Identifying clinical behaviors using the Motor Learning Classification Framework

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Abstract

Context: The clinical behaviors of student and experienced speech-language pathologists(SLP) were analyzed and compared using the newly developed Motor Learning Classification Framework(MLCF) in a simulated voice therapy setting. Although differences in clinical interactions with patients between student and experienced clinicians are well described, differences in therapeutic training behaviors have not been explored, especially in relation to motor learning principles.

Methods: Using a quasi-experimental design, five final-year student and four experienced SLPs with a voice therapy caseload taught a standardized patient to produce a vocal siren. Two trained raters categorized the clinicians' behaviors according to the MLCF.

Results: High intra-rater (91.9%, 92.3%) and inter-rater reliability (89.6%, 82.1%) was shown across both raters. Both clinician groups used the same percentage of behaviors classified as *verbal information* but differed in the subtypes of these behaviors. Experienced clinicians used behaviors categorized as *problem solving* and only experienced clinicians used repeated behavior sequences that included *perceptual training*. Both groups used significantly more talking behaviors than doing behaviors.

Conclusions: The MLCF can be reliably used to identify prepractice behaviors during client-interactions in voice therapy. Student and experienced clinicians showed similarities in behaviors but experienced clinicians used more *problem solving* and *perceptual training* behaviors than students. These differences have implications for student training. The greater use of talking behaviors than doing behaviors warrants further investigation into whether this impacts the subsequent quality of practice engaged by the client and ultimately treatment effectiveness.

1 | INTRODUCTION

Theoretically-based behavior analysis can be used to explore differences in clinical behaviors of student and experienced clinicians and can assist student clinicians in reflecting on their own clinical interactions. Well-documented differences exist between student and experienced clinicians across many fields. Student clinicians, for example, have difficulty discriminating the relevant information from the irrelevant and typically depend on abstract principles and context-free rules to guide clinical thinking[1,2]. Experienced clinicians use a relatively holistic approach in their client interactions that combines knowledge, procedural skills, problem solving skills and interpersonal skills[1,2]. To our knowledge, skill differences between student and experienced clinicians have not been explored in speech-language pathology or voice therapy. In this paper we investigate the application of a newly-developed behavioral rating tool to the voice therapy sessions of student and experienced clinicians.

1.1 | Motor learning in voice therapy

Voice therapy is appropriate when the voice has adapted to, or must compensate for, inefficient movement patterns, which can result in poor voice quality, vocal fatigue and/or vocal discomfort. Direct voice therapy for functional movement voice disorders involves learning or re-learning a motor skill, thus changing and optimizing vocal technique. The principles of motor learning(PML) are a set of training variables theorized to maximize the acquisition, retention and generalization of motor behaviors[3] and have been observed as occurring in voice therapy[4].

Two phases of motor learning have been distinguished, the prepractice and the practice phase[3]. The aim of prepractice is for the learner (client) to prepare for

individual practice by establishing the motivation to learn the motor skill, gaining an understanding of what constitutes a correct target movement, and performing the target movement under ideal conditions[3,5]. Through this process, a reference-of-correctness is developed, enabling the client to self-monitor and detect and correct 'errors'[5,6].

During individual practice, the 'skill' is rehearsed so that it is acquired, retained and generalized across different contexts[3,5]. The prepractice phase is typically revisited to further shape, refine and review the motor skill[5,6]. The practice phase has been addressed extensively in the motor learning literature, but the prepractice phase has received relatively little attention. In the following study, we address differences between student and experienced clinicians in the prepractice phase of voice therapy.

1.2 | Measuring clinical behaviors in the prepractice phase

Clinical behaviors can be described and replicated. In experimental research, prescriptive patterns of behaviors are devised to ensure consistency in protocols between participants[7]. Guidelines for structuring clinical behaviors based on theoretical models have also been applied in specific treatment protocols. For example, the eight-step continuum[8,9] consists of a specific sequence of clinical behaviors during treatment for acquired apraxia of speech. By analyzing clinical behaviors, the more implicit components of a therapy session are made explicit, to help create a method of clinical training and professional accountability[10]. For example, exploring the methods used for rapport building in a social context can inform strategies for rapport building in a clinical context[11].

A specific tool has been developed to measure and understand clinical behaviors suited to the prepractice phase of learning (or re-learning) a motor skill. Following a

comprehensive review of motor learning research, the behaviors of clinicians within prepractice therapy sessions, and the variables relevant to measuring these behaviors, were defined and identified[12]. The Motor Learning Classification Framework(MLCF)(Figure 1) illustrates the prepractice variables documented in the PML literature[4]. Prepractice variables are identified when the clinician engages in behaviors to motivate and prepare the client for effective practice. These behaviors include providing verbal information in the form of instructions, explanations or perceptual training, demonstrating, providing feedback, and engaging in conversation to elicit physical attempts from the client (Appendix 1). The MLCF was primarily developed to describe and understand clinicians' behaviors when teaching a voice motor task and was shown to be highly reliable in the identification of various motor learning related behaviors in commercially-available voice therapy training videos [4]. The framework has not been assessed in less structured clinical contexts with experienced clinicians and students.

1.3 | Study aims

We aimed to analyze and compare clinical behaviors of SLP students and experienced clinicians in voice therapy relevant to prepractice variables identified in the MLCF. In addition to providing information about the frequency and use of these behaviors, differences between these groups should help to inform which behaviors are likely effective for clinical practice, assuming that experienced clinicians are more effective than students. We were also interested in assessing the MLCF and how reliably it can be applied in voice therapy contexts. We hypothesized that the MLCF can be reliably applied in voice therapy contexts to identify prepractice variables in a simulated voice

therapy task, and that it would be sensitive to differences between student and experienced SLPs.

2 | METHODS

2.1 | Participants

Five female SLP undergraduate SLP students(S1-S5) and four female experienced SLPs(E1-E4) consented to participate. The students were in their fourth (final) year of the Australian professional preparation Bachelor of Applied Sciences (Speech Pathology) degree. All students had passed an academic course on the assessment and treatment of voice disorders during the second year of their degree. Two students had no clinical voice experience (S1, S4), two had undertaken additional voice therapy training (S2, S5), and one had supervised clinical voice therapy experience (S3).

The experienced clinicians were recruited via email through a local professional voice interest group. All four had been practising for five, seven, seven and thirty-five years and worked with a current voice therapy caseload of greater than the typical referral rate of 2%[13].

2.2 | Standardized patient

All of the student and experienced clinicians interacted with the same client, a standardized patient(StP). StPs are trained to simulate patients, primarily to evaluate clinical practice across a wide range of health professions[14,15,16]. StPs typically follow a consistent protocol so that responses, symptoms and body language remain consistent across clinicians[14,17].

The StP was a 31-year-old female without symptoms or history of voice disorder and was able to perform the specific vocal task to criteria (see 'Features of the Target', Appendix 2). She was trained one week before contact with the clinicians as per recommendations[18] and briefed on the role of an StP, the client case history, the task, and the range of responses that she should make (Appendix 3). The StP protocol required specific guidelines to be replicable across clinicians. Consequently the StP answered interview questions according to the standard case history and role, and responded to instructions and questions regarding the vocal technique[17]. An independent person marked the fidelity of the StP to the training protocol (Appendix 3) in two randomly selected sessions (S3, E1), as 95% in the two sessions.

2.3 | Equipment

The sessions were recorded on a Sony DCR-HC42E Handycam. The sessions were presented to the raters as DVDs on a television and DVD player.

2.4 | Procedure

2.4.1 | Vocal task

The clinicians were required to teach the StP a commonly-used vocal technique, a vocal siren (slide pitch up and down using a clear voice and effortless manner)[19] in order for the client to independently rehearse the technique at home following the session. This interaction emulates the prepractice phase in a voice therapy context. As the aim of prepractice is to prepare the client for individual practice[5], this study focused on the process of treatment, not the outcome.

In preparation for the session, each clinician listened to an audio-recording of the vocal siren. They were then given 15 minutes to read the task instructions and written case history information (Appendix 2). The StP then entered the room and the clinicians were given 15 minutes to teach the StP the task. The clinicians could terminate the session if they judged the task completed before the end of the 15 minutes. Otherwise, the first author entered the room after 15 minutes to terminate the session. A 15-minute maximum was selected based on analysis of the prepractice phase in commercially available voice therapy videos[4].

2.4.2 | Prepractice variable rating

The utterances and actions (behaviors) of each clinician and the StP were transcribed and presented as an observational checklist, adapted from a previous study[4] (see excerpt in Appendix 4). The columns of the spreadsheet were labeled according to the MLCF. They included the general prepractice variables of *motivation*, *modeling*, *feedback*, *physical attempts*, and *verbal information*. The specific prepractice variables of *instructions*, *explanations*, and *perceptual training* were also included as sub-categories of the *verbal information* variable. Additional categories of *conversation* and *other* were included as recommended by Madill et al.,[4].

Two raters experienced in using the MLCF rated the clinicians' behaviors. The raters completed a two-hour training session before rating the therapeutic sessions. The nine videoed sessions were presented to the two raters in a randomized order. Each session was presented once in segments of 50 transcribed behaviors/utterances, with one-minute pauses, to allow the raters sufficient time (Appendix 4). They were instructed to rate each behavior according to the perceived intent of the clinician,

regardless of the StP's response. The raters were instructed to add a description or title to any behavior they listed as *other*, and they could select more than one variable to categorize one behavior.

The ratings for the specific prepractice variables of *instructions*, *explanations*, and *perceptual training* were grouped into the general prepractice variable of *verbal information* for analysis of reliability and percentage of prepractice variables used by clinicians.

2.5 | Data analysis

2.5.1 | Primary analyses

2.5.1.1 | Reliability measures for the Motor Learning Classification Framework

An entire session (representing 10% of the total rated behaviors) was re-rated by both raters two weeks after the initial rating to calculate intra-rater reliability. We calculated intra-rater reliability using the percent agreement between each rater's first and second rating of the sessions. Inter-rater reliability was calculated using the percent agreement between the raters for each variable and behavior in each session.

Intraclass Correlation Coefficients, with two-way random effects, absolute agreement, were calculated to estimate inter-rater reliabilities[20] generalizable to other raters and rating occasions. A correlation ICC>0.7 is deemed acceptable (0.81-0.9 good, >0.91 excellent)[21].

2.5.1.2 | Comparing clinical behaviors of student and experienced clinicians

The raters' categorizations were analyzed for type and frequency of behaviors and differences between the student and experienced clinicians. For each client interaction, the frequency that each general prepractice variable was identified was divided by the total number of behavioral variables identified in the session, then multiplied by 100 to give a percentage. The resulting percentage frequencies were averaged over the two raters for students and clinicians. These data were compared in a 2(Clinician Type) × 5(Behavior Category: *motivation, modeling, feedback, physical attempts, verbal information*) ANOVA, with repeated measures on the last factor. For all comparative analyses, Bonferonni corrected *t*-tests were used to compare any significant main effects or interactions involving more than two means using SPSS version 17.0.0[22]. Overall alpha was set at .05.

To compare the use of specific *verbal information* variables (*instructions*, *explanations*, and *perceptual training*) by the two groups, a 2(Clinician Type) × 3(Verbal Information Category) ANOVA, with repeated measures on the second factor, was performed. The behaviors described in the category *other* were thematically coded and descriptively compared between the two clinician groups.

2.5.2 | Secondary analyses

The responses for each clinician were visually analyzed to identify common sequences in the use of prepractice variables. These sequences were counted and descriptively compared between groups. Also, the general prepractice variables were grouped into two behavior categories: talking and doing. *Motivation*, *feedback*, *verbal information*, *conversation*, and *other* were considered as talking behaviors, while *modeling* and *physical attempts* were considered as doing behaviors. A 2(Clinician Type) ×

2(Behavior Category) ANOVA, with repeated measures on the second factor was used to analyze these data.

3 | RESULTS

3.1 | Primary Analyses

3.1.1 | Reliability of the Motor Learning Classification Framework in voice therapy

High intra-rater reliability was shown across both raters, with percent agreement at 91.9% and 92.3% for each rater on 221 behaviors. The raters showed a mean total inter-rater percent agreement for the student group of 89.6% (SD=1.2%) and for the experienced clinician group of 82.1% (SD=7.9%). ICCs(2,1) for all but one of the general prepractice variables fell within the 'excellent' range of agreement[23](Table 1).

3.1.2 | Prepractice variable comparisons across student and experienced clinicians

Screening of residuals showed one student had extreme scores for *motivation* and *verbal information*, so their data was excluded from analysis. The use of prepractice variables across the groups did not differ [$F(1,6)=0.44$, $p=.53$, $\eta_p^2=0.07$]. There was a significant main effect for behaviors [$F(6,36)=40.76$, $p<.001$, $\eta_p^2=0.87$]. Post-hoc, Bonferroni-adjusted *t*-tests showed that *verbal information* was used more frequently by both student and experienced clinicians (Figure 2) compared to all other prepractice behaviors, which were not significantly different from each other. No interaction effects were observed between group and prepractice behaviors used [$F(6,36)=0.60$, $p=.73$, $\eta_p^2=0.09$].

There were no group differences in the percentage frequencies of the specific verbal information variables used [$F(1,7)=0.001$, $p=.99$, $\eta_p^2=0$](Figure 3), but planned orthogonal contrasts showed differences in the types of *verbal information*. In both groups, *instructions* were used more frequently than both *explanations* and *perceptual training* [$F(1,7)=119.09$, $p<.001$, $\eta_p^2=0.94$], with the latter two not differing from each other [$F(1,7)=0.025$, $p=.88$, $\eta_p^2=0.003$]. There were also significant interaction effects between group and *verbal information*. Student clinicians gave more *instructions* than experienced clinicians, whereas experienced clinicians gave more *explanations* and *perceptual training* than students [$F(1,7)=11.475$, $p=.012$, $\eta_p^2=0.621$](Figure 3).

The *other* category was used by both raters in rating all sessions except that of S4. Both raters identified four additional variables that did not fall within the general or specific variables of the MLCF: *confirming client information*, *checking prior knowledge*, *seeking information*, and *problem solving*. All of the experienced clinicians, except E2, used *problem solving* in their session. S3 (the only student with clinical experience in voice therapy) was the only student to use *problem solving* in their session.

3.2 | Secondary analyses

3.2.1 | Behavior sequences of prepractice variables

All clinicians showed repeated sequences of prepractice variables and most sequences were common to more than one clinician. For example, all but one clinician (S5) gave an *instruction* before the client *attempted* the vocal task, which was followed by *feedback* from the clinician. All experienced clinicians used a sequence that provided

perceptual training after a client's attempt, while only two students (S4, S5) used this sequence.

3.2.2 | Talking and doing behaviors

Data screening showed no outlying residual scores, so data from all nine participants were used. Significantly more talking behaviors than doing behaviors were used [$F(1,7)=50.7$, $p<.001$, $\eta_p^2=0.88$], but there were no differences between the groups [$F(1,7)=1.40$, $p=.28$]. Although experienced clinicians showed larger differences in the frequency of talking behaviors compared to doing behaviors, in comparison to the student clinicians, there was no interaction [$F(1,7)=4.10$, $p=.082$, $\eta_p^2=0.37$].

4 | DISCUSSION

The primary aims of this study were to assess the reliability of the MLCF in its application to voice therapy sessions and to compare student and experienced speech pathologists' clinical behaviors. We showed that prepractice behaviors could be reliably identified using the MLCF. Although there were similarities between clinician groups based on these behaviors there were some notable differences. In comparison to students, experienced clinicians gave more *explanations* and *perceptual training*. In secondary analyses, the experienced clinicians showed a trend for more talking behaviors than doing behaviors, and consistency in how (i.e., the order) these behaviors were delivered.

4.1 | Reliability of the Motor Learning Classification Framework

The high reliability of rating using the MLCF between and within raters across time was similar to reliability data reported in an earlier investigation of prepractice behaviors in voice therapy, among nine raters and across three therapy approaches[4]. In combination, these data provide evidence that the MLCF is a tool that can be implemented in a range of contexts and therapy approaches to assess differences in teaching the same and different techniques. Further reliability-based studies of the MLCF are recommended, particularly in a wider range of clinical areas and contexts, and where data are available about the effectiveness and efficiency of particular interactions.

In the current study, *conversation* was identified in every session and the use of the *other* variable in our study led to the identification of four new behavior types: *confirming client information*, *checking prior knowledge*, *seeking information*, and *problem solving*. This demonstrates that a voice therapy session is comprised of more parts than those that are directly relevant to motor learning. Further study of these additional components would help isolate critical ingredients of therapy, which encourage effective practice and lead to voice-related improvements. The use of *problem solving* is notable, as problem-based learning has been shown to be an effective learning tool across a variety of educational and motor-skill learning settings[24,25]. Problem-solving scenarios give the learner autonomy over change, and lead the learner to consider potential solutions before being given solutions[26,27]. Further study of this behavior would help to enhance the validity of the MLCF as a behavior change identification instrument in clinical settings.

The frequent occurrence of *verbal information* led to the subdivision of this variable into three types of prepractice information: *verbal instruction*, which was most frequently given by student clinicians, *explanations* and *perceptual training*, which

experienced clinicians were more likely to give. Like problem solving, the latter two behaviors encourage an active learning approach, compared to a direct instructional approach, which can encourage passive learning. Active learning approaches, where the instructor prompts the learner to discover what and how to change, have been shown to be an effective method for retention of motor skills in coaching and teaching of sports and other movement skills[28-30].

4.2 | Differences between student and experienced clinicians

Student and experienced clinicians used similar percentages of prepractice behaviors in their sessions, particularly *verbal information* behaviors, somewhat contradicting expectations from the literature[1,2]. The general lack of difference between the groups suggests that teaching any motor skill, regardless of experience, is based on a relatively invariant combination of variables. However, because of the small number of participants, further research is required to test any trends in the data, particularly related to the secondary analysis, for example how consistently certain sequences of behaviors are used among experienced clinicians. The most common sequence was *instruction*, followed by *modeling*, then *attempts*, for both the students and the experienced clinicians. *Feedback* or an *attempt* was frequently followed by some sort of *perceptual training* by the experienced clinicians, but not by the students. Perceptual training is thought to encourage the client to develop their own reference or standard for making self-comparisons based on intrinsic feedback from feel and sound[31].

4.3 | Talking and doing behaviors

Motor learning research has led to recommendations to use instructions that are relatively low on prescribing what to do, but are more focused on setting up task constraints and providing informative feedback to bring about desired behaviors[29,32]. The results of this study, as well as reports in other observational studies of voice therapy[28,33], demonstrate that clinicians in the prepractice phase use significantly more talking behaviors than doing behaviors. This mismatch with current recommendations might be related to the short duration of the session and a lack of time to allow the client to discover and design their own solutions, or it may be a result of the specific needs of clients in the prepractice phase of voice therapy. In the prepractice phase of client-clinician interactions, the role of the clinician is to ensure that the client is able to go away and practice safely and effectively. Hence there may be more need to explicitly instruct when clinician availability is limited. The costs of inefficient vocal movements, as may occur in incorrect attempts at a vocal task, can also instigate phonotrauma[34], so a more direct instructional approach may better suit the teaching of a voice motor task. This aspect of client-clinician interaction deserves further attention, to help determine what constitutes the optimal amount of instruction.

4.4 | Limitations

In addition to increasing the sample size to more sensitively evaluate if and how experience moderates the delivery of prepractice behaviors, it will also be important to evaluate the success of an intervention, and to determine how behaviors and outcomes co-vary. In future work, clinicians should train naïve clients to perform a vocal motor task so that learning outcomes can be assessed.

5 | CONCLUSIONS

Limited evidence exists in identifying the clinical behaviors that distinguish experienced SLPs from students in voice therapy. The MLCF can be reliably used as a rating tool to measure clinical behaviors in voice therapy and is ready to be used as an exploratory tool in other health education contexts that involve learning of motor skills (such as physical therapies, clinical assessments and medical procedures). Although there was little overall difference in the clinical behaviors of student and experienced clinicians, experienced clinicians used *problem solving* and *perceptual training* more routinely within their therapy sessions. Additionally, the identification of a higher frequency of talking behaviors compared with doing behaviors in these prepractice client-clinician interactions, despite current motor learning guidelines, prompts further investigation into what behaviors and strategies are the most efficient and effective for voice therapy and how we best might go about changing these behaviors to bring about long-term change.

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AUTHOR CONTRIBUTIONS

RR, RH, PM and CM were substantially involved in the design of the study, collection and analysis of data. All authors (RR, PC, RH, NH, DN and CM) were involved in

interpreting the data and revising the manuscript critically for its intellectual content. All authors have agreed to investigate and resolve any questions relating to the work.

CONFLICTS OF INTEREST

None.

ETHICAL APPROVAL

Ethical approval was provided by The University of Sydney Human Research Ethics Committee (03-2010/12546).

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TABLE 1 Intraclass correlation coefficients (ICC) of the prepractice general variables.

Variables	**ICC, Single Measures**
Motivation	.846
Modeling	.982
Feedback	.923
Verbal Information	.986
Conversation	.957
Physical Attempts	.998
Other	.985

FIGURE LEGENDS

FIGURE 1 A proposed Motor Learning Classification Framework. The main variables appear on the left of the model and are ordered somewhat in relation to how they are delivered chronologically. To the right of these variables are classifications of how these variables can be considered along with more specific examples. Note KR=Knowledge of results; KP=Knowledge of performance. This figure was published in: Madill C, McIlwaine A, Russell R, Hodges NJ, McCabe P. Classifying and identifying motor learning behaviors in voice-therapy clinician-client interactions: A proposed Motor Learning Classification Framework. *J Voice*. 2019; doi:10.1016/j.jvoice.2019.03.014. Copyright Elsevier (2019).

FIGURE 2 Percentage use of general prepractice variables in therapy sessions by clinician type (error bars=SD).

FIGURE 3 Percentage use of verbal information prepractice variables in therapy sessions, by clinician type (error bars=SD).

FIGURES

Fig 1

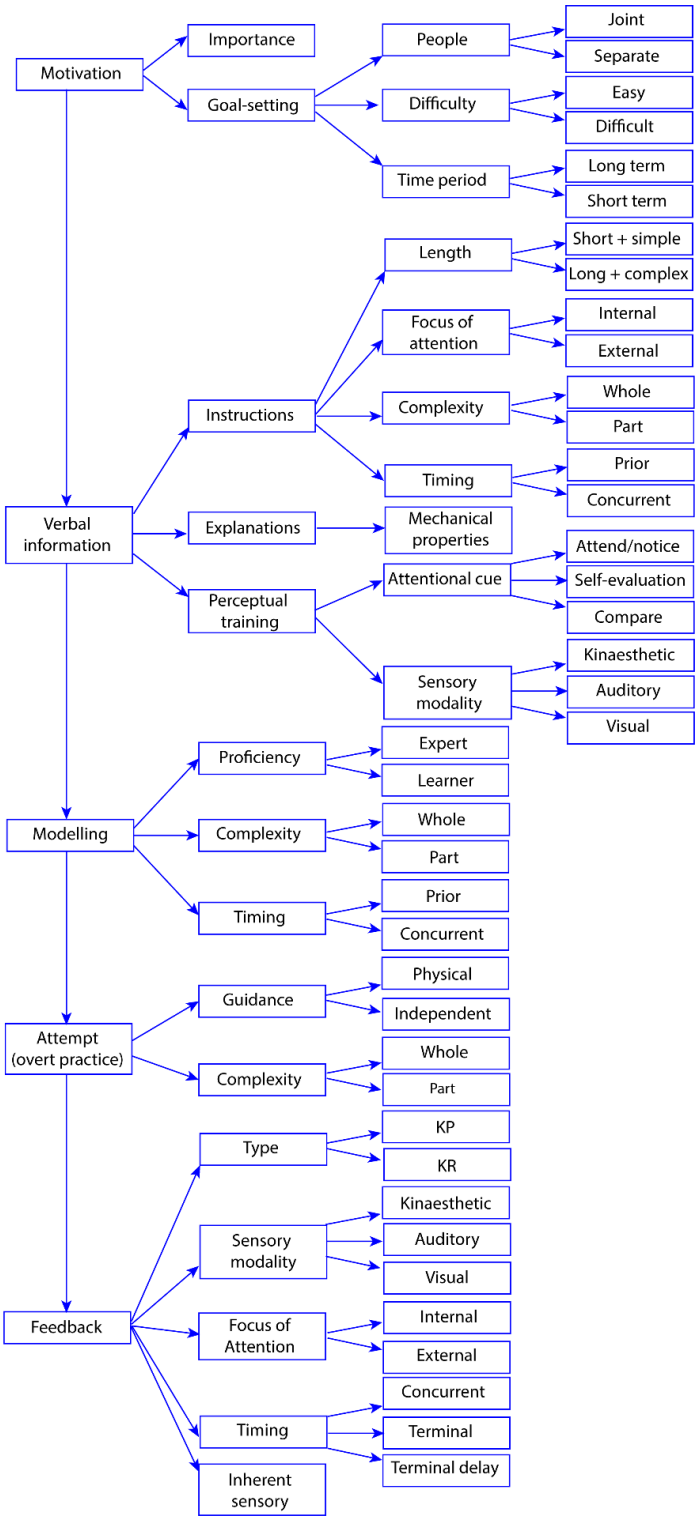


Fig 2

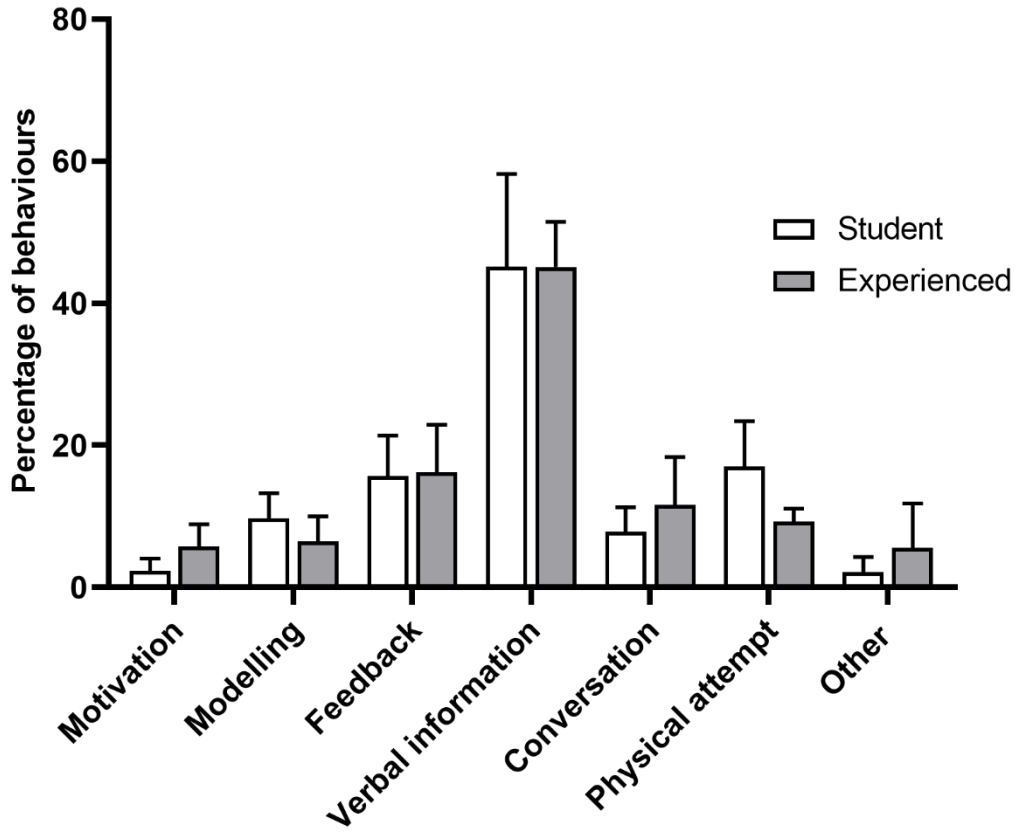
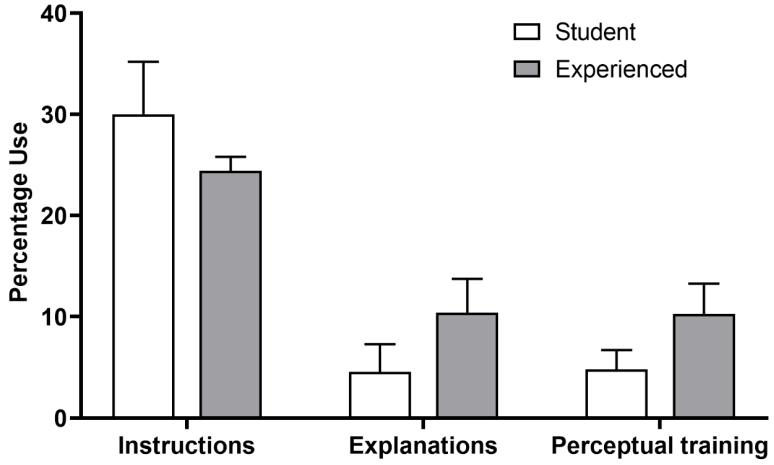

80
60
40
20
0
Percentage of behaviours
Student
Experienced
Motivation
Modelling
Feedback
Verbal information
Conversation
Physical attempt
Other

Fig 3


40
30
20
10
0
Percentage Use
Student
Experienced
Instructions
Explanations
Perceptual training