A cognitive schema approach to diagnose intuitiveness: An application to onboard computers

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ABSTRACT
Intuitive use is met when prior knowledge is transferred to new task environments. The empirical fact that transfer relies on schemas led us to diagnose intuitiveness based on schema induction. Two cognitive tasks were designed to make novice users perceive versus induce all the states of a prototype onboard computer. Subsequent interaction performances with the system validated the induction effect of the procedure and its interaction with familiarity, known as a primary factor of intuitive use. Implications for the diagnosis and the design of intuitive interfaces are discussed.

Categories and Subject Descriptors
H.5.2 [**User interfaces**]: Theory and methods.

General Terms
Measurement, Performance, Experimentation, Human Factors, Theory.

Keywords
Human Computer Interaction, Intuitive Use, Cognitive Modeling, Schema Induction, Design Evaluation.

1. INTRODUCTION
1.1 Context
With the increase of advanced technologies in everyday life, users await intuitive devices that can be understood and used with no particular effort. This demand is especially difficult to meet when several technologies are gathered in a same device. Automotive industry is uppermost concerned, when developing onboard computer that aggregate multimedia, communication, maintenance, driving assistance and telematic services.

Previous studies on intuitive interaction addressed remote controllers, VCR and digital cameras [1;2]. These devices, although hard to handle at the first attempt, are far simpler than onboard computers which largely exceed 100 states (*cf.* Audi's MMI and BMW's IDRIVE). States of onboard computers[1] typically display 3 to 15 graphical objects (*e.g.* labels, menus and icons) and form complex states-transitions networks.

Novice users, who do not know yet the system, must find by themselves the sequences of transitions and states leading to its functionalities. This activity can be assimilated to means-end analysis [3], where user iteratively judges which available object best reduces the distance to the desired state. Whether these means-end judgments can be performed intuitively is the matter of the present study.

1.2 A schema account of intuitive interaction
1.2.1 Current approaches of intuitive interaction
Intuition is a mechanism by which the solution of a problem is perceived without effortful analysis [4]. It has been empirically attributed, in psychology, to cognitive style [5-7] and to prior knowledge [8;9]. The HCI community recently adopted this concept to evaluate and design interfaces.

Main contributors, namely Blackler and colleagues in Australia and the IUUI (Intuitive Use of User Interfaces) Research Group in Germany, consensually attribute intuitive interaction to the unconscious application of prior knowledge to a new task or to a new environment. Blackler showed, from correlational analyses, that devices were more intuitive when their features (e.g. functionalities, graphical objects, commands) had already been employed in similar or in different devices [2;10]. Intuitive interaction typically requires the "transfer" of relevant prior experience "between products, and probably also between contexts" [10].

The two research groups employed slightly different models of design to anchor this conception. Blackler focused on the location, the appearance (e.g. shape, color, labeling) and the function of interfaced features [2]; the IUUI Research Group, on the conceptual, semantic, syntactic, lexical, and pragmatic (physical) "layers" of design [11]. These models led to reinstate classical and convergent recommendations such as [1;10]:

- employ shared labels and stereotypes when designing familiar functionalities, use affordances and semantics when designing unfamiliar functionalities, and identify

[1] Onboard computers are variably referred as multistate interfaces or as multifunction systems in the present paper.

external consistencies and metaphors originating from other domains, for designing innovative technologies;

- respect ISO standards such as the suitability for task, the conformity with user expectations, the self descriptiveness, affordances and Gestalt laws;
- focus on physical to semantic coupling and image schemas (*e.g*. visual clues of space, containment, process, force, etc.).

Whether these recommendations actually make easier the design of intuitiveness is yet questionable. Indeed, affordances, metaphors, consistencies and stereotypes are not operational enough to be properly managed and their definitions often lead to circular statements. For instance, intuitive use is supported by *self-descriptiveness,* itself presented as the implementation of *obvious* and *immediately clear* contents [10]. Expectedly, these constructs do not reliably impact performances [12].

Also, there is currently no mean to arbitrate which features or layers of a given interface should benefit from affordances, consistencies, stereotypes or metaphors. Blackler studied the intuitiveness of remote controllers, VCRs and digital cameras by inspecting each of their features' familiarity of [10]. More precisely, the interview determined whether the features' location, appearance and function had been used or encountered in similar and in different devices and contexts. This investigation was "very time consuming" and might be heavy to conduct on multifunction systems. Instead of declining prior familiarity, we could directly measure the transfer mechanisms previously reported to support intuitions. Actually, transfer has extensively been studied in cognitive psychology and elucidated, about 30 years ago, by the construct of cognitive schemas.

1.2.2 The schema hypothesis

The domain of analogical reasoning is concerned on how a procedure learned in a given context can be transferred to another and even unfamiliar one.

Transfer is studied in a two-phase protocol. Participants study a "source" problem and its solution, before receiving a "target" problem to solve. For instance, participants read a text explaining that an army should be spread in small units to attack a fortress surrounded by mines (source). Participants subsequently had to explain how to treat a tumor with X-rays without damaging healthy tissues (target problem or task) [13]. Despite very different contexts (military and medical), the source and the target both admit the "divide and disperse" solution.

Read the source for comprehension, summarize it or even read two analog source problems poorly led to solve the target problem [13]. Participants tried to analyze the problem from a medical perspective, instead of simply reusing the divide and disperse principle. Gick and Holyoack resumed this issue by requiring novices to compare two analog source problems [14]. Verbal protocols collected during this comparative study task revealed that participants mentioning the structure shared by the two source problems better solved the target one. Structural representation of the source was referred as a cognitive schema.

Replication experiments showed that schema induction is a by-product of comparative processing that supports transfer between different domains [15]. Schemas well sustain the previously stated idea that intuitive use relies on knowledge transfer.

1.2.3 A schema based model of intuitive interaction

Schema theory has been formalized by Norman and applied to Human Computer Interactions in a framework named ATS (*Activation Trigger Schema*) [16;17].

According to Norman, seven stages of activity determine the interaction. As illustrated Figure 1, the user perceives and interprets the current state of the interface in order to evaluate whether it is different or distant from its goal. If it is the case, the intention is formed to modify the state by handling an available object or command. To do so, the user specifies and executes one or several operations on the system's commands (*e.g*. mouse, stylus, etc.).

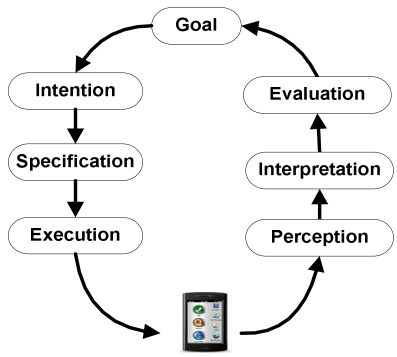

Figure 1. Norman's Action Cycle (1984)

Schema theory postulates that perception, interpretation, specification and execution can be shortcut when prior schemas are triggered. Action is direct, automatic -we might here say intuitive- if each stage benefits from prior schemas. Conversely, when no schema is triggered, the user has to analyze the interface content. This effortful mechanism is necessary until new *ad hoc* schemas are constructed. It is consequently important that the "system image" or the interface that fails to trigger prior schemas, at least supports the construction or induction of new ones.

ATS matches Blackler and the IUUI Research Group's step to model the compatibilities of design layers or dimensions with prior knowledge. Additionally, the framework offers interesting possibilities to diagnose affordances [18], human errors [19] and usability [20;21]. However, these implementations barely deal with the schema theory which actually interests us. A more promising approach was found in the domain of multimedia learning, where schema operations fostered by a source material are measured behaviorally, by an induction procedure.

1.3 Behavioral diagnosis

1.3.1 The induction paradigm

Multimedia are materials that combine text, illustrations, animations or simulation to describe a technical system such as an automotive engine, an air pump, a process plant simulation, an air traffic control simulation, etc.

Whether a multimedia helps to induce schemas is measured by requiring novices to study it before solving target problems or tasks. For example, novices study the illustration of an air pump, before being requested to explain what could be done to make a pump *more effective*, *more reliable*, etc. [22]. Such problems can only be solved if appropriate schemas are induced during the study phase[2] [23].

Read or listen a multimedia enables novices to recall its content (e.g. words, sentences) but not necessarily to solve target problems [24]. Similarly to analogical reasoning, induction is met when novices establish relationships among the source's objects and with familiar knowledge.

Mayer demonstrated the potential of comparative (*i.e.* comparing together different parts of the source) and integrative study tasks (*i.e.* comparing the source with prior knowledge) to induce programming schemas. Participants were requested to study a database instruction language (source) before using the database in a series of counting and sorting tasks (target). Four study groups were constituted [25] :

- The control group received a booklet listing the language's instructions with the instruction to read it.
- An "advance organizer group" also received the booklet, as well as familiar and concrete examples of database tasks.
- The "model elaboration group" also received the booklet, as well a sheet explaining the model of a computer, with the instruction to search its similarities with the database instructions.
- The "comparative elaboration group" was instructed to list the similarities and differences among the booklet's instructions.

The three experimental groups performed better on the transfer tasks than the control one, although they recalled fewer instructions from the booklet. Interestingly, the advance organizer group solved the most difficult target tasks, indicating that adding familiar and concrete information to the source to study particularly fosters induction.

1.3.2 Inductive tasks interact with expertise

Induction effect –*i.e.* the difference in target problem solving between inductive and non inductive study conditions- directly depends on prior experience. Mayer's meta-analysis of multimedia studies reveals that [26] :

- only novices benefit from inductive instructions,
- while experts or familiar persons reach high performances independently of the study and of the material. Their schemas are, as a matter of fact, rich enough to perform the problem test under most conditions.

This interaction pattern was repeatedly obtained in multimedia learning [23;27;28], analogical reasoning [29-31] and text comprehension studies [32]. It thereby seems relevant to differentiate intuitive transfer of prior schema (no difference after inductive and non inductive study conditions) from induction of new schemas (significant difference between an inductive and a non inductive study condition).

1.3.3 Induction procedure for onboard computers

The induction paradigm has been so far applied to documents, booklets, videos, simulations, etc., but never to materials reaching one hundred states. We developed two study tasks susceptible to make novices encode literally versus inductively such material. These tasks required to judge whether a given target matches a given state. Participants read a target, and then a state possibly containing (match) or not (non match) the target.

In the inductive condition, the target was a sentence describing a functionality in familiar (as less technical as possible) and concrete (explicitly detailing the context of the activity) terms. Example of function targets are: "*Calculate the distance covered with the car during the precedent weekend*"; "*Save the car's current GPS location in the address book*", etc. This Function Matching Task was designed to both foster the comparative and the integrative processing known to support schema induction. It indeed incidentally required to interpret and to compare the state's objects together and with a target which familiar and concrete labeling naturally activates prior knowledge.

In the non inductive condition, the target was a word (*e.g.* "*Next*"", "*Map*"). The Word Matching Task could be performed by simply scanning the state's words. This rather perceptive condition fits with definition of intuition as the immediate sensing and perceiving a schema solution. Successful solving of transfer tasks after this study task is in that attributable to intuition.

1.4 Empirical study

We experimentally addressed whether matching all the states of an interface with a function (Inductive Group) in comparison to a word (Perceptive Group) fosters schema induction and interacts with familiarity. A Control Group that only performed the transfer task scenario was also constituted to have baseline interaction performances.

We defined familiarity, based on Blackler's prior research [2], as the prior use of a feature in similar or other contexts. Additionally, we took into account the participants' cognitive style. The numerous studies dedicated to scale how individuals tend to intuit or to analyze problems [9] did not consider, to our knowledge, Human Computer Interactions. Nevertheless, as intuitive scales correlate with cognitive tasks by lowering the

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[2] This intra-system transfer is slightly different from the "inter-domain" transfer studied in the domain of analogical reasoning. In analogy studies, participants are taught the procedure we want them to transfer to a new domain. In multimedia stydies, participants have to induce the procedures required by subsequent transfer tasks by themselves.

processing and the assimilation of data [5;33] it is probable that "Experientials" (*i.e.* persons who tend to rely on their intuitions) will less perform the inductive operations appealed by the Function Matching task compared to "Rationals" (*i.e.* persons who tend to solve by analyzing). This was controlled by differentiating experiential and rational participants based on a Japanese version of Epstein's Rational Experiential Inventory (REI) [34;35].

2. METHODS

2.1 Participants

Forty three Japanese students, novice in the use of onboard computers, received 820 yens (approx. 9 $) to participate in a 45 minutes experiment.

2.2 Material

We first designed the material in English before translating it into Japanese. Instructions, targets and interface used well-shared and as less technical as possible wordings. Two Japanese students with no background in informatics and in automotive were independently recruited to improve the material by simplifying its formulations during informal interviews.

2.2.1 The tested interface

The interface to diagnose was a prototype onboard computer developed under C# and named DoIt#.

Developing this prototype enabled us to automatically record the participants' actions and corresponding time code in a log file. States-actions sequences were reconstructed using the task modeling tool AMME [36] as well as specific VBA macros. Prototyping also permitted us to test the procedure on common (*e.g.* temperature setting, dialing a call, display of gas level, defrosting, etc.), advanced (*e.g.* locker anti alcoholism, dust filters, traffic status, etc.) and "prospective" functionalities that do not yet exist in the market and, consequently, go beyond the participants' prior knowledge (*e.g.* wireless download of advertising and information tags, rear view mirror display of driving instructions, etc.).

DoIt# was composed of two windows: a command panel and a state window. The command panel had five menu buttons ("*Onboard Computer*", "*Navigation*", "*Air Conditioning*", "*Audio*" and "*Telephone*") as well as four navigation buttons ("*Up*", "*Down*", "*Enter*" and "*Escape*"). The state window displayed options lists, icons, pictures and virtual input devices.

Interaction with DoIt# mostly required to scroll options lists by clicking, with the mouse, the *Up* and *Down* buttons, and to explore lower or upper-level menus by clicking *Enter* or *Escape*. DoIt#'s functionalities could be achieved in 3 to 5 actions. For example, participants had to reset the odometer by activating the "*Onboard Computer*" and successively selecting the options labelled "*Driving Indices*", "*Mileage recorder*" and "*Reset*".

2.2.2 The matching task

Each state of DoIt# was captured and associated to a word and a function target.

Half pairs of the Matching Task were matched and the other half mismatched. Matching pairs were constituted by randomly selecting an object in a state of DoIt#, from which was taken a word, and derived an explicit and detailed description. Negative trials were constituted by inventing a target word and a target function absent thought realistic and coherent with the state.

Word and function targets are rather easy to generate. The experimenter simply needs, in the case of word targets, to select a word, and in the case of function targets, to describe and detail a functionality without repeating the state's wordings and without using technical terms. This requires a good knowledge of the concerned system and technology, as well as popularization skills. Function targets were improved by two reviewers, non-specialized in the technology domain, who pointed out and rephrased the difficult wordings.

A LabVIEW application was developed to display serially pictures of targets and states above three control buttons. Participants were instructed to (see Figure 2):

1. read a target, click on the button "GO"
2. read the state and clicking on "YES" if it matched or contained the target or on "NO" otherwise.

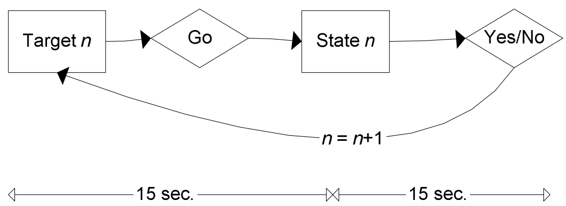

Figure 2. Timeline of the Matching Task

Figures 3 and 4 illustrate pairs of target-states for the two experimental conditions.

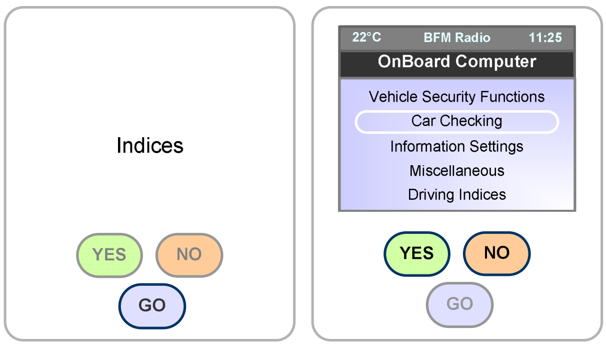

Figure 3. Illustration of a target-state pair for the Word Matching Task (Perceptive Group)

As stated previously, the Word Matching task (see Figure 3) requires neither to understand nor to compare the state's graphical objects (e.g. "*18°C*", "*Onboard Computer*" "*Vehicle*

Security Function", etc.). Participants only need to scan the words individually until finding (or not) the target one.

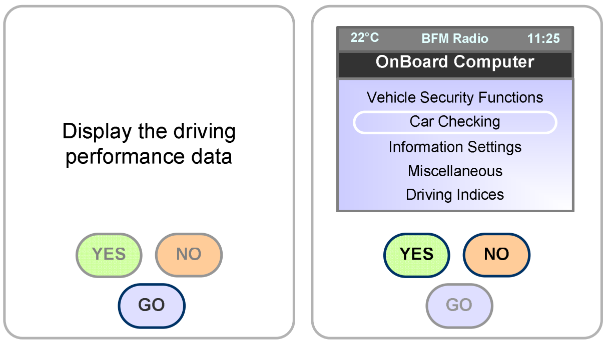

Figure 4. Illustration of a target-state pair for the Function Matching Task (Inductive Group)

Conversely, the Function Matching requires from the participants to understand the words, the object they belong to, their role in the interface and their relationship to the target. The participant also needs to compare the objects between them and with the target when significations are close.

2.2.3 *REI and Familiarity questionnaires*

The Rational – Experiential Inventory and the Familiarity questionnaires were administered by Excel. REI is a bipolar subjective scale comprising 20 experiential statements (*e.g.* "*I try to avoid situations that my intuitive impressions*") and 20 rational statements (*e.g.* "*I enjoy thinking in abstract terms*", "*I think that it is foolish to make important decisions based on feelings*"). Participants rated each statement on a 5-point scale ranging from *completely false* to *completely true*. Participants scoring beyond 120 points were considered as Rationals, whereas participants scoring over 120 points were considered as Experientials in subsequent analyses [6].

Our prior familiarity questionnaire listed all DoIt#'s functionalities. Participants were instructed to report for each described functionality whether it had been used or seen, in a similar or in a different context. We thus could code *a posteriori* the tasks that had been done or seen by all the participants as Familiar, and the others, as New.

2.3 Procedure

The four experimental phases (REI, Matching Task, Transfer Tasks and Familiarity questionnaire) were embedded in an animated PowerPoint presentation in order to minimize exchanges between the participants and the experimenter. This administration mode enabled us to test participants on three PC simultaneously.

Each participant started by filling the Rational / Experiential Inventory. Then, the participant watched either the Word or the Function Matching Task instructions with some recommendations to properly explore the states. The participant watched next a presentation of DoIt#'s main commands. After being showed two examples of task by the experimenter (*e.g.* call a recent dialed number and check the inbox messages), the participant received a task scenario printout. The ten target tasks were to (1) display the number of covered kilometres, (2) set the guidance to a friend registered in the address book, (3) request to avoid toils, (4) display the guidance instructions in the rear-view mirror, (5) set the temperature to 18°C, (6) launch the anti-drowsiness alert, (7) activate the over-taking assistant, (8) activate the filtering of inside air, (9) set the ventilation on silent mode, and (10) calculate the total break time during the trip. No mention to the speed or to the accuracy was made to let the participant act at his or her pace. At last, the participant filled the familiarity questionnaire by ticking the functionalities he or she had used or seen before the experiment.

2.4 Experimental design

The experimental protocol aimed to verify that:

- the Function Matching Task generates an induction effect, i.e. higher task performances for the Inductive Group compared to the Perceptive Group (Induction Hypothesis),
- both groups exhibit similar performances when performing Familiar Tasks (Interaction Hypothesis).

The level of Induction (Control *vs.* Perceptive *vs.* Inductive Group) was manipulated as a between-subject factor, the REI (Experientials *vs.* Rationals) was controlled as a between-subjects factor and the Task Familiarity (Familiar *vs.* New) was controlled as a Within-Subject and Between-Task factor.

The Control Group comprised 11 participants (5 Experientials and 6 Rationals), the Perceptive Group, 16 participants (7 Experientials and 9 Rationals) and the Inductive Group, 16 participants (8 Experientials and 8 Rationals). Among the 10 tested tasks, 4 were coded as Familiar and 6 as New.

3. RESULTS AND DISCUSSION

We first will examine whether matching tasks foster induction and interact with prior familiarity. This hypothetico-deductive perspective is followed by a qualitative analysis of raw data to question the diagnosis potential of the induction procedure.

We analyzed the mean number of erroneous transitions, calculated by the mean number of transitions minus the number of optimal transitions per participant and per task. Uncompleted tasks and tasks for which the participant asked the experimenter's assistance were excluded.

3.1 Hypothetico deductive validation

Participants made 10.1 (SD = 11.8) errors per task. Participants made 8.0 errors (SD = 8.8) for the Familiar Tasks and 13.2 for the New Tasks (SD = 14.7). The Control Group (Mean = 11.6; SD = 12.3) made barely more errors than the Perceptive Group (Mean = 11.0; SD = 13.0), which made more errors than the Inductive Group (Mean = 7.9; SD = 9.6). Also, Experientials (Mean = 11.4; SD = 13.6) made more errors than Rationals (Mean = 9.1; SD = 10.11).

The 3 (Level of Induction) x 2 (Task Familiarity) x 2 (REI) ANOVA revealed a main effect of the Task Familiarity, $F(1,229) = 10.286$; $p < 0.005$, as well as of the Level of

Induction, $F(2,229) = 3.684$; $p < 0.05$, validating the Induction Hypothesis. The REI factor did not reach significance, $F(1,229) = 2.641$; *n.s*. The only significant interaction was between the 3 factors, *i.e*. Task Familiarity x REI x Level of Induction, $F(2,229) = 4.070$; $p < 0.05$.

The Induction and the Interaction hypothesis were specifically examined in separate post-hoc analyses of the Experientials' and the Rationals' performances for the two experimental conditions (Perceptive and Inductive Groups; see Figure 6). The ANOVA of the Experientials' performances revealed the unique effect of the Task Familiarity, $F(1,70) = 0.323$; $p < 0.05$. The ANOVA of the Rationals' performances revealed a very significant effect of Task Familiarity, $F(1,94) = 17.178$; $p < 0.001$, and of Level of Induction, $F(1,94) = 12.039$; $p < 0.001$, and a significant interaction between the two factors, $F(1,94) = 7.576$; $p < 0.01$.

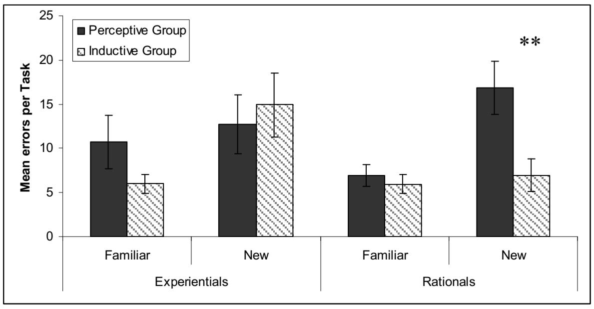

Figure 6. Mean errors per task by REI for the Perceptive and the Inductive Groups

The Rationals hence exhibited the attended Induction and Interaction hypotheses, *i.e.* only benefited from the inductive condition for New Task. The procedure however statistically failed to make Experientials induce schemas for New Tasks.

Yet, Experientials tended to make more errors and to benefit from induction during Familiar Tasks, which contradicts the current conception that familiarity supports intuitive interaction. We foresee here that Task Familiarity might, in fact, be deleterious for users that rely on their intuitions and prior knowledge to solve new tasks and problems.

3.2 Diagnosing perspective

Schema induction can be further addressed by discussing the benefits of schema induction over classical user tests and familiarity evaluation, and by relating prospectively the observed patterns of performance to design recommendations.

3.2.1 Schema induction versus task familiarity

The fact that Task Familiarity statistically improves performances does not imply a one-to-one correspondence between these two variables. Raw data per task and per condition indeed revealed discrepancies between Task Familiarity and performances (see Figure 7).

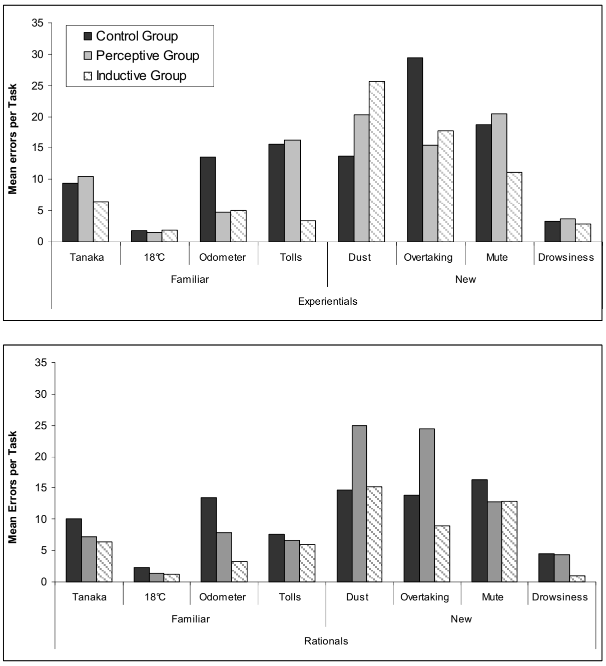

Figure 7. Mean errors per task by REI and by Level of Induction

For example the most intuitive tasks, *i.e.* 18°C and drowsiness were respectively coded as Familiar and New. The three other Familiar Tasks were relatively less intuitive to set in DoIt#. Prior familiarity subjectively reported by the participants poorly accounted for raw data performances. This indicator does not seem reliable enough to replace empirical evaluation.

3.2.2 A step towards design recommendations

The present experiment was designed to test two behavioral patterns known in other domains of psychology to account for induction and transfer.

- Few errors for both the Perceptive and the Inductive Groups indicate a transfer of prior schemas.
- More errors for the Perceptive compared to the Inductive Group reflect a positive induction effect (*cf.* Overtaking by Rationals, Figure 7).

Yet, raw data exhibited two additional patterns of performances.

- Fewer errors from the Perceptive in comparison to the Inductive Group reflect a negative induction effect (cf. Dust by Experientials).
- High errors for both experimental groups indicate that the Function Matching Task was inoperant in inducing new schemas (cf. Mute by Rationals).

Four implications for the design can be prospectively stated.

First, tasks that foster prior schema transfer are intuitive and do not need to be redesigned.

Second, tasks exhibiting a positive induction effect should gain in intuitiveness if familiar, descriptive or contextual information is added in the concerned states. Such intervention should actually lead to consider affordances and stereotypes.

Third, the negative induction might reflect a conceptual inconsistency between the schemas induced by the Inductive Group and of Doit#'s design. For example, the schemas induced by the Inductive Group might lead to consider erroneously that a menu does not fit well with the current goal and to search elsewhere. Studies should be performed to address further this negative induction effect. It would especially be interesting to determine whether designers should here adopt the Inductive Group's logic of interaction, or whether they should keep but improve their design with contextual clues.

At last, tasks for which the inductive condition was inoperant are certainly those to amend in priority. They might require metaphors and abstractions from other domains, instead of local and domain specific information, to gain in intuitiveness.

The induction procedure obviously enables to go beyond classical user tests (e.g. Control Group) in that it indicates among the low performance tasks those which actually can be induced, those which actually suffer from inconsistency and those actually too difficult to support any schema operation.

4. CONCLUSION

We identified from the multimedia learning literature that:

- schema induction can be obtained by using a comparative task applied to familiar and detailed content,
- inductive tasks interact with prior knowledge, expertise and familiarity factors.

Our empirical contribution consisted in adapting these two principles to the particular case of multistate interfaces.

The proposed procedure is relatively easy to perform in a design process. First, the main advantage of behavioral methods is to minimize the intervention of experimenters during the collection, the processing and the interpretation of data. Here, the tests do not require from the experimenter a specific expertise in Human Factors and are fully instrumented. Second, time resources are reasonable as about twenty persons can be tested in a couple of days. Moreover, data processing can be largely automated from the moment that actions on commands are recordable.

The schema induction procedure differentiated prior schema transfer from new schema induction. It also seemed to account for inconsistent and inoperant induction effects. The overall method appears relevant to study whether stereotypes, affordances, metaphors or consistencies contribute to intuitiveness (more transfer effect), assimilation (more induction effect), or whether they are inoperant.

The study also revealed two interesting facts about intuitiveness and about the role of cognitive schema in Human Computer Interactions.

First, familiar interfaces might be deleterious for the users who tend to rely on their intuitions. Though the distinction between Rationals and Experientials did not affect significantly the overall performances, we should keep in mind that experiential users are, in fact, misled by familiar contents. Additional studies should specificallty address this issue and state to what extent experientials fail by intuition. If such hypothesis is confirmed, research on intuitiveness should include strategies to limit familiarity and to prevent experiential users from interacting with interfaces in an instinctive but erroneous fashion, *i.e.* to adopt strong but wrong behaviors.

Second, several tasks lead participants to make about thirty errors. As DoIt#'s main menus counts less than 20 states each, it is probable that most states were seen several times, but that participants failed to understand and to remember them. This remark corroborates that:

- Human Computer Interaction is essentially a reactive activity [17],
- performance remains low as long as the states' schemas are no induced [17],
- means-end analysis interferes with the induction of new schemas [37].

Schemas, which the present study demonstrated the operationality, seem all the more reason to be a key step to intuitive interaction.

5. ACKNOWLEDGMENTS

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