APPLIED COGNITIVE PSYCHOLOGY, VOL. 7, 191–204 (1993)

Becoming a Bartender: The Role of External Memory Cues in a Work-directed Educational Activity

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SUMMARY

Two kinds of external mnemonic cues are distinguished within the activity of becoming a bartender. Verbal mnemonic symbols (VMS) are materially arbitrary with respect to their referents. Material mnemonic symbols (MMS) bear a direct material relation to their referents. Both sets of cues are socially constituted. Combined ethnographic and experimental analyses indicate that external mnemonic cue use shifts from VMS, to MMS, to the use of neither with increasing experience. These shifts are interpreted within an activity theory framework as they occur in relation to the changing goals of becoming a bartender.

The issues surrounding how one learns to become a dairy worker (Scribner, 1984a), waitress (Stevens, this issue), phone salesperson (Laufer, 1990), bartender, or psychologist are intertwined with questions of how and to what end occupational information and skills are remembered. Our personal experiences suggest that external aids to memory such as lists, timers, notebooks, photographs, and calendars are critical to acquiring and maintaining knowledge necessary for effective functioning in the workplace. Their role is implicit in traditional experimental memory procedures such as recognition, paired-associate, and free recall (Watkins, 1979). Here the external mnemonic cue serves a methodological function rather than being the focus of inquiry.

Studies of mediated memory are more explicit with regard to the importance of external cue use as part of the memory process being decribed (e.g. Meacham and Singer, 1977; Harris, 1984; Deloache, 1983). However, most studies of external mnemonics have isolated cues from their developmental course by losing sight of the social affordances and constraints which shape that course beyond the laboratory, if not within it. As a result, theories and methods behind these accounts are unable to generate an adequate description of the changing role played by external memory cues while becoming an experienced participant in some form of human activity such as bartending, schooling, or playing soccer. All activities are collective endeavours in which the mnemonic cues both construct and are constructed by the psychological subject and a broader social ethos.

There are at least three prerequisites to an adequate description of the use of

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The study was carried out while the author was a member of the Laboratory for Cognitive Studies of Work, City University of New York Graduate Center.

0888–4080/93/030191–14/$12.00
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external memory cues within a socially prescribed activity that have not been encompassed by previous accounts. Scribner (1984b) states that most non-laboratory activities require the subject to acquire and flexibly apply multiple strategies in line with the goals of learning an activity. Scribner's examination of flexible strategy use in a simulated work task was carried out across different problems subsumed under similar if not identical goals. Flexibility occurred through the acquisition and adaptive use of the most efficient means for achieving the same goal. The most efficient means varied with the particular problem at hand. Though not examined in Scribner's set of studies, flexible strategy use can be considered with respect to changing goals across identical problems as well. A description of memory cue use while becoming experienced in an activity must therefore encompass the goals constructed by the person-as-part-of-the-activity. These guide the acquisition and flexible use of a number of potential mnemonic strategies during the process of becoming experienced.

Second, the external mnemonic cue cannot be construed simply as a passive internally directed stimulus. In so far as external cues mnemonically signify objects, persons, events, themselves, and the intangible, they are symbols with a social history. Their reconstruction as part of ontogeny affords their mnemonic potential.

Last, changes in the roles played by external mnemonic cues during the course of becoming experienced need an analytic framework that permits an integrated description of the social and cognitive processes involved. Activity theory (Leontev, 1978; Wertsch, 1981) provides the integrating framework necessary for describing these changes without resorting to cognitive or social reductionism.

The present study describe changes in the role played by external mnemonic cues as part of adults becoming experienced at a work activity: bartending. Activity theory is used to integrate and interpret the findings generated through the combined use of ethnographic and experimental methods.

ETHNOGRAPHIC METHOD

Rather than explicitly searching for laboratory phenomena in work activities as a beginning, an endeavour which seems epistemologically backwards (Erlich, 1979) as well as unnecessarily constraining, the approach taken in this study consisted of selecting an occupation which intuitively seemed to place heavy demands on memory. Bartending met this criterion. A commercial school in New York City which trains adults 18 years of age and older to become bartenders was chosen as a promising research site. The bartending school bears relations both to school as an institution and to bartending. The standard 2-week course entailed formal lecture–demonstration sessions by the instructor and extensive practice mixing drinks behind a series of working bars. A graduate of the school was expected to be able to mix any combination of approximately 100 different drinks rapidly and accurately from memory.

The researcher initially enrolled in the school as a student to construct an ethnographic description of the memory skills involved in learning to become a bartender. With time, the description began to focus on the function of various types of mnemonic cues used by the students. Introspections and observations recorded as field notes, as well as structured and unstructured interviews with students and instructors, were used to formulate the description (Beach, 1985). The focused ethnography

assisted in defining the various types of external cues used by students mixing drinks, and why they used them. It also motivated the construction of an experimental hypothesis. The hypothesis concerned the changing role played by external mnemonic cues related to changes in goals associated with becoming a skilled bartender.

DESCRIPTION OF THE BARTENDING CLASSES

The classes ranged from 22 to 30 students and two instructors with one or two assistants. The students ranged from 18 to 63 years of age. Their backgrounds varied as widely as their ages: bank teller, off-Broadway actor, college student, cocktail waitress, the long- and short-term unemployed. Their reasons for taking the course focused on three themes: making money, having a job which permitted extensive close contact with people, and having flexible work hours. Both instructors had extensive experience as professional bartenders. The assistants had more limited experience working as bartenders.

Each class session consisted of an hour lecture with the instructors demonstrating how to mix various drinks. After each lecture–demonstration session students practised in teams of three or four behind a series of working bar stations for the remaining 3 hours of the class. Students took turns functioning as bartender and as customers ordering drinks. The nature of the practice session was largely determined by the students working at each station. The instructors and assistants circulated from station to station to answer their questions and assess students' progress. On the third day of the course the instructors began to introduce a series of 'speed drills' during the practice session. Students were asked to fill an orally presented order for several drinks while being timed.

Accuracy and eventually speed in mixing drinks was stressed by both students and instructors as training objectives. These objectives reflect the social and economic reality of working for a living as a bartender. In addition to accuracy and speed, instructors emphasized that certain types of social interaction with customers were important to successful bartending (i.e. to receive larger tips) but had to be learned on the job rather than at the school.

Written and practical examinations were administered at the end of the 2-week course. The written examination required the students to list the ingredients and steps in mixing most of the drinks covered in the course. The practical examination required the students to mix 12 drinks requested by an instructor in 7 minutes or less. A maximum of three or four errors was permitted. Of the 26 students in the researcher's class, 22 passed the written and practical examinations and were graduated. Most graduates took advantage of the school's placement service which has an ongoing relationship with a large number of bars, restaurants, and discos.

Two general systems of external memory cues were used by students learning to mix drinks: verbal and material. Verbal mnemonic symbols (VMS) consisted of the names of drinks that were ordered which were orally rehearsed by the students and the written recipe for those drinks available in a mixology guide (Tiano, 1983) as are almost all linguistic cues. VMS are materially arbitrary with respect to their referents, a second system of cues, material mnemonic symbols (MMS), are materially non-arbitrary with respect to their referents. They are an integral part of the object to which they refer. For example, the shape of a glass placed on the bar rail can

limit the number of drink names that can be associated with that glass. One cannot mix a martini in a collins glass, given society's conception of what a martini is. The colour and amount of the ingredient already in the glass can assist in the recall of both the drink name and the ingredients which should follow. One cannot add dark rum to a glass containing half an ounce of red sweet vermouth if the drink is to conform to any known recipe, let alone be palatable.

The focused ethnography served as the basis for designing an experiment to examine potential differences in the role played by VMS and MMS among novice students, recent graduates, and instructors. It was hypothesized that external mnemonic symbol use would shift from VMS to MMS from novice student to recent graduate. Furthermore, instructors would use VMS with less frequency than either the students or the graduates. The bases for the hypothesis are 2-fold. First, the focused ethnography suggested that a shift from VMS use to MMS use occurs, though the details and extent of such a shift remained unclear. Second, activity theory would predict a shift in mediational means as the goals of becoming a bartender shifted from acquiring knowledge of drink names and ingredients (emphasis on accuracy) to mixing the drinks rapidly (emphasis on speed) to increasing tips (emphasis on interacting with customers). It was posited that VMS were useful for initially remembering drink and ingredient information, but were time-consuming and might be easily disrupted by external distractions. The opposite would be true for MMS. It was posited that instructors would not use VMS and minimally attend to MMS, allowing them to freely interact with customers.

EXPERIMENTAL METHOD

Subjects

Ten novice students, 10 recent graduates, and two instructors from the bartending school volunteered to participate in the study. Novice students had completed one week of the course at the time of their participation. All novice students included in the experiment passed the final written and practical examinations one week later. Graduates had completed the entire course and had passed their final written and practical exams the day before their participation. Novice student and graduate ages ranged from 18 to 46 years with mean ages of 30.1 and 28.4 years, respectively. Gender was balanced across the student and graduate groups and various ethnic groups were represented across the groups. None of the students had previous working experience as a bartender. One instructor had 10 years of experience as a professional bartender and had taught at the school for 8 years. The other instructor had 6 years of experience as a professional bartender and had taught at the school for 2 years. Their ages were 44 and 32 years, respectively. Both were male.

Design

The experiment was devised from an already existing school practice: the speed drill. The speed drill requires students to mix a combination of four drinks quickly and accurately as one 'order.' Each subject completed six speed drills. The non-orthogonal design was a 3 experience (novice, graduate, instructor) $\times$ 2 MMS availability (high, low) $\times$ 2 rehearsal distraction (yes, no) factorial with trial (1 to 6)

as a within-subjects repeated measure. Level of experience was a between-subjects variable. MMS availability and rehearsal distraction were within-subjects variables. Dependent variables were time to complete each drill, number of common ingredients used, number of drink errors (wrong drink, but correct ingredients), number of ingredients errors (right drink, but one or more wrong ingredients), frequency of overt rehearsal, number of looks at mixology guide, number of looks into glasses, and glass position.

Materials and procedure

The drink combinations within each of the six speed drills were constructed such that each called for at least two different glass shapes. The name of an ingredient was not contained in the name of the drink, and there was at least one pair of drinks that shared a common ingredient in each combination. Each order for four drinks was presented orally. The names for drinks requiring identical glasses were not presented next to each other in the order.

The subjects were asked to use the regular bar glasses for the first three speed drills: collins, cocktail, rock, champagne. The second set of three drills required the subjects to mix the same drinks with the names presented in a different within-combination sequence. In this set of drills the subjects used opaque black glasses which were identical in shape. The MMS of shape was eliminated and the black colour required subjects to tip the glass to view the colour and amount of an already poured ingredient. A 15-minute break was taken between the two sets of drills, during which the subjects read a passage from an ethnography of cocktail waitresses (Spradley and Mann, 1975). The glass conditions were not counterbalanced across subjects as any practice effect would tend to increase accuracy in using the black glasses and would be counter to the reduced availability of MMS.

Subjects were asked to count backwards from 40 by threes during the second and third speed drill within each glass condition. This was done to reduce the efficiency of rehearsal strategies, providing an indirect measure of whether subvocal rehearsal of drink names was used. The request was made immediately after subjects placed the glasses on the bar rail before beginning to mix drinks. The mixology guide was always available for use by the subjects. All speed drills were timed to one-hundredth of a second. The subjects were asked to point to and name each of the four drinks they had mixed at the end of each speed drill.

Data collection and coding

All speed drills were carried out at a school bar station and were recorded on colour video-tape using a fixed camera and a lapel microphone. Video-tapes were coded for the time it took to complete each speed drill, number of common ingredients used, number of drink errors, number of ingredient errors, frequency of overt rehearsal, number of looks at the mixology guide, and number of looks into glasses. In coding the video-tape a glass position strategy was discovered and coded. Some subjects placed glasses in sequence so that identical glasses (or black glasses that would have been identical) were next to each other and/or allowed additional space between glasses of different shapes. Interrater reliability obtained from two raters on two of the 22 complete subject protocols was 97 per cent.

EXPERIMENTAL RESULTS

Analysis of variance was carried out separately for novice–graduate, novice–instructor, and graduate–instructor pairings on MMS availability and rehearsal distraction with speed drill trial as a repeated measure. A general linear models procedure using the method of least-squares was used as the design was unbalanced. Variance due to trial was included in the error term in all analyses as trial did not add to the explanation of the variance in any meaningful way. *T*-tests were carried out on difference scores calculated from cell means.

There were four clear main effects indicating increasing speed in mixing drinks with increasing experience, as shown in Table 1. Graduates mixed each combination

Table 1. Means and standard deviations for speed by experience per speed drill

	Speed	
Experience	Time (second)	Common ingredients (maximum of three)
Novice ($n = 10$)	258.48	.33
	(90.70)	(.66)
Graduate ($n = 10$)	155.50	1.55
	(27.46)	(.61)
Instructor ($n = 2$)	82.00	2.58
	(14.21)	(.67)

of four drinks in 60 per cent of the time taken by novices $F(1,18) = 224.98$, $p < .001$. Instructors mixed each combination in 50 per cent of the time taken by graduates $F(1,10) = 70.68$, $p < .001$. Graduates also detected and simultaneously poured ingredients common to two or more drinks four times more frequently than novices, thereby reducing the time required to mix drinks $F(1,18) = 7.05$, $p < .05$. Instructors used common ingredients 40 per cent more frequently than graduates, though the difference was not statistically significant. Both of these findings support speed as one of the goals of skilled mixology performance.

Accuracy in mixing drinks was also greater for graduates than for novice students as indicated by the smaller number of drink errors $F(1,18) = 19.10$, $p < .01$ and ingredient errors $F(1,18) = 16.08$, $p < .01$ made by graduates using regular glasses, as seen in Table 2. There were no significant differences between graduates and instructors using regular glasses on drink errors and ingredient errors. This supports the notion that accuracy is a goal of skilled performance together with speed. However, it should be noted that mixing accuracy was relatively high even for novices in contrast to the potential for error.

The use of VMS sharply decreased with increased experience, as shown in Table 3. Graduates overtly rehearsed drink names at only 5 per cent of the novice frequency of rehearsal $F(1,18) = 77.61$, $p < .001$ and used the mixology guide at only 2 per cent of the novice frequency of use $F(1,18) = 129.56$, $p < .001$. There were no significant differences in the use of rehearsal or the mixology guide between graduates and instructors.

It can be seen in Table 4 that increased experience did not simply result in the internalization of rehearsal to a subvocal level. There was a significant interaction

Table 2. Means and standard deviations for accuracy by experience per speed drill for regular glasses only

	Accuracy	
Experience	Drink errors (maximum of four)	Ingredients errors
Novice ($n = 10$)	.37	2.30
	(.49)	(1.02)
Graduate ($n = 10$)	.07	.17
	(.25)	(.38)
Instructor ($n = 2$)	.00	.17
	(.00)	(.41)

Table 3. Means and standard deviations for VMS frequency by experience per speed drill

	VMS	
Experience	Rehearsal	Looks at guide
Novice ($n = 10$)	2.57	2.21
	(2.07)	(1.42)
Graduate ($n = 10$)	.13	.05
	(.34)	(.29)
Instructor ($n = 2$)	.08	.00
	(.21)	(.00)

between novice–graduate levels of experience and distractor presentation on drink error $F(1,18) = 13.33$, $p < .002$. The disruption of counting backwards increased the number of drink errors for novices $t(9) = 2.63$, $p < .01$, but not for graduates $t(9) = 1.17$, $p > .10$. We would have expected a similar increase in number of drink errors with the disruption for graduates if they used rehearsal. The disruption of counting backwards literally made no difference in the number of drinks errors for instructors. Like graduates, they rarely used rehearsal, either vocal or subvocal.

It is important to note that the distraction did not increase the number of *ingredient* errors for novices $t(9) = 1.34$, $p > .10$, graduates $t(9) = 1.71$, $p > .10$, or instructors $t(1) = 1$, $p > .10$. Rehearsal assisted the recall of drink names for novices and therefore decreased the number of drink errors, whereas the mixology guide may have assisted the recall of ingredient information, though this was not examined directly. As the graduates and instructors were much better at rapidly and accurately mixing drinks using regular glasses than were the novice students, yet did not use the mixology guide or rehearsal, the question must be raised as to how this was achieved.

The partial answer is that graduates used MMS to recall drink information, as shown in Table 5. The black glasses reduced the availability of MMS. There were significant interactions of novice–graduate levels of experience and MMS availability on drink errors $F(1,18) = 89.05$, $p < .001$ and ingredient errors $F(1,18) = 5.76$, $p < .05$. There was a 17-fold increase in drink errors $t(9) = 8.51$, $p < .001$ and a 9-fold increase in ingredient errors $t(9) = 2.75$, $p < .02$ for the graduates moving from regular to black glasses. There were no significant differences in the number of drink errors

Table 4. Means and standard deviations for accuracy by experience and rehearsal distraction per speed drill

Experience by distraction	Accuracy	
	Drink errors (maximum of four)	Ingredient errors
Novice ($n = 10$)		
with distraction	.43	2.65
	(.55)	(1.67)
without distraction	.10	2.40
	(.31)	(.88)
Graduate ($n = 10$)		
with distraction	.58	1.00
	(.68)	(1.30)
without distraction	.75	.60
	(.72)	(.60)
Instructor ($n = 2$)		
with distraction	.00	.00
	(.00)	(.00)
without distraction	.00	.25
	(.00)	(.50)

Table 5. Means and standard deviations for accuracy by experience and MMS availability per speed drill

Experience by MMS availability	Accuracy	
	Drink errors (maximum of four)	Ingredient errors
Novice ($n = 10$)		
high availability	.37	2.30
	(.49)	(1.02)
low availability	.27	2.83
	(.52)	(1.76)
Graduate ($n = 10$)		
high availability	.07	.17
	(.25)	(.38)
low availability	1.20	1.57
	(.48)	(1.25)
Instructor ($n = 2$)		
high availability	.00	.17
	(.00)	(.41)
low availability	.00	.00
	(.00)	(.00)

$t(9) = 1.96$, $p > .10$ or ingredient errors $t(9)\text{d} = 1.22$, $p > .10$ across MMS availability for novice students.

MMS assisted in the recall of both drink names and ingredient information for graduates. This is illustrated by the increased number of both drink and ingredient errors on the black glasses for graduates. Students of bartending relied more upon MMS than VMS with increasing experience, as was suggested by the ethnographic description. As MMS are non-arbitrary with respect to their referents, the speed

with which MMS and therefore information can be accessed may be greater than that for VMS. However, as MMS are not initially overlearned, as are VMS, a large and well-organized base of specific mixology knowledge must have been acquired before the MMS could assist in recall. The VMS assisted in this acquisition.

The striking lack of VMS used by the graduates could be construed as an argument against mnemonic flexibility as a characteristic of expertise, given the increase in the number of drink and ingredient errors with decreasing MMS availability. However, the achievement of mnemonic flexibility in a given occupation is not particularly useful if said flexibility knows no bounds. The boundaries of flexibility in how one remembers to mix drinks are set by the social and material task environment in the process of learning. The extremely low frequency with which graduates used VMS suggests that these mnemonic strategies were not viewed as appropriate parts of the job. A bartender would not hold a job for any length of time if he or she had to constantly refer to a mixology guide and rehearse the names of drinks that had been ordered. Rather, graduates acquired the ability to tap potential MMS which permitted the accurate mixing of any combination of drinks without subverting speed.

The story is quite different for instructors, as seen in Table 5. Though instructors made fewer drink errors $F(1,10) = 6.15$, $p < .05$ and ingredient errors $F(1,10) = 86.52$, $p < .001$ than novices, like novices, MMS availability had no effect on instructor drink errors $F(1,10) = .30$, $p > .62$ or ingredient errors $F(1,10) = .46$, $p > .53$. Though instructors made the same number of drink and ingredient errors as graduates on the regular glasses, there was an interaction between graduate–instructor levels of experience and MMS availability on drink errors $F(1,10) = 244.75$, $p < .001$ and ingredient errors $F(1,10) = 23.30$, $p < .01$. Graduates made a greater number of drink errors $t(9) = 8.51$, $p < .001$ and ingredient errors $t(9) = 2.75$, $p < .02$ on black than on regular glasses. Instructors, however, literally made the same number of drink errors and ingredient errors $t(1) = 1$, $p > .40$ across glass MMS availability.

Unexpectedly, the instructors resembled novice students in that they did not rely on the use of MMS to recall drink information. However, it should be noted that a 'floor effect' on the low number of drink errors could obscure a subtle use of MMS by the instructors. The instructors resembled graduates in that they did not rely on VMS. Yet, the instructors mixed drinks more rapidly and made fewer drink and ingredient errors than novice students and graduates. Interviews with the instructors suggested that they did not consciously attend to glass shape and the colour and amount of ingredients in the glasses, nor did they feel the need to refer to a mixology guide or rehearse the names of the ordered drinks. Both said that they took speed and accuracy as givens which they achieved 'automatically without thinking about the drinks', allowing them to concentrate on conversations with customers. Both instructors stated that, given accuracy and speed, interacting with customers was the best way to increase their income.

Graduates utilized two strategies in an attempt to compensate for the reduced availability of MMS with the black glasses, as shown in Table 6. Novice students rarely displayed these strategies however. There was a significant interaction between novice and graduate levels of experience and MMS availability on looking inside the glasses $F(1,18) = 89.05$, $p < .001$. Graduates tipped and looked into the black glasses 17 times more frequently than with the regular glasses $t(9) = p < .000$. Novice students looked in black and regular glasses with equally low frequency $t(9) = 1.96$,

Table 6. Means and standard deviations for frequency of glass strategies by experience and MMS availablilty per speed drill

Experience by MMS availability	Glass Strategies	
	Looks in glass	Glass positioning (maximum of 2)
Novice ($n = 10$)		
high availability	.01	.53
	.00	(.68)
low availability	.30	.16
	(.28)	(.46)
Graduate ($n = 10$)		
high availability	.07	.17
	(.10)	(.15)
low availability	1.20	1.57
	(.48)	(.45)
Instructor ($n = 2$)		
high availability	.17	2.00
	(.41)	(.00)
low availability	.00	2.00
	(.00)	(.00)

$p > .08$. Similarly, there was a significant interaction between novice and graduate levels of experience and MMS availability on glass position $F(1,18) = 5.76$, $p < .05$. Graduates positioned the black glasses that would have otherwise shared the same shape next to each other, and arranged additional space between black glasses that would have otherwise had different shapes 9 times more frequently than for regular glasses $t(9) = 2.75$, $p < .02$. Novice students positioned regular and black glasses with equally low frequency $t\,(9) = 1.22$, $p > .10$.

Once again the story is quite different for the instructors. Like the novice students, instructors rarely looked in the glasses $F(1,10) = .31$, $p > .58$ and did not compensate for the reduced availability of MMS in the black glasses by increasing the number of glass looks $t(1) = 1$, $p > .50$. There was a significant interaction between graduate–instructor levels of experience and MMS availability on glass looks as a result $F(1,10) = 37.50$, $p < .004$. Unlike both novices and graduates, instructors always used both facets of the glass position strategy. Though there was a significant main effect for novice–instructor levels of experience on glass position $F(1.10) = 84.94$, $p < .001$ with instructors using glass position strategies 4 times more frequently than novices, there was no interaction between experience levels and MMS availability on glass position $F(1,10) = 5.30$, $p > .09$. Glass condition did not affect the number of position strategies used by novices $t(9) = 1.22$, $p > .10$ or instructors $t(1) = 1$, $p > .50$. There was a significant interaction between graduate–instructor levels of experience and MMS availability on glass position as a result $F(1,10) = 4.52$, $p < .003$. The instructors did not compensate for the reduced availability of MMS by looking in the black glasses. This supports previous evidence that instructors did not use MMS in remembering drink names and ingredient information. However, the instructors always used both facets of the glass position strategy under both glass conditions. Instructors may have assigned drink names to glasses based on spatial position rather than glass shape. Though some assessment of glass shape must take place in originally

selecting the regular glasses, the shape itself did not seem to serve a mnemonic function.

DISCUSSION

Formalisms in the current memory literature capture only portions of the multifaceted role played by memory in becoming skilled at an activity. The role of external mnemonic symbols in becoming a bartender does not simply involve their acquisition and deployment. As Naus and Ornstein (1983), Chi (1978), and others have pointed out, the development of mnemonic skills involves knowledge as well as strategies. A bartending student must acquire a sufficient base of mixology knowledge through the use of VMS before MMS can be used.

Metamemory as superordinate knowledge *about* memory (Wellman, 1983; Flavell, 1969) is also unable to encompass the role played by external mnemonic symbols in bartending. Knowledge of the social–material conditions of bartending plays as critical a role in the shaping of mnemonic decisions as specific knowledge about memory. Strategies, metamemory, and other formalisms may be components of the development of external mnemonic symbols in the process of becoming a bartender. However, these components, as well as more encompassing social and cognitive processes related to the development of external mnemonic symbols, make sense in the realm of bartending only in so far as their changing relations constitute an important human activity.

Activity theory (Leontev, 1978) and Vygotsky's (1978) earlier concept of internalization, or the transformation of external symbol functions into internal functions, provides an analytic framework for describing the changing role played by external mnemonic symbols in becoming a bartender. Activity theory is not structural in a logico-mathematical sense. Rather, its structural units are derived from human activity and are defined by the function they fulfill rather than by any set of invariant properties they may possess. This allows the same function to potentially be carried out in a variety of ways (Wertsch, 1981) depending on relations and transformations between the units. Vygotsky's concept of internalization laid the foundation for a second major aspect of activity theory, the transformation of functions from the interpsychological plane to the intrapsychological plane during acquisition. This necessarily presupposes transformation in the opposite direction as well.

As an activity, becoming a bartender has its own structure, internal transformations, and development. Figure 1 depicts the development of external mnemonic symbols for the individual within the activity of becoming a bartender.

For the novice bartending student, recent graduate, and professional bartender alike, the motive of making a partial or full income from a job that meets certain criteria defines the activity. Passing the course is an initial goal subordinated to the motive. The subgoal of achieving accuracy and some degree of speed directs the action of using VMS to acquire and recall drink information. In addition to its intentional aspect (goals and subgoals), the action of using VMS has an operational aspect—the means by which the action can be carried out. For the novice student, operations consist of the memorization of recipes and the use of the mixology guide and rehearsal to recall information. The specific operations carried out are defined by the conditions under which the subgoal can be realized. His or her limited know-

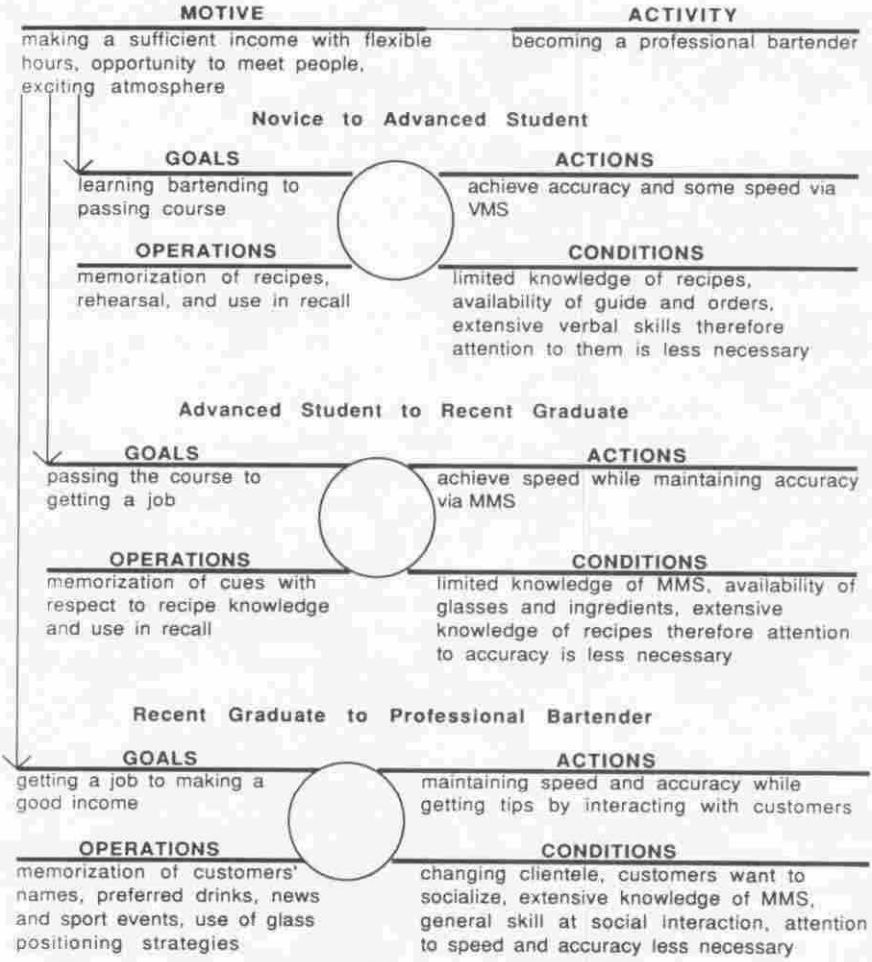

Figure 1. Development of external mnemonic symbols as part of the activity of bartending: novice student to recent graduate to professional.

ledge of mixology, the ready availability of the mixology guide and verbal drink order, the verbal skills initially brought to the activity, and the freedom of attention from the mechanics of reading and listening are the conditions which constrain and afford the operations.

The function of the content of the subgoals, action, and operations related to memory shift with practice and their transformation into internal psychological functions, creating the conditions for the use of MMS when the students become more experienced. For recent graduates, the conscious goal subordinated to the motive becomes one of getting a job in bartending. It is necessary to mix drinks with speed while maintaining accuracy to both pass the course and impress potential employers. This subgoal directs the formulation and use of MMS to recall drink names and ingredients. The operational aspect of this action consists of memorizing cues in relation to already acquired mixology knowledge and their use in recall. The conditions affording and constraining these operations are increasing knowledge of

MMS, availability of distinctive glasses and ingredients, extensive knowledge of drink and ingredient information, and the resultant freeing of attention from its focus on accuracy.

The function of the content of these subgoals, actions, operations and conditions are also transformed in the process of internalization, creating the conditions for the professional bartender to interact with customers. For the professional, the conscious goal subordinated to the motive becomes one of making a good income. It is necessary to receive hefty tips while maintaining accuracy and speed in mixing drinks. This subgoal directs professional bartenders' social interactions with customers. The operational aspect of this action consists of memorizing customers' names, their preferred drinks, and facts concerning recent news, sports events, and the like. The conditions affording and constraining these operations are increasing skill at interacting with customers, customers wanting to socialize, extensive knowledge of MMS, extensive general skill at social interaction, and the resultant freeing of attention from its focus on mixing speed and accuracy.

The development of external mnemonic symbol use described in this study focuses on the individual in relation to the collective activity of becoming a bartender. This is only part of the story, however. Activity theory can also be used to formulate an analysis of the transformation in drink mnemonics in the collective, socially distributed aspects of the activity such as the negotiation of mnemonics between students and instructors. Further, combined individual- and group-centred analyses of external symbol mnemonics in other activities can begin to shed light on their development with respect to their socially constructed and individually reconstructed functions.

ACKNOWLEDGEMENTS

I am grateful to Sylvia Scribner and the other members of the Laboratory for Cognitive Studies of Work at the City University of New York Graduate Center and to William Hirst of the New School for Social Research for their invaluable assistance during the progress of the study. I thank the instructors and students of the bartending school for their patience in assisting this researcher-cum-novice bartender and for the use of the school's facilities.

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