Validating Design Knowledge in the Home: A Successful Case-study Of Dementia Care

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ABSTRACT

This paper reports research, which aims to validate design knowledge, as the products of a structured analysis and design method (MUSE – Lim and Long, 1994). The products or 'containers' of the method (MUSE(C)) are used in the re-design of a range of domestic technologies, intended to support dementia care in the home. The case-study is judged a success. An evaluation showed the technologies to be more effective following re-design. The design products were shown to be correctly operationalised. Problems in their application are documented. MUSE(C) can, thus, only be considered to have been partially validated. The solution of these problems constitutes a requirement for future research.

Keywords

Design knowledge, validation, structured methods, dementia care, home technologies.

INTRODUCTION

Technology is fast becoming as pervasive in the home as in the workplace. As a result, Cognitive Ergonomics is increasingly concerned with how people use technology in their daily lives and, in particular, how to understand, design and evaluate such technology. The research, reported here, reflects trends in all three areas, of homecare, technology and Cognitive Ergonomics.

Trends in healthcare include the reduction of patients' 'stay time' in acute care centres and the move away from emergency medical treatment of patients to disease management and prevention. This transition from organised centres to flexible patients' homes constitutes a major trend in homecare (Mamykina et al., 2004). In addition, the proportion of older people in the population continues to increase (Audit Commission, 1997). Most of these people would prefer to live at home. In the UK, government initiatives, such as 'Care in the Community' also support the notion of home-based care.

Trends in technology development to support homecare include: the use of sensors for monitoring; the recognition that technology needs to include all the (designed) artefacts of domestic systems and not just information technology; and the importance of usability, with respect to 'designing for all' (Askham, 2002).

Trends in Cognitive Ergonomics include the transfer of design knowledge from the workplace to the home (Long, 2004) and the ongoing need to validate that knowledge. For example, researchers have been criticised for not building on each others' work. Newman (1994) claimed that only 30% of such work enhanced modelling techniques, solutions and design tools, as against 90% for Engineering more generally. Elsewhere, Long (1996) claims that poor discipline progress resides partly in the failure of research to validate its design knowledge.

The aim of this paper is to report a successful case-study, which attempts to validate design knowledge by applying the products of a structured method – MUSE (Method for Usability Engineering – Lim and Long, 1994) to the re-design of dementia care technology in the home.

OVERVIEW OF MUSE AND MUSE(C)

MUSE is a structured analysis and design method for use by human factors specialists. The product of MUSE is the specification of an interaction artefact. The method approaches design in a 'top-down' manner, based on information derived 'bottom-up'. MUSE is divided into phases and stages, each of which results in one or more design products. The first phase is that of Information Elicitation and Analysis, which identifies desirable and undesirable features of existing systems. The second phase, Design Synthesis, establishes the human factors perspective on the design, the semantics of the application domain and the conceptual design of the artefact. The final phase is that of Design Specification, in which the conceptual design is decomposed to a device-specific, implementable and interactive artefact. A schematic representation of the MUSE method appears in Figure 1.

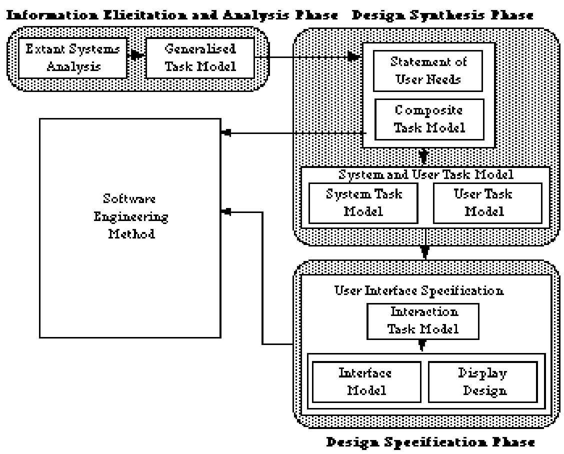

Figure 1. A schematic Representation of the MUSE Method (Lim and Long, 1994)

MUSE(Containers), that is, MUSE(C) was proposed by Colbert (see Murphy, 1997) as a derivative of MUSE. It consists of MUSE design products (that is, the containers), but not the procedures, or notations (with respect to which human factors specialists are assumed to have training, sufficient to carry out the required design processes, for example, task analysis, allocation of function, task synthesis etc.). MUSE(C) is claimed suitable for advanced technology projects in which ‘concept demonstrators’, using new technology, need to be developed often in the absence of detailed user requirements. Products are developed as and when possible. The semantics of the application domain, for example, might be explicitly developed early or late in a project, depending on the timing of domain selection. MUSE(C) attempts to exploit the structured features of MUSE, that is, its comprehensive set of design products, without commitment to its associated design procedures and notations.

FEATURES OF A MUSE(C) APPLICATION

Following Long (1996), the validation of design knowledge requires its: conceptualisation; operationalisation; test; and generalisation. Any case-study, then, which aims to test MUSE(C), must ‘correctly’ operationalise those features of the method, explicit in its conceptualisation (Stork, Middlemass and Long, 1995). For MUSE(C), these features are: 1. design completeness; 2. design consistency; 3. application of domain knowledge; 4. application of human factors knowledge; 5. integration of desirable features of existing systems; 6. design rationale for 3, 4, and 5; and 7. these features as embodied in MUSE(C) products. Such address by the products constitutes a pre-requisite for the validation (or not) of the method.

In addition, case-studies of such methods can be considered ‘successful’ or ‘unsuccessful’ (Middlemass, Stork and Long, 1999). Successful case-studies demonstrate that a method, here the design products of a method, are applicable to a type of design scenario (and so contribute to the validation of the method/products by specifying interaction artefacts, required by the scenario). Unsuccessful case-studies demonstrate that a method is not applicable to a type of design scenario, failing to produce interaction artefacts, required by the scenario. To enable reasoning about the implications of successful and unsuccessful case-studies, the types of design scenario can be characterised in terms of how well-defined, complex and observable they are (as proposed by Stork et al., 1995). Thus, successful and unsuccessful case-studies can support the development of more effective versions of the method/products by showing that their current applicability does, or does not, extend to design scenarios of a certain sort.

CASE-STUDY DESIGN SCENARIO

The design scenario for the present case-study is that of an advanced research and development project, whose aim is to develop more effective technologies, to support dementia care in the home for both carers and carees. The project is in an initial phase, intended to produce a rapid re-design of current technologies, as a demonstrator to suggest ways of developing the technologies further. There are no detailed user requirements as such. However, the design scenario requires the specific re-design of current technologies and general suggestions, concerning the development of future technologies. In terms of the design scenario characteristics, cited earlier, the present scenario is not well-defined. Neither the range of technologies, nor the users, nor effectiveness are well specified. The scenario is not complex. The technologies are simple. Only the caree and the carer are involved in their use. Last, the scenario is very observable, the designer had full access to both the caree and the carer.

In the case-study, the caree (or cared for) is ‘A’, who suffers from fronto-temporal dementia (FTD). Typically, FTD preserves the instrumental tools of cognition, but impairs their effective application in the service of purposive, goal-directed behaviour (Snowden, Neary and Mann, 1996). Visual and auditory perception are preserved, along with motor and spatial skills. FTD, however, while not resulting in clinical amnesia, causes difficulties in information generation and organised search. Concerning executive, that is, regulatory/control functions, FTD results in poor sustained attention, poor cognitive application to tasks and poor self-monitoring, so that errors go unrecognised. Abstraction, planning, organisational and strategic functioning, as well as cognitive flexibility, are also impaired. (Snowdon et al., 1996). In summary, and for design purposes, FTD can be considered to impair both memory and reasoning.

‘B’ is ‘A’s husband and full-time, principal carer. ‘C’ is a human factors specialist, but with no MUSE application experience and no knowledge of FTD. 'C' knew 'A' and 'B' before the onset of FTD, but was not an intimate of theirs. 'C' had access to 'A' and 'B', the caree and the carer, and also to the method/products to be validated, in the form of a paper-based version of MUSE(C) (Murphy,1997). 'C' was responsible for the products application and the re-design. 'C' also kept a design diary, which was used to record any decisions or strategies 'C' adopted tp apply MUSE(C). The diary was to inform 'C's difficulties in the application. 'C' is the second author of this paper. The scope of the application is 'A's quality of life and workload, as supported by the domestic living/dining rooms' technology systems and sub-systems (for example: hifi, radio, Walkman , piano etc).

'D', experienced in MUSE applications, acted as an 'intelligent interface' to the method/products of MUSE(C). If 'C' was unable to apply any of the MUSE(C) products, he asked 'D', who advised him how to proceed. In addition, 'D' monitored 'C's re-design products and identified any misapplication of MUSE(C) and indeed any MUSE(C) misapplication of MUSE, which might have jeopardised completion of the case-study. All of 'C's application difficulties and all other product misapplications, of whatever sort, were categorised as MUSE(C) design problems and documented. Possible design solutions were also suggested and recorded. These design problems and solutions are reported later (see Table 3). 'D' is the first author of this paper.

APPLICATION

MUSE(C) was applied by 'C' to the full range of domestic technologies, used by 'A', sometimes with the support of 'B'. The range includes the following sub-systems: hifi (comprising CDs, tapes and radio); jigsaw/games; TV and VCR playstation; books and magazines; photo albums; ornament case; and tapestry. For the full range – see Table 2 later. Products here, however, are illustrated only for the re-design of the hi-fi system, due to space limitations. The system consisted of a stack of sub-systems, comprised, from the bottom up, of: amplifier; tape player; CD player; and radio. All systems have an 'on/off' power switch. The amplifier (having its own power switch) services all other sub-systems, which are selected by means of a 'function', that is, 'mode' switch. Examples are provided for all MUSE method phases (see Figure 1). In addition, each example identifies the 'correct' MUSE(C) features operationalised (see earlier).

Phase 1 Information Elicitation and Analysis

This phase includes the following containers: Task Description of current and related systems (TD); Rationale for the re-use of design features; and Generalised Task Model for existing and target (that, is, to-be-designed) systems. Figure 2 shows a TD for 'A's use of the CD sub-system, as part of the hifi system. A TD characterises the use of current and related systems. It describes the composition of the task (that is, sub-tasks etc) and the sequence, selection, and iteration of task steps. In addition, it notes observations (for example, of errors and difficulties and their frequencies) and the associated implications/speculations for re-design. The level of description varies – high enough to express the logical (that is, device independent) characteristics of the system, but low enough to capture important (that is, good and bad) interaction design features.

As can be seen in Figure 2, 'B' supports 'A' in the selection of the CD to be played – first by music type – classic, salsa, or jazz, then by CD instance – Rachmaninov, Mahler, Mozart etc. Although keen to listen to music she enjoys, 'A' fails to initiate the playing of music, either due to impaired memory or reasoning or both. 'A' then prepares the hifi for use,

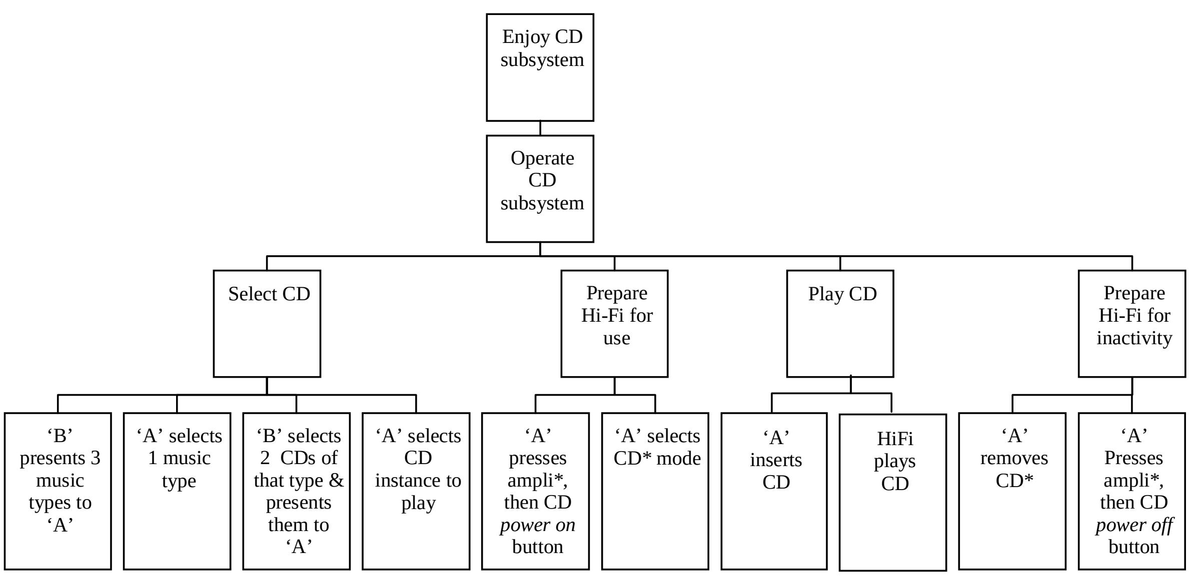

Figure 2 - Task Description of extant HiFi subsystem (*'A' often forgets, and 'B' performs the action instead.)

plays the selected CD and prepares the CD for inactivity. However, although ‘A’ has no difficulty activating the CD ’ power on’ and ’power off’ buttons, she often forgets to activate the amplifier ’power on’ and ‘power off’ and function buttons. If the hifi plays the CD, but emits no sound, because it is in tape mode, ‘A’ is unable to reason that either the amplifier is not switched on or it is switched on, but not in CD mode. Being unable to listen to the CD reduces ’A’s quality of life. ‘A’ had no difficulty using the hifi before the onset of FTD. Indeed, she was mostly responsible for its specification and acquisition.

The TD operationalises Feature 1 of the MUSE(C) application criteria (see earlier) – design completeness. CD selection, as well as the playing of the CD are included. Also operationalised are Features 3 and 4 – application of domain and human factors knowledge, as reflected in the identification of CD mode errors, due to memory and/or reasoning impairments.

According to MUSE(C), a Rationale is an appreciation of characteristics of existing systems, which may be beneficially re-used in the system to be re-designed. Here, the organisation of the music media is carried forward into the re-design, for example, the alphabetical organisation of the tapes by composer and the three music categories, then alphabetical organisation of the CDs by musician/singer.

Phase 2 Design Synthesis

This phase includes the following containers: Statement of User Needs, expressed as a human factors perspective on the re-design (derived from the analysis of Phase 1); Domain of Design Discourse, that is, the semantics of the domain entities and their relations; Domain Objects and Relations, that is, what can be performed on the latter by the former; Composite Task Model (CTM), that is, a device independent model of the re-designed system; System Task Model, that is, a decomposition of the CTM; and User Task Model, that is, the user’s off-line – non-technology based – tasks.

Figure 3 shows a CTM for the re-designed CD player sub-system. The CTM is device independent and synthesises desirable design features of existing and target Generalised Task Models (see Phase 1 earlier). The CTM distinguishes on-line tasks, which require interaction with the technology, such as ‘play music’, from off-line tasks, which require no such interaction, such as ‘select music’. The CTM comprises the selection, the supply, and the playing of music and the preparation for inactivity of the hifi.

The STM decomposes the CTM and describes cycles of user-device interactions, required to perform on-line (that is, technology-supported) tasks. In the re-designed hifi system, ‘select music’ is an off-line task (see Figure 3), performed by ‘A’ with ‘B’s support, as in the existing system (see Figure 2). However, ‘prepare hifi for use’ and ‘inactivety’ are now performed entirely by ‘B’ (to avoid ‘A’s amplifier power on and CD mode errors), while ‘A’ continues to perform

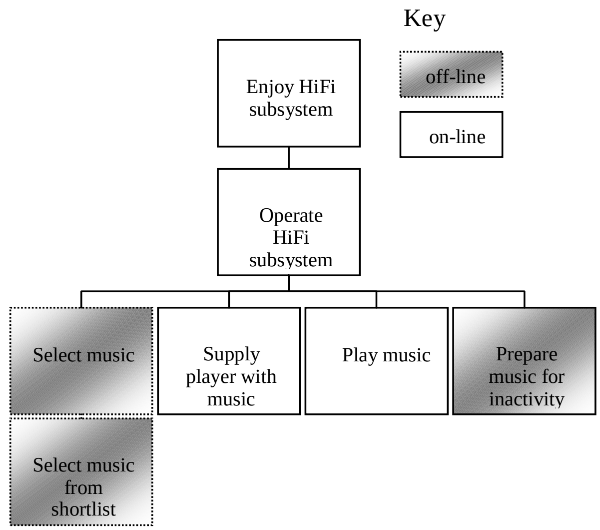

Figure 3 - Composite Task Model of CD Player Sub-system

‘supply music’ and ‘play music’, which she is able to carry out correctly. ‘A’, thus, continues to select and to play CDs and so to enjoy music and to sustain her quality of life. The re-designed STM illustrates Feature 5 – integration of desirable features of existing systems. ‘A’ and ‘B’s joint selection of music is retained and ‘A’s playing of the CDs is supported by the re-design. The latter also illustrates Feature 6 – design rationale. Hifi preparation is allocated to ‘B’ to avoid ‘A’s amplifier and mode errors.

Phase 3 Design Specification

This phase specifies the design in sufficient detail to be implemented. It includes the following containers: Interaction Task Model (ITM), that is user behaviours; Interface Model, that is, device behaviours; Pictorial Screen Layout, that is, display design; Dialogue and Error Message Table, that is, error dialogue; Dialogue and Inter Task Screen Actuation Descriptions, that is, screen activations; and Dictionary of Screen Objects, that is, display graphical representations.

An ITM is a device-level description of user behaviours, representing error-free interactions, in terms of hardware input actions and user interface development environment (if used in the design process). The ITM groups meaningful task units for the user and is linked to lower level design products, for example, pictorial screen layout, interface model, dialogue and error messages etc (see earlier). Its purpose is to decompose the system task model further (also see earlier) and to support subsequent design of device behaviour, error recovery, feedback messages and screen displays.

Table 1 shows an ITM for the re-designed CD sub-system. It describes the behaviours of ‘A’ for introducing and playing of CDs (Column 2 – user actions – see Figure 3). A ‘media receptacle’ now performs in the new design the function of CD tray in the original design. It suggests the idea for new

Table 1 - Interaction Task Model for redesigned CD Player Sub-system. *Receptacle* is replacement device for CD tray. *'B' takes over when error conditions occur, for example when 'A' forgets to perform an action.

Interaction No.	Device state	User Action	Device Action
1	Media (CD, etc.) selected. CD player	*Present redesign*, 'B' puts amplifier power on *Future redesign*, HiFi is constantly powered, and has no power off mode	*Present redesign*, Display power on light. 'A' prevented from experiencing power mode error. *Future redesign*, display power on light. 'A' prevented from experiencing power mode error.
2	CD player power on, receptacle is closed, no media present	*Present redesign*, 'B' puts amplifier input into CD mode *Future redesign*, device selects appropriate mode itself, see Interaction No. 5	*Present redesign*, mode knob shows CD mode selected. 'A' prevented from experiencing input mode error. *Future redesign*, 'A' prevented from experiencing input mode error. See Interaction No. 5
3	Receptacle is closed	*Unchanged*, 'A' presses 'receptacle open' button	*Unchanged*, Opens receptacle
4	Receptacle is open	Ditto	*Present redesign*, close receptacle. Error condition – 'B' to intervene. *Future redesign*, Display message that receptacle is already open
5	Receptacle is open, no media present	*Unchanged*, 'A' Introduces media (CD, etc.)	*Present redesign*, device does nothing *Future redesign*, receptacle closes, adjusts own mode according to media, begins playing media. No mode selection by 'A' required, so mode errors avoided.
6	Receptacle is open, media already present	Ditto	*Present redesign*, device does nothing* *Future redesign*, display feedback that media is already present*
7	Receptacle is open, media present	*Present redesign*, 'A' shuts receptacle *Future redesign*, see Interaction No. 5	*Present redesign*, begin playing media, display feedback: track data, time *Future redesign*, receptacle automatically controlled, cannot be closed when empty. Also see Interaction No. 5
8	Receptacle is open, media is absent	*Present redesign*, 'A' shuts receptacle *Future redesign*, 'A' attempts to shut receptacle	*Present redesign*, display message that media is absent. Error condition – 'B' to intervene. *Future redesign*, Display message that receptacle is empty. Error condition – 'B' to intervene. see Interaction No. 7
9	Music finishes	*Unchanged*, 'A' Listens to music till it finishes. 'B' prepares system for inactivity	*Present redesign*, display feedback *Future redesign*, display feedback, open media receptacle

technology development of a generalised media receptacle, replacing current individual tape and CD trays. 'A' opens the receptacle, introduces the medium, here CD, closes the receptacle and listens to the music. Removal of medium is not shown. The ITM is consistent with the contents of the other containers, to which it is cross-referenced by the interaction number (Column 1). It operationalises Feature 2 (design consistency) and Feature 7 (embodiment in MUSE(C) products).

It should be noted that inclusion of device states (Column 3) and device actions (Column 4) (not implemented in the present case-study) in the ITM is an incorrect operationalisation of MUSE(C). The ITM should include only user behaviours. This incorrect inclusion was identified by 'D' and is documented as a MUSE(C) design problem for the ITM container. It is likely that part of the ITM description in MUSE(C) misled 'C' into including device states and actions in the ITM: "Its purpose is to support design of computer behaviour and specification of error recovery, feedback messages and screen displays". A possible MUSE(C) design solution would be, for example: " to expand the definition of the ITM and to relate it to the three levels of interface design: input/output; dialogue; and task levels (see Table 3 later).

Application Summary

The MUSE(C) application in total resulted in over 50 design products. Of these, 18 were different products, as required by the re-design of all the domestic technology sub-systems. The re-design generally supported the demonstration of more effective domestic dementia care technologies and suggested further developments, as required by the design scenario – see next section.

EVALUATION OF THE RE-DESIGN AND FURTHER TECHNOLOGY DEVELOPMENTS

Following 'C's instructions, 'B' rated (out of 10, with 10 being high) 'A's quality of life (TQ(A)) and workload (W(A)), as associated with the use of each domestic sub-system, before and after the re-design. Table 2 shows the evaluation of 24 domestic sub-systems in total – 18 existing and 6 new sub-systems, suggestive of future developments. The re-design resulted in a modest average increase of 'A's quality of life (before=4.2 and after=5.4) and decrease of 'A's workload (before 5.5 and after 4.7). For the new sub-systems, 'A's quality of life was somewhat below (3.8) and her workload somewhat above (5.8), both the before and after re-design ratings of the original sub-systems. The evaluation indicates that the re-design generally increased 'A's quality of life and decreased 'A's workload, but only modestly in both cases. Some of the effects of the re-design were dramatic, For example, the TV sub-system (Task Quality 0 to 7; Workload 10 to 8). Other effects were negligeable, for example, the Walkman subsystem (Task Quality 3 to 4; Workload 8 to 7.

Further developments for future domestic technologies for dementia care, a requirement for the design scenario (see earlier), are also indicated by the new sub-systems, which appear in Table 2. New sub-systems comprise: use of 'A's bookcase, adjacent to her favourite sofa seat, as an interface to other interfaces, for example, Walkman, radio, photo albums, tapestry; drawing/colouring sub-system; radio sub-system, separate from hifi radio; playstaion sub-system; pinball sub-station; and soft toys sub-system.

Yet further suggested developments for future domestic technologies are to be found in the design products themselves. For example, the Statement of User Needs for the re-designed hifi system, attempting to eliminate CD mode errors (see earlier) suggested the following possibilities: 1. Make the amplifier modeless by combining inputs with additional hardware or by integrating circuits inside the amplifier. 2. Remove all sets of media and the hardware to play it, but one. For example, by dispensing with tapes or CDs; by recording CDs on to tape and dispensing with CDs; or by recording tapes on to CDs and dispensing with tapes. Further developments are also suggested by the device action column of Table 1, dialogue for CD operation, not implemented in this case-study.

In summary, the evaluation of the re-design and the suggestions concerning further developments for future domestic technology indicate the requirements of the design scenario to have been met by the application of MUSE(C).

VALIDATION OF MUSE(C) AND CASE-STUDY SUCCESS.

The application can claim to have validated MUSE(C) at least partially. The application resulted in design products, appropriate for the design scenario. MUSE(C) was operationalised correctly, as illustrated by the application features (see earlier), embodied in the re-design. The re-designed sub-systems generally demonstrated increased effectiveness. However, 'C' experienced a range of difficulties in operationalising MUSE(C), as illustrated by Table 3. The difficulties are associated with individual MUSE containers. The difficulties were either identified by 'C' and confirmed and clarified by 'D', or identified by 'D' as a misapplication of MUSE(C) containers by 'C', or as a misapplication by MUSE(C) of MUSE design products. 'C's difficulties of application are expressed in terms of diagnoses – of a design problem for MUSE(C) and a prescription of a (possible) design solution for the problem. Since more than 30 design problems were experienced by 'C, its validation, then, can be considered only partial.

The case-study, however, is judged a success. It applied MUSE(C) correctly and produced a demonstrator of more effective domestic technologies for dementia care and suggestions concerning their future development. The case-study can thus be added to the body of other successful case-studies in terms of the design scenario features cited earlier. This design scenario was not well-defined. Neither the range of technologies, nor the users, nor effectiveness were well specified. The scenario was not complex. The technologies are simple and only 'A' and 'B' are involved in their operation. Last, the scenario is very observable. 'C' had full access to 'A' and 'B'.

Table 2. Actual performance of domestic systems, before and after redesign by MUSE(C). B=before, A=after; Freq. of use: H=high, M=medium, L=low, Z=zero

Subsystems	(re-designs)	1 to 10 TQ-(A)		1 to 10 W-(A)		Freq. of Use		Comments
		B	A	B	A	B	A	
Hi-fi	(simplify to use CDs only, CDs cached in the book case)	1	3	9	7	Z	L	CD player not easily accessible
Photo albums	(no change)	8	8	2	2	H	H	Selection/meaning could be improved
Books	(simplified selection)	5	6	5	4	M	M	One to two books attract most of 'A's attention
Book-case	(new subsystem interface to interfaces)	/	7	/	6	/	M+	Increases range and accessability.
Drawing book	(new subsystem, cached in bookcase)	/	2	/	7	/	L	'A' Requires prompting; colouring book better
Radio	(new subsystem, separate radio from hi-fi, cached in bookcase)	/	3	/	3	/	L	Function seems unclear e.g. classical music
Walkman	(separate tapes from hi-fi, made more salient, tapes cached in bookcase)	3	4	8	7	L	L	'B' tape playing an easier option?
Coffee table	(no change)	6	6	2	2	H	H	develop actual use patterns of 'A'
Piano	(new music, bookmarks)	4	7	7	7	L	H	'A' only plays exposed piece
Wall displays	(no change)	3	3	1	1	L	L	Meaning unclear to 'A'
Display cabinet	(integrated into book case)	1	1	9	9	L-	L-	Meaning / use not specified
Tapestry	(no change)	8	8	5	5	H	M	Frequency decreasing ; needs boosting
Flowers	(no change)	7	7	2	2	M	M	'A' likes buying them
TV	(single channel, on/off, more salient button)	0	7	10	8	Z	L	'A' likes to watch 24 hour news
Video	(tapes in bookcase, easier operation, more salient button)	0	7	10	8	Z	L-	Effective for 'B's use; much used.
Newspaper	(no change)	8	8	3	3	M	M	'A' likes to look at pictures
Jigsaw	(cached in bookcase and jigsaw holder to improve availability)	7	7	8	7	L	L	'B's setup critical
Scrabble	(cached in bookcase to improve availability)	0	2	9	8	L-	L-	Meaning unclear to 'A'; 'B's prompt required
PlayStation	(new subsystem, reduced configuration)	/	1	/	8	/	L-	'A' has not really learned. 'B' prompts.
Hoovering	(no change)	3	3	4	4	L	L	'B' prompts
Bottle bank	(no change)	8	8	3	3	M	M	'B' controls walking route
Pinball	(new subsystem)	/	2	/	9	/	L-	'A' finds difficult to use
Soft toys	(new subsystem)	/	8	/	2	/	M	'A' likes cuddly toys
Correspondence	(no change)	3	3	2	2	L	L	'A' re-reads a lot

These design scenario features can be compared with those of Murphy's MUSE(C) application (1997) to the representation of security in network administration systems. Again, the design scenario was not well defined, requiring the exploration of alternative security representations. However, the scenario was

Table 3 - Table illustrating diagnosis and prescription of MUSE(C)

MUSE Container	Diagnosis	Prescription
CTM(x)	There was difficulty in operationalising this container. The CTM's definition as describing elements of the design in "slightly less general terms than a General Task Model" is ambiguous and gave little guidance.	Amend description of CTM, give concrete example of CTM and General Task Models, illustrating the difference in generality between them..
ITM(y)	It is difficult to distinguish between ITM and Interface Model from their definitions	Expand definition of ITM. Relate it to the 3 levels of interface design: Input/output, Dialogue, and Task levels.
TD(ext)	Does not tell you how to prioritise parts of systems to model / redesign. Need to prioritise comes from my HF knowledge. Closest MC comes to this is a Rationale	Attempt was made to frequency count 'A's activities, as first approximation to task importance, see "R(ext) 'A's activities 0.5 .doc".
SUN	Statement of user needs seems to replicate information found in other containers, without adding much to them. It seems to be misnamed, as it contains information about design of the new system.	Rename the container? Amend its definition? Remove it entirely and spread its contents to the other containers?

complex, unlike the present scenario. Security access and suspension in distributed, multi-level systems is much more complex than domestic technologies. Last, again unlike the present scenario, the security system was not very observable. The system and the application were developed on two different sites. The two design scenarios, thus, had poor definition in common, but differed on complexity and observability. Since both were successful case-studies, however, together they extend the range of MUSE(C)'s operationalised and tested scope of application.

CONCLUSION

The case-study can be considered a success. MUSE(C) was applied to a new domain, that of dementia care in the home, having previously only been applied to network administration systems (Murphy, 1997). Its validation, however, was only partial, as indicated by difficulties experienced by 'C' in its application. The identification of design problems and (possible solutions) suggest how a more effective version of MUSE(C) might be developed. Further research should have this development as its aim, along with additional cycles of operationalisation, test and generalisation. Only in this way can design knowledge be validated. Only in this way can researchers build on each others' work, so advancing Cognitive Ergonomics as a discipline, as required by Newman (1994) and Long (1996) – see Introduction.

ACKNOWLEDGMENTS

We thank 'A' and 'B' for making the case study possible. 'C' is the second author and 'D' is the first author of this paper.

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