinese speakers of English. Results suggest acceptance of the approach of receiving feedback on their language through an open learner model, with students initially exploring their own rules and then comparing their language to native speaker rules. We therefore recommend further research into this alternative method of promoting language awareness.

Keywords. learner independence; advanced second language speakers; learner language; language awareness; open learner model.

Introduction

While non-native English speaking students studying in U.K. universities are operating at advanced levels of English, some nevertheless still have difficulties constructing accurate English such as required in coursework and project reports. It would therefore be useful to offer students a method to help them identify their specific problems in order that they may then undertake appropriate work to overcome them. Given that most such students are not based in language departments, an approach that students can use independently alongside their main study and any other university-provided language support, is desirable. Thus students can work as suits them, according to other constraints in their academic schedule.

It has been suggested that raising awareness about language, or noticing items in the input to which they are exposed, may help to focus learner attention and support language acquisition (Rutherford & Sharwood Smith, 1985; Schmidt, 1990). While there is no agreement over the extent to which focusing on language form may be useful, *some* degree of attention to form is probably helpful (Ellis, 2005; Swan, 2005). This article introduces a personalised computer-based approach to help raise learner awareness of their problems that can be used on its own or in addition to other language support offered by the student's university.

A learner model is a representation of a user's current knowledge or skills, inferred according to their interaction with a learning environment. An open learner model is a learner model that is directly accessible to learner viewing. Previous work has already identified that an open learner model *can* facilitate noticing and

awareness-raising in language learning, and noticed elements were retained in a delayed post-test one week after interaction with an open learner model, where no additional instruction on those features had taken place (Shahrour & Bull, 2008; 2009). We here build on this work to look at whether a language open learner model may be flexible enough to allow users to interact in a manner that suits their individual preferences. In this instance our target users are Chinese speakers of English. Modal verbs are one of the aspects of language that can cause problems for this group (Chang, 1987; Hinkel, 1995; Mohamed et al., 2004), for example, where there is no clear Chinese equivalent, or in the nuances conveyed by English modals. We here focus on this area in order to provide a concrete example. However, the approach is intended as a general one, relevant also for different language features, to users from different language backgrounds, to learners at different levels, and to learners of other languages.

In the following section we introduce adaptive learning environments in order to explain the context of the typical learner model. We then present the idea of open learner models, and make the distinction between standard open learner models and independent open learner models. In Section 'OLMLA: an independent open learner model for language awareness', we describe our independent open learner model, and then present the results of an initial study of use of the independent open learner model in the section 'Will users accept an independent open learner model as a method of feedback?'.

Open learner models

Adaptive learning environments take account of individual differences between users. They maintain a model of the individual's current knowledge, skills or beliefs, commonly constructed based upon their recent actions in the environment (e.g. navigation, help or hints requested; and in particular, success (or otherwise) at tasks, or responses to questions). This learner model is dynamically updated as the student learns, enabling the environment to adapt the educational interaction according to the immediate learning needs of the user.

Many adaptive learning environments have been implemented for language learning, with recent examples including: e-Grammar, which adapts according to the student's age, native language, cultural background and level of knowledge (Yang et al., 2006); E-Tutor, that performs a linguistic analysis of learner input with the aim of offering error-specific feedback (Heift, 2008); TAGARELA, which models language use in context, relating linguistic ability to specific goals and tasks (Amaral & Meurers, 2007); the Intelligent Tutor for Academic English that allows communicative and analytical interaction styles according to learner preference (Dodigovic, 2005); TenseITS for the handheld computer, which adapts the interaction taking into account features of the learner's current location that may affect their ability to focus effectively on learning (Cui & Bull, 2005); the REAP tutor which allows student self-assessment of vocabulary to contribute to the personalised selection of appropriate texts from the Web (Kulkarni et al., 2008); ICICLE, which generates tutorial feedback based on the English text of deaf learners of English (Michaud & McCoy, 2006); a QA (question and answer) function to adaptively select questions on the semantics of stories (Kunichika et al., 2005); FreeText, which provides a multi-media communicative task-based approach to noticing and grammatical consciousness-raising (Hamel, 2008); and the Tactical Language and Culture Training System for the U.S. Military, which supports learners in their

acquisition of communication skills using interactive lessons and serious games (Johnson, 2007). It can be seen, therefore, that there is a range of potential applications for learner models in language learning, at various levels, and across different time-scales.

The learner model is usually hidden from the learner it represents, but increasingly environments are adopting an open learner model approach, in which the learner model is accessible for viewing by the user in an understandable format. One of the main reasons for opening the learner model to the learner is to prompt reflection on concepts, knowledge, skills and difficulties, and on their own understanding of the concepts, etc. Therefore, rather than presenting a performance score or general feedback related to the correctness or otherwise based on all answers, as is more common in computer assisted language learning (and more reflective of a standard 'testing' situation), displaying the learner model focuses the learner's attention towards the *current* state of their rule use, understanding or skills (i.e. as the learner model is dynamically updated during an interaction, the user sees the representations of their *present* knowledge state). Open learner models related to language have been developed for: technical terminology (Dimitrova, 2003); historical text comprehension (Grigoriadou et al., 2003); 'skill meter' overviews of knowledge level of English grammar items (Zapata-Rivera et al., 2007); and facilitating noticing in language learning (Shahrour & Bull, 2008). Similar approaches include the availability of performance reports (Heift, 2005). However, to date, few environments have opened the learner model to users such as ours.

An open learner model for non-native language speakers provides the user with the opportunity to scrutinise parts of their own language use. Increasing the saliency of linguistic features has been recommended for the computer assisted language learning context (Chapelle, 1998), and has been shown to help facilitate noticing in an open learner model (Shahrour & Bull, 2008; 2009). Allowing the second language (L2) speaker to inspect their learner model and to compare this information to a representation of the equivalent structures of the target language, can help raise awareness of gaps in their knowledge.

Open learner models can be part of larger adaptive learning environments, incorporating a model of the domain (or expert model) which, used together with the learner model, allows individualised tutorials, individualised feedback, instructional sequencing, a range of materials, exercises or tasks selected or generated as appropriate for the specific learner, etc.; or they can be used independently of a fuller environment - 'independent open learner models' (Bull et al., 2008). In the latter case, one of the primary aims is to promote learner independence and formative assessment (e.g. Bull et al., 2006), and to facilitate metacognition in learning (Bull & Kay, 2008). Thus, instead of the learner being closely guided by the system according to their needs, as inferred from their learner model with reference to the domain model, the independent open learner model is provided in order to give more control and responsibility to the learner, for their learning (see Kay, 1997). By showing the user representations of their understanding, the independent open learner model helps the learner to identify their knowledge for themselves, so that they may then decide where they need or wish to improve their knowledge and skills, and carry out the corresponding activities autonomously to achieve this improvement (i.e. without the more traditional individualised guidance of adaptive learning environments). This support for learner independence reflects the interest in self-directed language learning (e.g. Cotterall & Murray, 2009) and learner autonomy (e.g. Wenden, 1991). In our current study we adopted the independent open learner model approach as our

participants are advanced L2 speakers of English taking postgraduate courses (see below), and so are suited to independent study and are expected to be willing and capable of developing responsibility for their learning.

In the following section we present our independent open learner model for English modal verbs. We then describe the results of an investigation into students' acceptance of the approach as a form of feedback on their language use, and then discuss the extent to which users may be able to interact flexibly with the environment, according to their study preferences.

OLMLA: an independent open learner model for language awareness

This section describes the learner modelling process in OLMLA (Open Learner Model for Language Awareness), and then presents the independent open learner model, as viewed by the learner.

Learner modelling

The learner model of our system is constructed according to the student's responses to statements including modal verbs, which offer multiple alternatives to fill the blank, as shown in Figure 1. Each item has four options, only one of which is correct, and at least one of which corresponds to a specific common misconception amongst this target group. Users may choose to leave an item blank if they are unsure.

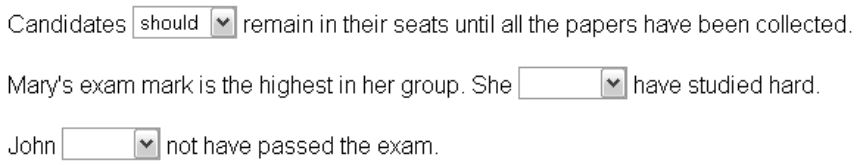

Figure 1. Excerpt from questions to model the learner's language rules

Of course, there are limitations to multiple-choice selection for evaluation of a learner's language use, for example, multiple-choice options may over-predict understanding, and they do not assess language production. However, multiple choice questions do require the student to select an option (i.e. make a choice), thereby circumventing conscious or unconscious language avoidance strategies (Mendychowski, 1993). Response options can be included to elicit common overgeneralisations, and typical difficulties of a specific language group such as related to language transfer - use of the rules of the native or other language in production of the target language (Odlin, 1989). (Future work could increase the range of tasks, or extend the methods of obtaining information about the user (see Jameson, 2007), as appropriate to the specific language learning context).

For this study the learner modelling technique is quite simple, though the open learner model approach can also be employed with more complex modelling techniques. Each component of the model is based on the learner's most recent five responses for questions on the rule concerned, dynamically updated with each further attempt. Thus the learner model always represents current rule use (i.e. it is not an overall performance score, but the model updates as a student interacts). Represented in the learner model are: misconceptions, identified by comparing the student's input to a misconceptions library of commonly used 'incorrect rules' by this target user group, as identified from the literature (see above); and knowledge level of 'correct

rules', stored in a separate representation of the relevant target language rules. (Note that our use of the term 'rule' is not intended to imply that the learner necessarily has an explicit knowledge of grammatical rules.) Users' use of eight verbs are modelled (can, could, may, might, must, ought to, shall, should) in relation to their function (describing: ability, inevitability, necessity, obligation, permission/promising, possibility/assumption, recommendation/suggesting, requesting). Table 1 shows the simple calculations for the learner model attributes - i.e. the user's use of each of the verbs.

Table 1. Classification of knowledge level for each rule (based on the last five attempts)

Knowledge Level	*Correct*	*Incorrect*	*Misconceptions*
Excellent	= 5	0	0
Good	>= 3	<= 2	<= 1
Problematic	<= 2	>= 3	<= 2
Misconceptions held	<= 2	<= 2	>= 3

The aim of the learner modelling in this environment is to identify the rules that the user is currently using consistently, be this native-like usage or 'incorrect' language. So, for example, if the user answered all five of their last five attempts at a particular rule correctly, their rule use is identified as 'excellent'. If they responded three or more times with a response indicating a misconception (i.e. consistently applying an incorrect rule), this is identified as a probable misconception, regardless of whether the other responses were correct or incorrect. Use of a rule is identified as 'good' if the user answered: (i) four questions correctly, and one with a general mistake (not identified as a misconception); (ii) four questions correctly, one with a misconception; (iii) three questions correctly, two with general mistakes (not identified as misconceptions); (iv) three questions correctly, one with a misconception and another incorrectly (not identified as a misconception). All other combinations are classified as 'problematic' (i.e. the user's answers neither indicate consistently correct rule use, nor a probable misconception).

As stated above, the open learner model approach could be used with more complex learner modelling techniques, for example: constraint based models (Mitrovic & Martin, 2007); Bayesian models (Zapata-Rivera & Greer, 2004); or it could be employed with similarly simple modelling approaches where the most recent of a set of representations are weighted more heavily in the model (Johnson & Bull, 2009). An adaptive testing technique could be used (see e.g Dunkel, 1999). For our study we selected an approach that has been shown to be useful to students across a selection of courses over time (Bull et al., 2008); and has been demonstrated to help facilitate noticing in language learning in a lab setting (Shahrour & Bull, 2008; 2009).

The independent open learner model

It has been found that students may have different preferences for the format of an independent open learner model: for computer programming (Mabbott & Bull, 2004); and music (Johnson & Bull, 2009). Furthermore, as identified in an eye-tracking study, students may pay attention to different information in their learner model depending on whether it is presented in a form that they prefer (Bull et al., 2007). OLMLA is therefore available in four formats to allow the learner to access the information in the manner that suits their preferences. Figure 2 shows the full screens to highlight the similarities and differences in the overall structures of these learner model views, and includes enlarged excerpts to illustrate the details.

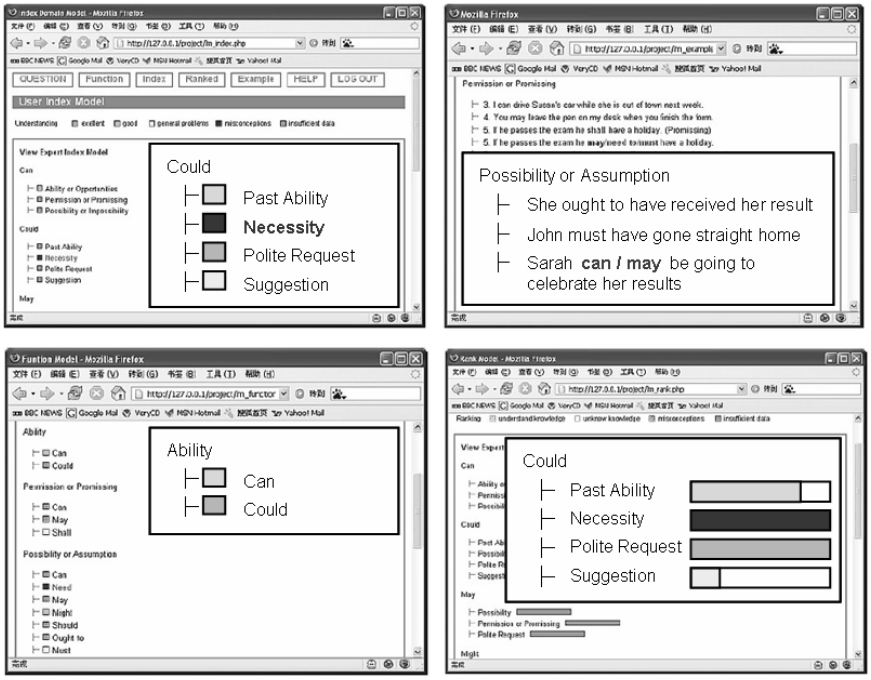

Figure 2. The multiple-view open learner model: (i) upper left - alphabetical index; (ii) lower left - language function; (iii) upper right - example sentences; (iv) lower right - skill meter

Each of the learner model presentation formats shows the user's use of modal verbs, with the aim of helping them to recognise the state of their knowledge as a starting point for their independent investigation of any difficulties. Green shows excellent rule use; blue, good rule use; yellow, problematic; red, the existence of consistently applied incorrect rules (modelled as misconceptions); and grey, rules for which there is insufficient data to model the learner. Again, our use of the term 'rule' should not be taken to imply that the learner necessarily has an explicit knowledge of the rule.

The *alphabetical index* (upper left of Figure 2) displays the modal verbs alphabetically. Our illustrative screen shows the learner's rules for 'can' followed by 'could' (with scrolling to access the remaining verbs). Taking 'could' as an example, the learner model indicates that the student uses 'could' to express: past ability, necessity, polite request and suggestion. The node for 'necessity' is red (shaded darker in Figure 2), to indicate that the learner's use of 'could' for necessity is a consistently applied incorrect rule for this learner.

The second example (lower left of Figure 2) shows the learner model organised by *language function*. Visible on the screen are: ability, permission or promising, possibility or assumption. Here the use of verbs for each of the functions is given. In the enlarged excerpt we show the learner's use of 'can' and 'could' to express ability. Similarly to the above, scrolling provides access to the other language functions modelled.

The *example sentence* view (top right of Figure 2) gives example sentences that could be generated from the learner's use of language. Therefore, for rules used correctly, a correct sentence is shown; and where there are difficulties, the sentence shows the learner's use. If the learner might use multiple rules (correct and/or incorrect), each example is given, e.g.: "Sarah can/may be going to celebrate her

results". (Note that these are *not* the user's answers to specific questions, but are examples of sentences the user might produce, given the current contents of their learner model.)

The final learner model view shows a *skill meter* (lower right of Figure 2) against each learner model entry. The skill meter portrays the extent to which the learner applies the rule correctly. For example, a full bar indicates that the learner uses the rule accurately ('excellent'). A mostly filled bar indicates that the learner has not fully acquired the rule, but is on the way to doing so ('good'), and so on. A red skill meter (darker shading for 'necessity' in Figure 2), is used where there is a misconception, similarly showing the extent of application of the incorrect rule.

As well as identifying their rule use for this aspect of language, use of an open learner model allows the learner to easily test their hypotheses as they may observe changes to their learner model as they try out different ideas in their selection of alternative responses to the multiple choice options offered for filling the gap.

In addition to the four views of the learner model, students can access the corresponding representations of the expert (or native speaker) rules in the same four formats, for comparison to the model of their own rule use. The aim is to help learners become aware of the difference between their learner model and the target rules (similar to 'noticing the gap' between their language and native speaker language (Schmidt & Frota, 1986)). Examples are given in Figure 3 for the alphabetical index and example sentence views, alongside the corresponding views of the learner model from Figure 2, for ease of comparison.

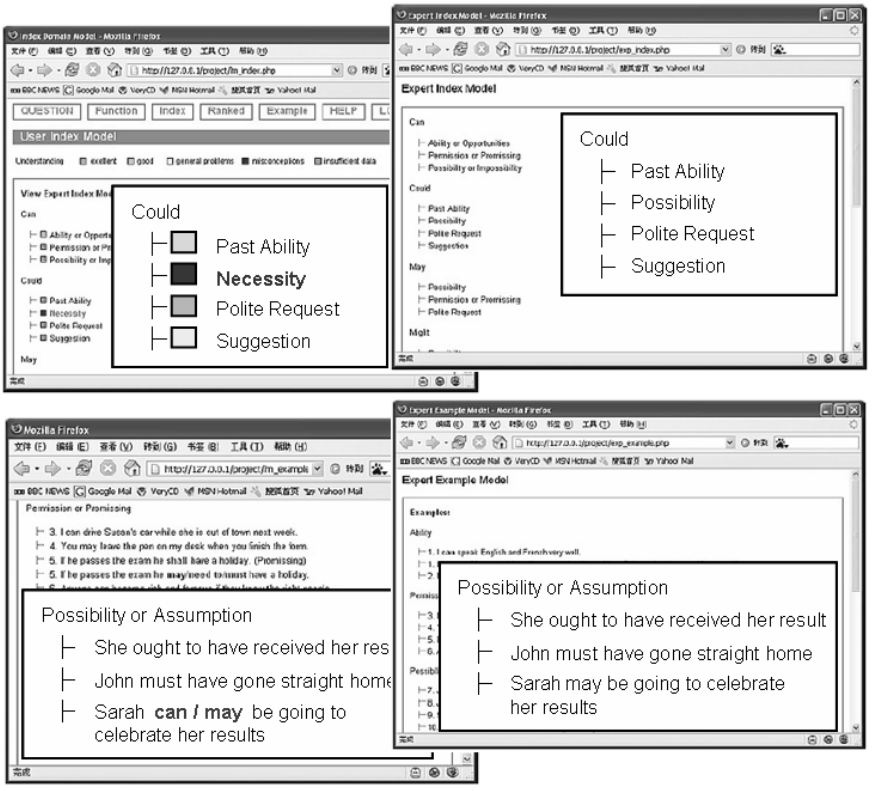

Figure 3. Comparison of two learner model views and the corresponding expert information: (i) upper - alphabetical index; (ii) lower - example sentences

In the alphabetical index (upper component of Figure 3), as stated previously, the learner model shows 'could' being used for necessity. Obviously this use is missing from the expert information, thus facilitating the student's recognition that their own use is incorrect. The expert information also shows 'could' used to indicate possibility - this use is missing from the learner model.

In the example sentence view, as described above, the learner model shows sentences that could be generated from the user's language rules. The expert information shows correct versions of the same sentences, for the context of use. Therefore, as for the alphabetical index presented above and the remaining two learner model views, this expert view is designed to highlight differences between the non-native speaker's language and the language of a native speaker.

It is not expected that this type of information will necessarily be sufficient for learners to acquire the underlying rules. Indeed, the aim is to provide students with a starting point: to raise their awareness in order that they may then start to notice use in the language they encounter, or prompt them to more actively investigate any highlighted difficulties. The next section presents a lab-based study of use of OLMLA.

Will users accept an independent open learner model as a method of feedback?

In this section we describe advanced L2 speakers' use of, and acceptance of the independent open learner model approach to facilitate recognition of remaining language difficulties. This is the first, but crucial step before deploying a larger scale system covering a greater number of potential language difficulties, suitable for users with a variety of language backgrounds. The aim of this stage of the research, therefore, is to identify how language users might use a system designed for independent study, to raise their awareness of the target language and their own problems. As stated previously, it has already been found that this type of open learner model *can* prompt noticing in language learners that can be retained over a one week period (Shahrour & Bull, 2008; 2009). The main question here is whether participants' usage patterns indicate that they are investigating their language use in relation to expert use (which could facilitate 'noticing the gap' (Schmidt & Frota, 1986)), and whether the provision of a choice of views of the learner model and expert language rules would be useful to cater for individual differences in preferences in this context. Specifically we examine:

(i) the number of inspections of expert information
(ii) the number of inspections of learner model viewings
- to determine which information participants use when allowed to interact freely
(iii) the breakdown of learner model viewing throughout the session
(iv) the breakdown of expert information viewing throughout the session
- to determine the timing of use of the learner model and expert information during the session
(v) the breakdown of inspections of the four views
- to determine the extent to which it is useful to provide alternative representations
(vi) user perceptions of the utility of OLMLA in helping them identify their difficulties.
- to determine user acceptance of the independent open learner model approach as helpful in their learning

Thus our aim is to provide information to help inform future designs of open learner models for language learning.

Participants, materials and methods

Participants were volunteers: 15 Chinese MSc students studying at the University of Birmingham. All had already reached an advanced level in English as required for postgraduate study (IELTS 6.0 minimum for Science and Engineering subjects), and were no longer formally studying English. At the time of the study the participants were close to the stage of writing their final project reports and were, for the most part, anxious about certain aspects of their English, including their use of modal verbs.

Participants were given a demonstration of OLMLA, and allowed to explore it to the extent they wished for familiarisation, before commencing their session. The experimenter was available to answer any questions about system use. Participants selected their responses (presented as shown in Figure 1) to enable the learner model to be constructed, and viewed their learner model and the expert information as required (Figures 2 and 3). No direction was given as to the expected frequency of model viewing, and participants were informed that they should use (only) those views that they found helpful (i.e. it is not expected that students should use all views). Sessions lasted around 40 minutes. All interactions were logged by the system to enable identification of actual usage: the number and timing of inspections of the learner model and expert information; and the number and timing of inspections of the specific views. The learner models were also used to identify the difficulties that students had. As the purpose of the independent open learner model is to trigger *subsequent* noticing or further work, we do not here use pre- and post-tests to measure improvement. As stated above, such noticing has already been identified in Shahrour & Bull (2008; 2009).

At the end of the session a questionnaire was administered, with responses to statements required on a five-point scale (strongly agree, agree, neutral, disagree, strongly disagree). For clarity of presentation of the results, we combine the responses of strongly agree and agree; and strongly disagree and disagree.

Results

Table 2 shows the number of general problems (lack of consistent correct rule use) and specific misconceptions (consistently incorrectly applied rule, or consistently applied incorrect rule) demonstrated at some stage during participants' interactions, identified from the learner models. (We consider a problem or misconception to have been revealed if a representation appeared in the learner model for a verb not used appropriately - i.e. one of the eight verbs used incorrectly with reference to the eight language functions.)

Only one participant had no difficulties with the use of modal verbs, and only one user had just one difficulty (misconception). The mean number of general problems was 1.8; median, 2; and range, 0-3. The mean number of misconceptions held was 1.3; median, 1; range, 0-3. Considering both categories together, the mean number of difficulties was 3.1; median, 3; and range, 0-5. Therefore, despite their advanced level, most students still had some difficulties with modal verbs.

Table 2. Number of difficulties demonstrated by participants

User	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
general problems	2	3	1	1	2	3	0	1	2	0	2	2	3	3	2
misconceptions	1	0	3	1	0	1	1	2	2	0	3	2	1	2	1
gen. prob. + misconceptions	3	3	4	2	2	4	1	3	4	0	5	4	4	5	3

Figure 4 shows the figures for use of the expert information and learner model views (points i, ii & v). Learner models were consulted more frequently, but expert information was also consulted for each view. It was not necessarily the case that a learner's most frequently used expert view matched their most frequently used learner model view. This can be seen, for example, with the index view, which was the most frequently used learner model view, but not the most frequently used expert view; and the function and example sentence views which had similar levels of inspections of the learner models, but differing levels of access to the expert information.

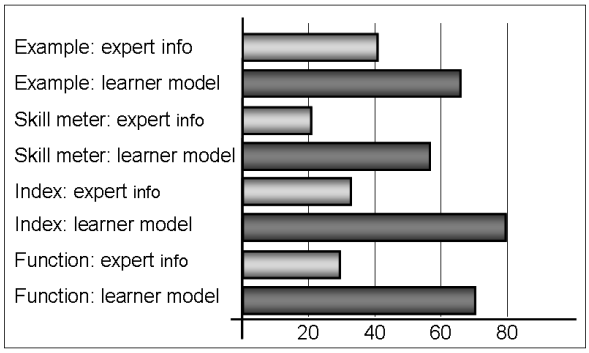

Figure 4. Inspections of the expert information and learner model views (logs)

Figure 5 shows the number of inspections of the learner model and expert information throughout the session (points iii & iv), taken from the system logs of all users. Initially, in the first five minutes after completion of the familiarisation period, there was a high level of use of the learner model views and relatively little use of the expert information. During the next five minutes (5-10) and also the following five minutes (10-15), the level of viewing of the learner model dropped to about half its previous level. Viewings of the expert information increased to almost match the level of learner model viewings during this period. After 15 minutes, the viewing levels of both dropped.

With reference to point v, Figure 6 shows the breakdown for each of the learner model views. Except for the skill meter view, where initial inspections were lower, the pattern for the separate views follows that of the viewings overall. There was more variation between views for the expert information, as shown in Figure 7, though the general pattern of fewer initial viewings followed by an increase, then decrease, holds for each of the views. Figure 8 shows use of the individual expert and learner model views compared against each other over time, confirming the general pattern as described above.

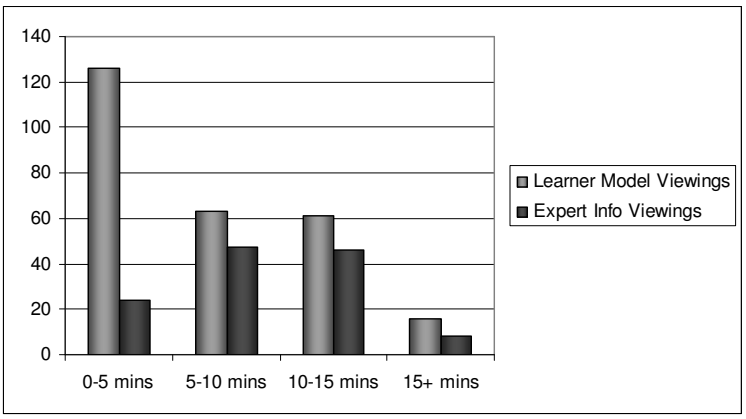

Figure 5. Inspections of the learner model and expert information throughout the sessions (logs)

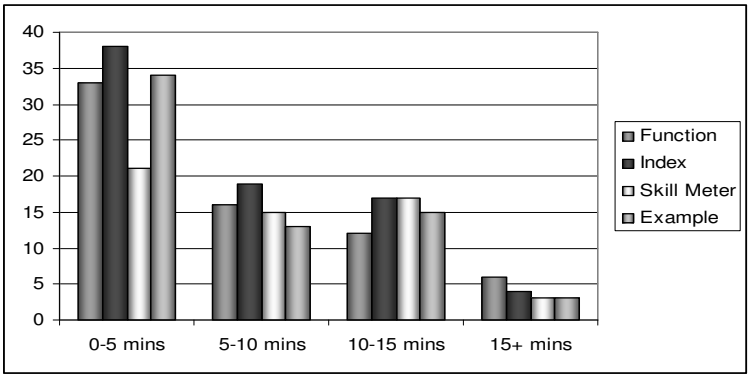

Figure 6. Inspections of the learner model views throughout the sessions (logs)

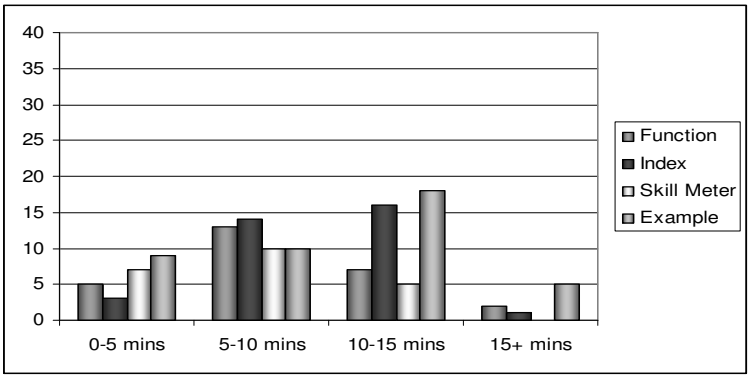

Figure 7. Inspections of the expert views throughout the sessions (logs)

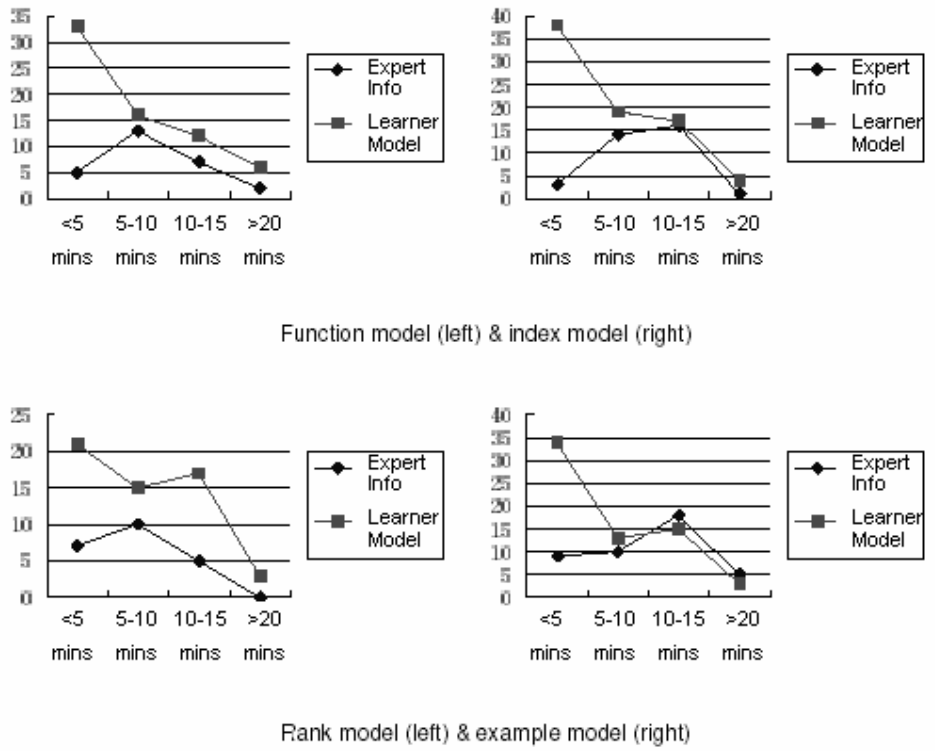

Figure 8. Inspections of the individual learner model and expert information views (logs)

Table 3 shows the perceived utility of the open learner model for recognising difficulties (general problems and misconceptions), as indicated by the questionnaire responses (point vi). An asterisk indicates that a participant claimed to find at least one of the open learner model views useful for identifying the corresponding difficulty. A dash indicates that the student did not have the difficulty indicated (and so would not be able to judge the utility of the open learner model for identifying the difficulty). Blank cells indicate that the student had at least one instance of the difficulty, but answered neutrally or negatively in response to the questionnaire statement about the utility of the open learner model for identifying general problems or misconceptions.

Table 3. Perceived utility of the open learner model for identifying general problems and misconceptions (questionnaires)

User	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
general problems	*	*	*		*	*	-		*	-	*	-	*	*	*
misconceptions	*	-	*	*	-		*	*	*	-	*	*	*	*	*

There were three cases where participants had difficulties but did not respond positively with reference to the open learner model being useful to help identify their general problem (2 users) or misconception (1 user). As can be seen by comparing Table 3 with Table 2, in all three of these cases, the user had only one difficulty. Thus those with a greater number of difficulties did appear to find the open learner model helpful as a support for the identification of their problems. The only user who did not

find the open learner model useful for identifying difficulties was the user who had no difficulties with modal verbs.

Discussion

This study builds on findings that noticing in language learning may be prompted using an independent open learner model (Shahrour & Bull, 2008; 2009); we have therefore not here investigated actual noticing of the features that have been highlighted to the users.

Despite the fact that our participants were advanced second language speakers who had previously studied modal verbs, as shown in Table 2 the learner models indicated that only one student had no difficulties, and only one had just one difficulty, with a mean of 3.1; median of 3; and a range of 0-5 problems appearing in the learner models. While these numbers seem quite low, it must be remembered that the domain covered by the system was narrow. Had other language features been included, more difficulties would likely have been revealed. Therefore there does appear to be a place for raising the awareness of advanced L2 speakers, of their difficulties.

As shown in Figure 4, each of the four learner model views had continued use during the session (after the familiarisation period). Therefore we suggest providing a range of learner model views in order to allow the user to select the option they prefer (as recommended previously for computer programming (Mabbott & Bull, 2004) and music (Johnson & Bull, 2009), as also being applicable for advanced L2 speakers. Addressing such preferences is important as users may pay attention to different information in their learner model depending on whether it is presented in a format that they are comfortable with (Bull et al., 2007).

There were more learner model viewings made, than expert information viewings. This is not surprising since it may be more difficult for a learner to gain a meaningful overview of their own language use, than to interpret expert rules (as the learner model shows a different type of information from that which they would normally see). As shown in Figure 5, initially, during the first five minutes, students accessed their learner model more frequently than the expert information as they tried to gain an understanding of their language rules for this aspect of English. Subsequently their rate of viewing their learner model dropped by about half over the next ten minutes, while their rate of viewing the expert information increased to become close to the viewing levels of the learner model at that time, as students compared their own language use to the target rules. Viewing levels of both sets of data then dropped once students had made the comparisons. The timing of this decrease in accessing the learner and expert views may of course be because we were using a restricted domain for the purpose of the study. Nevertheless, we suggest that an independent open learner model may be a useful means of allowing students to gain a better understanding of the state of their language, as students were examining their learner model and then comparing to the expert information spontaneously (i.e. without specific instructions to do so) in our study. This outcome should be verified over a longer time period, to determine whether users maintain their interest. Similarly, we do not know the extent to which students would inspect their learner model and the expert information if a greater range of language features were included. However, even if students do not retain interest, this kind of approach could still be used for a restricted set of key or typical difficulties experienced by users (for example, designed for a specific target group for common problems resulting from language transfer

(Odlin, 1989)), as interest (or, at least, curiosity) has been demonstrated for a shorter time period and a small set of language rules. Furthermore, use of a simple independent open learner model has been maintained over a term in other university courses (in electronic, electrical and computer engineering subjects - Bull et al., 2008).

While in this study we used an independent open learner model as our participants were at advanced levels of study, where there is a high expectation of learner independence, our results may also be applicable to open learner models embedded in larger systems where the computer-based learning environment aims to guide the learner more closely. This may be particularly applicable to learners at a lower level, or those who are less successful or less experienced with independent learning.

Summary

Open learner models have been used to help raise learner awareness of their knowledge, difficulties and misconceptions, in order to support reflection on learning, development of self-assessment skills, development as autonomous learners, planning of learning, etc. Open learner models can also be useful to support the advanced language speaker, to encourage learner autonomy and the other metacognitive benefits listed above, but also to support some of the key issues that relate to language learning. In particular, this paper has focused on the potential for using an independent open learner model to raise the advanced L2 speaker's awareness of the state of their language use, in comparison to native speaker use.

Students initially used their open learner model to identify their rule use. Once they had gained an understanding of their own rules, their inspection of their learner model decreased, while inspections of the expert information increased, as students compared the two. Participants generally claimed to find the explicit identification of their current rule use, to be useful, and used different learner model views. We therefore recommend further investigation of open learner models to support the language learner, both in understanding their language use and in noticing the distance of their language from the target.

References

Amaral, L. & Meurers, D. (2007). Conceptualizing Student Models for ICALL, in C. Conati, K. McCoy & G. Paliouras (eds), *User Modeling 2007: 11th International Conference*, Springer-Verlag, Berlin Heidelberg, 340-344.

Bull, S., Cooke, N. & Mabbott, A. (2007). Visual Attention in Open Learner Model Presentations: An Eye-Tracking Investigation, in C. Conati, K. McCoy & G. Paliouras (eds), *User Modeling 2007: 11th International Conference*, Springer-Verlag, Berlin Heidelberg, 177-186.

Bull, S. & Kay, J. (2008). Metacognition and Open Learner Models, in I. Roll & V. Aleven (eds), *Proceedings of Workshop on Metacognition and Self-Regulated Learning in Educational Technologies*, International Conference on Intelligent Tutoring Systems, 7-20.

Bull, S., Mabbott, A., Gardner, P., Jackson, T., Lancaster, M., Quigley, S., Childs, P.A. (2008). Supporting Interaction Preferences and Recognition of Misconceptions with Independent Open Learner Models, in W. Nejdl, J. Kay, P. Pu, & E. Herder (eds), *Adaptive Hypermedia and Adaptive Web-Based Systems*, Springer-Verlag, Berlin Heidelberg, 62-72.

Bull, S., Quigley, S. & Mabbott, A. (2006). Computer-Based Formative Assessment to Promote Reflection and Learner Autonomy, *Engineering Education: Journal of the Higher Education Academy Engineering Subject Centre* 1(1), 8-18.

Chang, J. (1987). Chinese Speakers, in M. Swan & B. Smith (eds), *Learner English*, Cambridge University Press, Cambridge, 224-237.

Chapelle, C.A. (1998). Multimedia CALL: Lessons to be Learned from Research on Instructed SLA, *Language Learning and Technology* 2(1), 22-34.

Cotterall, S. & Murray, G. (2009). Enhancing Metacognitive Knowledge: Structure, Affordances and Self, *System* 37(1), 34-45.

Cui, Y. & Bull, S. (2005). Context and Learner Modelling for the Mobile Foreign Language Learner, *System* 33(2), 353-367.

Dimitrova, V. (2003). StyLE-OLM: Interactive Open Learner Modelling, *International Journal of Artificial Intelligence in Education* 13(1), 35-78.

Dodigovic, M. (2005). *Artificial Intelligence in Second Language Learning: Raising Error Awareness*, Multilingual Matters Ltd., Clevedon.

Dunkel, P.A. (1999). Considerations in Developing and Using Computer-Adaptive Tests to Assess Second Language Proficiency, *ERIC Clearinghouse on Languages and Linguistics*, EDO-FL-99-07.

Ellis, R. (2005). Principles of Instructed Language Learning, *Asian EFL Journal* 7(3), 9-24.

Grigoriadou, M., Tsaganou, G. & Cavoura, T. (2003). Dialogue-Based Reflective System for Historical Text Comprehension, in S. Bull, P. Brna & V. Dimitrova (eds), *Proceedings of Workshop on Learner Modelling for Reflection*, Supplemental Proceedings vol 5, International Conference on Artificial Intelligence in Education 2003, 238-247.

Hamel, M-J. (2008). Natural Language Processing Tools in CALL, in D. Ayoun (ed), *Studies in French Applied Linguistics*, John Benjamins Publishing Company, Amsterdam.

Heift, T. (2005). Inspectable Learner Reports for Web-Based Language Learning, *ReCALL* 17(1), 32-46.

Heift, T. (2008). Modeling Learner Variability in CALL, Computer Assisted Language Learning 21(4), 305-321.

Hinkel, E. (1995). The Use of Modal Verbs as a Reflection of Cultural Values, *TESOL Quarterly* 29(2), 325-343.

Jameson, A. (2007). Adaptive Interfaces and Agents, in J.A. Jacko & A. Sears (eds). *Human-Computer Interaction Handbook*, 2nd Edn, Lawrence Erlbaum Publishers, Mahwah.

Johnson, M. & Bull, S. (2009). Belief Exploration in a Multiple-Media Open Learner Model for Basic Harmony, in V. Dimitrova, R. Mizoguchi, B. Du Boulay & A. Graesser (eds), *Artificial Intelligence in Education*, IOS Press, Amsterdam, 299-306.

Johnson, W.L. (2007). Serious Use of a Serious Game for Language Learning, in R. Luckin, K.R. Koedinger & J. Greer (eds), *Artificial Intelligence in Education*, IOS Press, Amsterdam, 67-74.

Kay, J. (1997). Learner Know Thyself: Student Models to Give Learner Control and Responsibility, *International Conference on Computers in Education*, AACE, Charlottesville, VA, 17-24.

Kulkarni, A., Heilman, M., Eskenazi, M. & Callan, J. (2008). Word Sense Disambiguation for Vocabulary Learning, in B.P. Woolf, E. Aimeur, R. Nkambou & S. Lajoie (eds), Intelligent Tutoring Systems, 9th International Conference, Springer-Verlag, Berlin Heidelberg, 500-509.

Kunickika, H., Urushima, M., Hirashima, T. & Takeuchi, A. (2005). Realizing Adaptive Questions and Answers for ICAL Systems, in C-K Looi, G. McCalla, B. Bredeweg & J. Breuker (eds), *Artificial Intelligence in Education*, IOS Press, Amsterdam, 854-856.

Mabbott, A. & Bull, S. (2004). Alternative Views on Knowledge: Presentation of Open Learner Models, in J.C. Lester, R.M. Vicari & F. Paraguacu (eds), *Intelligent Tutoring Systems: 7th International Conference*, Springer-Verlag, Berlin Heidelberg, 689-698.

Mendychowski, M. (1993). Multiple Choice - Testing or Something More? *CALICO Journal* 10(3). Available from: https://www.calico.org/html/article_547.pdf (accessed 17 September 2007).

Michaud, L.N. & McCoy, K.F. (2006). Capturing the Evolution of Grammatical Knowledge in a CALL System for Deaf Learners of English, *International Journal of Artificial Intelligence in Education* 16(1), 69-97.

Mitrovic, A., Martin, B. (2007). Evaluating the Effect of Open Student Models on Self-Assessment. *International Journal of Artificial Intelligence in Education* 17(2), 121-144.

Mohamed, A.R., Lian, G.L. & Eliza, W.R. (2004). English Errors and Chinese Learners, *Sunway College Journal* 1, 83-97.

Odlin, T. (1989). *Language Transfer, Cross-Linguistic Influence in Language Learning*, Cambridge University Press, Cambridge.

Rutherford, W.E. & Sharwood Smith, M. (1985). Consciousness-Raising and Universal Grammar, *Applied Linguistics* 6(3), 274-282.

Schmidt, R.W. (1990). The Role of Consciousness in Second Language Learning, *Applied Linguistics* 11(2), 129-158.

Schmidt, R. & Frota, S. (1986). Developing Basic Conversational Ability in a Second Language: A Case Study of an Adult Learner of Portuguese, in R.Day (ed), *Talking to Learn: Conversation in Second Language Acquisition*, Newbury House, Rowley, MA, 237-326.

Shahrour, G. & Bull, S. (2008). Does 'Notice' Prompt Noticing? Raising Awareness in Language Learning with an Open Learner Model, Adaptive Hypermedia 2008, Springer-Verlag, Berlin Heidelberg, 173-182.

Shahrour, G. & Bull, S. (2009). Interaction Preferences and Learning in an Inspectable Learner Model for Language, in V. Dimitrova, R. Mizoguchi, B. Du Boulay & A. Graesser (eds), *Artificial Intelligence in Education*, IOS Press, Amsterdam, 659-661.

Swan, M. (2005). Legislation by Hypothesis: The Case of Task-Based Instruction, *Applied Linguistics* 26(3), 376-401.

Wenden, A. (1991). *Learner Strategies for Learner Autonomy*, Prentice Hall, Hemel Hempstead.

Yang, M., Zapata-Rivera, D. & Bauer, M. (2006). E-Grammar: An Assessment-Based Learning Environment for English Grammar, in E. Pearson & P. Bohmen (eds), *Proceedings of World Conference on Educational Multimedia, Hypermedia and Telecommunications*, Association for the Advancement of Computers in Education, Chesapeake VA, 2474-2479.

Zapata-Rivera, J.D., Greer, J.E. (2004). Interacting with Inspectable Bayesian Models, *International Journal of Artificial Intelligence in Education* 14, 127-163.

Zapata-Rivera, J.D., Vanwinkle, W., Shute, V., Underwood, J.S. & Bauer, M. (2007). English ABLE, in R. Luckin, K.R. Koedinger & J. Greer (eds), *Artificial Intelligence in Education*, IOS Press, Amsterdam, 323-330.