DOCUMENT RESUME

ED 108 600 IR 002 111

AUTHOR Follettie, Joseph F.
TITLE On-Line IDCMS Delivery of Different Types of Stimulus Sequences.
INSTITUTION Southwest Regional Laboratory for Educational Research and Development, Los Alamitos, Calif.
REPORT NO SWRL-TN-1-72-03
PUB DATE 8 Feb 72
NOTE 15p.

EDRS PRICE MF-$0.76 HC-$1.58 PLUS POSTAGE
DESCRIPTORS *Computer Programs; Computer Science; Computer Storage Devices; Educational Research; Information Processing; Instructional Media; *Instructional Technology; Media Specialists; *On Line Systems; *Program Design; Stimuli; *Stimulus Devices
IDENTIFIERS IDCMS

ABSTRACT

On line presentation of the items of a given stimulus sequence may or may not require on line retrieval of items and composition of the sequence. This paper sketches a preliminary taxonomy for auditory, visual, and mixed auditory stimulus sequences. It preliminarily assesses the capability of the Southwest Regional Laboratory Instructional Development Control and Monitoring System to compose and/or control presentation of such sequences during interactive use of the system. (Author/JY)

SOUTHWEST REGIONAL LABORATORY
TECHNICAL NOTE

DATE: February 8, 1972

NO: TN 1-72-03

ON-LINE IDCMS DELIVERY OF DIFFERENT TYPES OF STIMULUS SEQUENCES

Joseph F. Follettie

ABSTRACT

Instructional items formed on one or more of seven types of elements are described. Potentially desirable characteristics of sequences of such items are preliminarily enumerated. Comments anticipate some of the questions concerning system employment that designers of IDCMS software will raise.

ON-LINE IDCMS DELIVERY OF DIFFERENT TYPES OF STIMULUS SEQUENCES

Joseph F. Follettie

On-line presentation of the items of a given stimulus sequence may or may not require on-line retrieval of items and composition of the sequence. A system that permits retrieval-composition of the sequence just short-of-simultaneously with successive presentation of its items will have an on-line (conditional) <u>composition</u> capability. Moreover, if the system permits automated presentation of the sequence conditional on specified facets of performance, then it will have an on-line <u>control</u> capability. All possible stimulus sequences considered, any system that is capable of supporting student-system interaction to any extent will have both composition and control capabilities for some sequences, only control capabilities for some other sequences, and perhaps neither composition nor control capabilities for still other sequences.

Although tactile, thermal, olfactory, and gustatory stimuli on occasion will be apt to education, visual and auditory stimuli are primary to contemporary general education. This paper sketches a preliminary taxonomy for auditory, visual, and mixed auditory-visual stimulus sequences and preliminarily assesses the capability of the SWRL Instructional Development Control and Monitoring System (IDCMS) to compose <u>and</u> control or to control presentation of such sequences during interactive use of the system. IDCMS potentially can compose and control presentation of any sequences whose items are placed in its audio and video storage assemblies. The system in Version 1 configuration can also (probably) control presentation of any stimulus sequence that is jacked to the system at audio and video patchboards, but it cannot compose such sequences on-line until augmented by appropriate external source hardware that is bound to the system by appropriate software. If experience shows a need for files of short moving picture and animated cartoon clips, for rather high-speed random accessing of these files and on-line composition of sequences to which these files contribute, then later versions of IDCMS may incorporate the needed assemblies, including buffering assemblies required under multiple usership.

Several types of stimulus elements can be transmitted to earphones or CRT. Immediately apparent ones are: audio speech (AS), audio nonspeech (AN), video still graphic (VG), video moving pictures (VF), video animated cartoons (VC), video still print (VS), and video moving print on moving pictures and animated cartoons (VM). Complex stimuli can be built using two or more of these element types. So as to be able to specify when we will count one stimulus and when we will count two or more, associative stimuli will be taken as unitary and contrastive stimuli as reflecting two or more unitary stimuli. (Simple stimuli, not of present interest, will be the sort used in threshold assessments and discrimination training.) A basis will be provided for distinguishing between single and repeated presentations of any stimulus. Thereafter, representative instructional sequences will be identified and classified.

Associative (Unitary) Stimuli

A stimulus will be considered unitary if no part of it can be deleted without distorting or reducing the information that E wishes to transmit concerning an associative state of affairs. Above the discrimination level, the smallest bit of instruction consists of a unitary stimulus or associative message in the context of one or more instructions that E gives to S regarding handling or processing of the stimulus. The stimulus can be unitary while featuring successive presentation of information over time, as is the case when one successively presents the words of a linguistic-form message, the notes of a musical composition, or the frames of a moving picture that portrays an action, process or complex still display. However, a contrastive state of affairs can only be described using two or more stimuli.

All items exemplarizing a given concept are linked to the concept and so perhaps to each other in consequence of shared features that exemplarize the concept. Unless these items belong to an identity set, then every pair of items also is contrastive due to irrelevant or nonshared features. The taxonomy will treat any two exemplars of a concept as two different stimuli; that is, it will emphasize their contrastive rather than their associative relation. Thus, any member of an n-item list of exemplars of a concept will count as one stimulus. Conversely, any associative pair (or n-tuple) in an n-pair (or n-n-tuple) list will count as one stimulus.

An audio instructional item might take the form "(Note that) the following item is named Bolero." Play Bolero. Or it might take the form "The word 'dog' is spelled d-o-g." Or "Bolero keeps repeating the same simple theme, but with loudness and tempo increasing over time." Or, if S is quite musically advanced, "Write down the structure of Bolero." Play Bolero.

A video instructional item might take the form of a representation of a real or imagined structure or process, which might be accompanied by an instruction in printed form, a caption, or both. Or it might take the written form "The word dog is spelled d o g." Or it might take the written form "Bolero keeps repeating the same simple theme, but with loudness and tempo increasing over time."

However, the video instructional item need not be confined to static form. Using moving pictures or animated cartoons, the video item can portray dynamic action or can pan over complex still displays. Dynamic video items also can be accompanied by instructions and captions in printed form, whether static or moving.

Finally, the instructional item can make use of both audio and video elements. Thus, audio can be used to say "We spell "dog" . . ." and video to show in synchrony "d o g." Or audio can be used to play Bolero after video shows the message "This composition is named Bolero." Or channels can be used redundantly--e.g., audio saying "We spell 'dog' d-o-g," with video either coming up with the still frame "d o g" at the appropriate time or successively spelling out the word "d," "d o," "d o g."

Single vs. Repeated Presentation

It is taxonomically convenient to reduce instructional materials to items on which instructional sequences can be formed. Such items over time will be associated, contrasted, repeated, or a combination of these. The implied manipulations presuppose ability to distinguish between single and multiple presentations of an item. When presentation duration is vested in S, definition of a single presentation is less critical than when it is vested in the system, acting as E's agent.

Where presentation duration is vested in E and continuous discourse in written or spoken form is presented, E's normal tendency will be to pace presentation rate consonant with his perception of the rate at which S can take in and comprehend the material. That is, E will set presentation rate consonant with his perception of S's "speech-listening" or "print-reading" rate. E may require either that S extract all pertinent information contained in an instructional item or as much information as he can during a shorter interval. If E levies the first sort of requirement, then he will try to set item duration long enough to insure that the pertinent information is extracted but not so long as to cause S to waste time following extraction of the information.

The same train of thought is applicable to messages some of whose elements take nonlinguistic form. During instruction, E may wish to associate "This is a trumpet playing high C" with a recording of a trumpet playing high C. E's object may be that S respond "This is a trumpet playing high C" when duration of the auditory stimulus is a minimum value. After preliminary instruction involving such items shows S the structure of a knowledge system for music, it would not be unreasonable for E to establish a "music-listening" rate for S and to begin setting durations for musical stimuli consonant with his perception of such a rate for S. A visual parallel might have E wishing to associate "this is a red triangle" with a graphic representation of a red triangle. After preliminary instruction shows S the structure of the knowledge system for plane geometry, it would not be unreasonable for E to begin setting durations for geometric stimuli consonant with his perception of S's "geometry-reading" rate.

Whether on an explicit empirical basis or a more intuitive one--and whether effectively, based on consideration of apt information processing characteristics of S, or ineffectively, based on consideration of less apt information processing characteristics of S or even of an average S--instructional systems are not unmindful of a need to match instructional pace for continuous discourse processing tasks with certain characteristics of S growing out of his prior educational experience. Where the task is to process continuous discourse, the notion of a single presentation as that duration that S requires in order to extract the information that E considers pertinent is hardly novel. If the notion is applicable to messages in linguistic form, then it should be applicable also to messages part or all of which are in nonlinguistic form--e.g., trumpet notes and graphic illustrations. That is, a single presentation of any stimulus, however complex, is performance-definable as that duration that S requires in order to extract the pertinent information. Repeated presentations then have only refresher and overlearning implications.[1]

---

[1]Dynamic stimulus elements--single spoken words, stretches of speech, musical compositions, moving picture and animated cartoon displays--can be prolonged without distortion only slightly by slowing the rate of presentation of characters or frames. If an item consisting of such an element or containing such an element still does not yield desired information processing performance, then it either must be reduced for information or repeated. Were one to adopt the view that repeated presentations should have only refresher and overlearning implications, then the single presentation criterion sketched above would imply a need to shorten or informationally-reduce any item that S could

Types of Stimulus Elements

Below we characterize the seven types of stimulus elements enumerated earlier as they relate to IDCMS.

AS - An audio speech element. Typically, such an element will range from phonemic to multisentence length. It reaches S from a random accessible Audio Master Reproduction store reproduced to Audio Buffer. Given a decision to require S to negotiate Instructional Sequence X--20 AS-VG item pairs (VG = video still graphic)--one can discern the following options: a) Retrieve and duplicate Item 1 AS element to Track 1 of Audio Buffer; retrieve and duplicate Item 2 AS element to Track 2 of Audio Buffer while Item 1 AS is being presented; alternate presentation and retrieval-duplication between tracks throughout negotiation of the sequence. b) Procedure would be the same except that retrieval and

---

not process at slowest nondistorting speed. (Conversely, it would require lengthening of any item that S could more than process at fastest nondistorting presentation speed.)

Homogeneous audio items--puretones, white noise, trumpets hitting high C--and static video displays can be prolonged indefinitely. By definition, any presentation duration for such stimuli that is greater than S requires to extract the pertinent information represents repeated presentation time. It is probable that information extracted from an item per unit time increases with negative acceleration rather than linearly as a function of amount of information contained in the item. Hence, even though the single presentation criterion sketched above does not preclude using static items that vary appreciably for contained pertinent information--such items can be prolonged indefinitely--perhaps, on processing efficiency grounds, static items also should be bounded for informational contents.

duplication to Track 2 would extend to as many AS elements of the sequence as could be retrieved and duplicated during Item 1 AS element presentation time. c) Store Instructional Sequence X as an ordered file in Audio Master Reproduction; when needed, retrieve and reproduce Sequence X to Audio Buffer; present AS elements in order according to specifications. The AS elements of a sequence are digitally coded when it is desired that video frames appear in synchrony with these elements. This is called an intrinsic control system because the System Controller then is relieved of the retrieval and synchronization functions for video frames.

AN - <u>An audio nonspeech element</u>. Typically, such an element will range from a short nonspeech sound to several bars of music. All comments made for AS apply to AN.

VS - <u>Video still print element</u>, the printed equivalent of AS. Such an element either may be stored as a video frame on the Video Master Storage Disc or may be generated automatically or manually from a Character Generator. If produced by the Character Generator, VS enters S's CRT through a Video Patch Panel. If stored as a video frame, it enters the CRT following duplication to Video Buffer. Video Buffer will accept and transmit only one video frame at a time. Retrieval-composition of a video frame sequence normally is under control of the intrinsic control system, with control of presentation of the items of the sequence imposed on

Audio Buffer by a Controller program. (The Character Generator normally is used to caption VG or other video graphic items. If it does this one character at a time, then the element produced probably should class as video moving print (VM) rather than video still print.)

VM - Video moving print element, the equivalent of VS except that printed material may develop one character at a time, may appear as successive sentences or paragraphs, or both. VM messages or captions enter S's CRT through the Video Patch Panel in consequence of automatic or manual operation of the Character Generator. VM synchronization with VG, VF, or VC presentations in an automated mode probably necessitates System Controller execution of an appropriate program. VM messages or captions to be generated would have to be accessed from the system's Data Disc.

VG - Video still graphic element. Such elements are stored as video frames on the system's Video Master Storage Disc for reproduction one at a time to S's Video Buffer. Specification of a VG sequence normally is accomplished by the system's intrinsic control system, which reads digital codes from Audio Buffer tape and retrieves frames as needed.

VF - Video moving picture element. VFs enter S's CRT through the Video Patch Panel. The system in Version 1 configuration makes no provision for automatic retrieval and composition of VF sequences from VF elements. However, it seems possible to synchronize presentation of a VF element with a VM sequence or an AS sequence or both. Given that a VF projector is suitably loaded, system start-stop control should be no problem.

VC - <u>Video animated cartoon element</u>. All VF comments apply. The VC element permits stylized and simplified presentations of information in static and dynamic graphic form that VF is not suited for. Thus, one can portray a line drawing on VC as a moving series of dots, can explode an assembly to show its subassemblies or vice versa, and in general can perform various informational analyses and syntheses in graphic form. Its educational symbol is Ludwig von Drake rather than Donald Duck.

Certain elements can stand alone as items. "The word 'dog' is spelled d-o-g" is an associative item using only the AS element. VS items also are possible; perhaps VG, VF, and VC items are.

The following pairs of elements might make interesting associative instructional items:

AS-AN - "This is a trumpet" + (toot).

AS-VS - Spoken "dog" or /d/ + written <u>dog</u> or <u>d</u>.

AS-VM - Spelled "d-o-g" + written <u>d</u> to <u>do</u> to <u>dog</u>.

AS-VG - "This is a trumpet" + (representation).

VS-AN - <u>Fire engine sound</u> + (representation).

VS-VM - Written <u>dog</u> + written <u>d</u> to <u>do</u> to <u>dog</u>.

VS-VG - Written <u>dog</u> + (representation).

AS and VM sequences might also be paired with VF and VC elements to form single items of possible interest. E.g.:

AS seq-VF - Running spoken commentary synchronized with a film clip.

VM seq-VF - Running written commentary synchronized with a film clip.

Three-element items of possible interest:

AS-AN-VS - "This is a trumpet" + (toot) + This is a trumpet.

AS-VS-VG - "Trumpet" + trumpet + (representation).

AS and VM sequences might also be associated with VF and VC elements to form triplet items of possible interest. E.g.:

AS seq-VM seq-VF - Running spoken commentary and running written commentary synchronized with each other and with a film clip.

AS seq-VM seq-VC - Running spoken commentary and running written commentary synchronized with each other and with an animated cartoon clip.

If an oscilloscope is brought into the system in lieu of a VC element shown on a CRT, then such triples are possible as AS seq-AN-VC', where AS is the spoken commentary, AN is a musical composition, and VC' is the composition's frequency-amplitude graph shown on the oscilloscope. Bringing oscilloscope capability into the system opens up the possibility for defining all sorts of interesting complex dynamic items.

Sequences

Given the sorts of elements and items enumerated above, a given sequence can be homogeneous or heterogeneous for item form. Beyond this, sequences can be classed according to whether instructional or evaluative and (if this turns out productively useful) whether associative or contrastive.

For most purposes, instructional sequences probably can be viewed as having lengths that are fixed by E's intent rather than by characteristics of S's performance. All such sequences can be viewed as ng a single fixed order for purposes of <u>first</u> presentation. Some of these sequences will most productively be taught if invariantly negotiated in the same order; these sequences must be fully ordered sets. Other sequences may invite productive teaching when negotiated either in a few alternative orders--if these sequences must only be semiordered--or when negotiated in any order--if these sequences do not require ordering. Where the series requires semiordering or no ordering, then any requirement to recycle S through the sequence can be the occasion for partial or full random reordering of the sequence.

Evaluative sequences also can be viewed as having fixed lengths, even though S might not be required to negotiate the sequence to completion. This would be particularly true where concept-learning is evaluated. For instructional purposes, an evaluative sequence can be viewed as having a single fixed order during <u>first</u> presentation. For research purposes, it often will be necessary to randomize test order over Ss even for purposes of first presentation. Wherever concept learning is evaluated, tests should be formed by drawing items at random from a large store of exemplars. In such instances, a series of tests formed to evaluate acquisition of given concepts probably should be formed by sampling without replacement.

Where items do not contain VF or VC elements, IDCMS as a hardware system capable of automatic control through use of appropriate software seems capable of forming various sorts of sequences by random accessing to item elements and storing successively-retrieved items or elements until needed. In consequence, it can handle randomization problems as these are encountered. The test of such capability is not so much one of identifying files and composition storage areas and their capacities and finding the system able to perform the necessary functions as it is one of time. It appears tenable that we can cause any such sequence to be formed. The question is how long, after the command to form such a sequence is given, can we allow the system before asking it to begin presenting the sequence. Such questions await definitive answers.

It often will be possible to specify and form sequences off line. Where this is so and alternative orders are required, then the question becomes one of how much needs to be stored in a given day and whether the system's Version 1 secondary storage can handle the requirement. While we cannot answer that sort of question definitively either, it is already clear that we need not arm the system with a single homogeneous strategy in such matters. In some instances, we can ask the system to form sequences on-line and to keep one or two items ahead of S. In others, we can form sequences off line or store them in such a way that even the slowest system assemblies--the audio ones--can retrieve them while randomizing for order.