

COMPARING TWO FORMS OF THE MRQ IN PREDICTING TASK PERFORMANCE

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What is the Multiple Resource Questionnaire (MRQ) ?

- The Multiple Resource Questionnaire (MRQ) (Boles, Bursk, Phillips, & Perdelwitz, 2007) is a cognitive process-sensitive workload measure of participant task performance.
- The MRQ purportedly addresses a wide variety cognitive processes utilized during task performance. These processes include: auditory-emotional, auditory-linguistic, facial-figural, facial-motive, planar-categorical, spatial-attentive, spatial-concentrative, spatial-emergent, spatial-positional, spatial-quantitative, tactile-figural, visual-lexical, visual-phonetic, short-term memory, visual-temporal, manual-response, and vocal-response cognitive processes (Boles, et. al., 2007).
- The MRQ is reportedly sensitive to changes in participant task pairings and is a diagnostic tool to predict bottlenecks in participant task performance via workload assessment. Multiple performance barriers challenge individuals who use augmentative and alternative communication devices to communicate. The MRQ is a tool that may provide the means to assess performance barriers in Augmentative and Alternative Communication.
- In its original state, however, the MRQ appears too linguistically complex for use across a wide range of individuals. Additionally, there have not been any studies with the MRQ and AAC device use. The purpose of this study is to document the revision process and to determine its applicability to study AAC.

The MRQ's application to AAC

Multiple performance barriers challenge individuals who use augmentative and alternative communication devices to communicate. Despite advancements in AAC device design, product features may specifically impact the performance of individuals using these technologies.

An assessment like the MRQ could help researchers and designers address the following questions:

1. What performance-related problems do AAC users experience during communication and other work-related activities?
2. How do performance-related problems relate to limitations in technology design?
3. How do performance-related problems relate to the physical and cognitive capabilities of the user?
4. How can the primary workload factors associated with AAC device use be identified (e.g., physical, mental, temporal, demands, frustration, effort)?
5. What design features of AAC devices allow successful use in educational or employment settings?

Methods

Participants: 10 students enrolled in the Communicative Disorders and Sciences program at the University at Buffalo participated in this study. Each participant was randomly assigned to one of two groups:

1. original MRQ group
2. revised MRQ group

Participants were asked to complete 3 tasks that target the concepts found on both versions of the MRQ.

Procedure:

1. Modifications to the original MRQ were made during group sessions with the primary investigator and an experienced researcher.
2. Modifications of the MRQ included reviews and evaluations provide by three experts in human factors and industrial engineering.
3. 2 AAC experts in AAC then observed each data entry task and then rated MRQ questions for both versions as to each question's ability to differentiate between tasks.

Tasks: Participants performed 3 data entry tasks using Portable Impact software loaded on a Tablet XL (Impact) AAC device.

1. Task one: required manual (direct select with index finger) entry of a 7-word phrase
2. Task two: required the use of a standard mouse to enter a 7-word phrase
3. Task three: required the use of column/row scanning to input a 7-word phrase

Participants were given the following instructions following each task and then asked to complete the MRQ.

Original MRQ (2007)	MRQ Revised
<p>The purpose of this questionnaire is to characterize the nature of the mental process used in the task with which you have become familiar. Below are the names and descriptions of several mental processes. Please read each carefully so that you understand the nature of the process. Then rate each task on the extent to which it uses each process.</p> <p>All parts of the process definition should be satisfied for it to be judged as having been used.</p> <p>Please judge the task as a whole, averaged over the time you performed it. If a certain process was used at one point in the task and not at another, your rating should not reflect "peak usage" but should instead reflect average usage over the entire length of the task.</p>	<p>The goal of this questionnaire is to describe how you performed the task that you just completed. When completing the questionnaire, please read each description carefully before you answer.</p> <p>It is very important that you answer only what question is asking. Please think about what you did during the whole activity. Your rating should not reflect peak usage. Rather, it should reflect average usage over the entire task.</p> <p>Please read each question carefully so that you understand the nature of the process.</p>

Original MRQ Questionnaire (2007) & MRQ Revised

Cognitive Domain	Original MRQ (2007)	MRQ Revised
AEP	1. Required judgments of emotion (e.g., tone of voice or musical mood) presented through the sense of hearing.	1. You heard speech or music during the task. You judged the emotional content of the speech or music.
ALP	2. Required recognition of words, syllables, or other verbal parts of speech presented through the sense of hearing.	2. You heard speech during the task. You identified words, syllables, or other parts of speech that you heard.
FFP	3. Required recognition of faces, or of the emotions shown on faces, presented through the expression of emotion.	3. You saw faces during the task. You needed to recognize faces or judge the emotional content of the faces you saw.
FMP	4. Required movement of your own face muscles, unconnected to speech or the expression of emotion.	4. You moved your face muscles as part of the task. These movements did not involve talking or displaying emotion.
MP	5. Required movement of the arms, hands, and/or fingers.	5. You moved your hands, arms, and/or fingers while completing the task.
S-TMP	6. Required remembering of information for a period of time ranging from a couple of seconds to a half a minute.	6. During the task, you had to remember something for more than a couple of seconds to a half a minute, but not as long as a minute.
SAP	7. Required focusing of attention on a location, using the sense of vision	7. To complete the task, you focused your attention on a location using your vision.
SCatP	8. Required judgment of simple left-versus-right or up-versus-down relationships, without consideration of precise location, using the sense of vision.	8. During the task you used your vision to make simple left-versus-right or up-versus-down relationships
SConP	9. Spatial concentrative process- Required judgment of how tightly spaced are numerous visual objects or forms.	9. During the task you were required to judge how closely things were positioned.
SEP	10. Required "picking out" of a form or object from a highly cluttered or confusing background using the sense of vision.	10. During the task, you used your eyes and pick out an item from a crowded or confusing background.
SPP	11. Spatial positional process- Required recognition of a precise location as differing from other locations, using the sense of vision	11. During the task, you used your eyes to identify exactly where something was located.
SQP	12. Required judgment of numerical quantity based on a nonverbal, non-digital representation (for example, bar graphs or small clusters of items), using the sense of touch	12. During the task, you looked at a drawing or graph in order to tell how much something was or how many items there were. There were no numbers involved.
TFP	13. Required recognition or judgment of shapes (figures), using the sense of touch.	13. During the task, you were required to use touch to recognize or judge shapes.
VLP	14. Required recognition of words, letters, or digits, using the sense of vision.	14. During the task, you had use your eyes to recognize words, letters, or numbers.
VPP	15. Required detailed analysis of the sound of words, letters, or digits, presented using the sense of vision	15. During the task, you had to use your eyes to identify a visual picture of spoken words, letters, or numbers.
VTP	16. Required judgment of time intervals, or of the timing of events using the sense of vision.	16. During the task, you used your vision to make judgments about the time something occurred or the timing of different events.
VP	17. Required use of your voice.	17. During the task, you were required to use your voice.

Key:

AEP = auditory emotional process
 S-TMP = short-term memory process
 SPP = spatial positional process
 VTP = visual temporal process
 ALP = auditory linguistic process

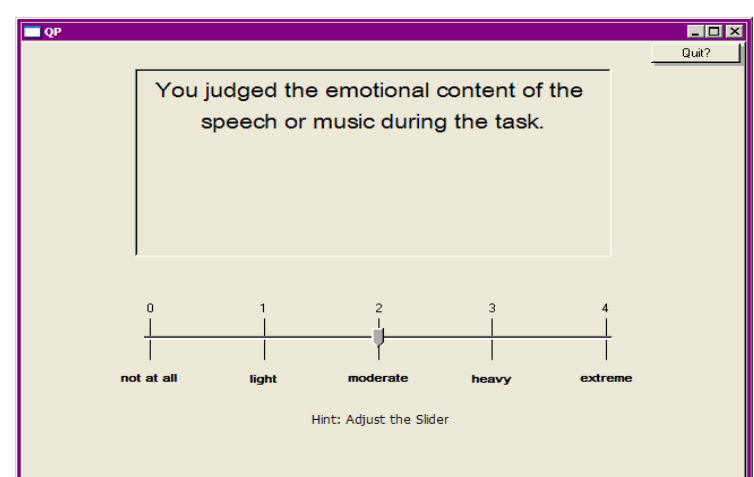
SAP = spatial attentive process
 SQP = spatial quantitative process
 VP = vocal process
 FFP = Facial figure process

SCatP = spatial categorical process
 TFP = tactile figural process
 FMP = facial motive process
 SConP = spatial emergent process

VLP = visual lexical process
 MP = manual process
 SEP = spatial emergent process
 VPP = visual phonetic process

Questionnaire Software

	A	B	C
1	--qAsk "	qID	qText
2	--qChoose "	qID	qText
3	--qOK	qID	paragraph1
4	--qSlider "	qID	qText
5	--qt5 "	qID	qText
10	qt5 "	q01	You judged the emotional content of the speech or music during the task.
11	qt5 "	q02	You identified words, syllables, or other parts of speech that you heard to complete the task.
12	qt5 "	q03	You needed to recognize face or judge the emotional content of the faces you saw to complete the task.



The MRQ was administered using the Questionnaire Program (QP), a general purpose questionnaire application developed at UB. This software application designed to organize and present the most question types as well as a variety of multimedia stimuli. The QP then provides researcher with detailed results via a tab-delimited report.

- Example of a MRQ-source worksheet and its corresponding appearance on the QP. Each row of the spreadsheet contains most of the details for your output file to be displayed in the QP. In addition to the text of a question, the QP can also present sounds and pictures.
- The spreadsheets below display the raw and processed QP output of the MRQ test.

	A	B	C	D	E
1	QuestionFile	QuestionNum	Subject-Trial	Response	Date Time
206	MRQ.txt	q07	p03-1	1.01	7/30/09 10:34:51 AM
207	MRQ.txt	q07	p03-2	1.23	7/30/09 10:44:13 AM
208	MRQ.txt	q07	p03-3	1.77	7/30/09 10:57:06 AM
209	MRQ.txt	q07	p04-1	3.50	7/30/09 3:52:51 PM
210	MRQ.txt	q07	p04-2	3.54	7/30/09 4:04:29 PM
211	MRQ.txt	q07	p04-3	4.00	7/30/09 4:27:29 PM
212	MRQ.txt	q07	p05-1	3.01	5/9/11 9:45
213	MRQ.txt	q07	p05-2	3.00	5/9/11 9:58
214	MRQ.txt	q07	p05-3	4.00	5/9/11 10:13
215	MRQ.txt	q07	p06-1	2.15	11/13/09 9:45:20 AM
216	MRQ.txt	q07	p06-2	3.67	11/13/09 10:03:13 AM
217	MRQ.txt	q07	p06-3	3.45	11/13/09 10:28:00 AM
218	mrq 2007 test.txt	q07	p07-1	4.00	3/25/10 11:43:49 AM

	A	B	C	D	E	F	G
1	Qid	Trial	avg MRQ_txt	avg mrq 2007 test_txt	sd MRQ_txt	sd mrq 2007	p02
2	q01	t1	0.69	1.00	1.07	1.00	0.00
3	q01	t2	0.53	0.09	0.76	0.21	0.00
4	q01	t3	0.61	0.51	1.37	1.14	0.00
5	q02	t1	1.30	1.81	1.31	1.64	1.00
6	q02	t2	1.33	1.32	0.54	1.31	1.01
7	q02	t3	0.99	1.29	1.04	0.97	0.01
8	q03	t1	0.10	0.00	0.23	0.00	0.00
9	q03	t2	0.04	0.00	0.08	0.00	0.01

Analysis

Q1. Do experts agree on the MRQ questions can pinpoint specific modalities required to perform specific AAC tasks?

Discrepancy analysis:

- 2 experts in AAC rated the MRQ (2007) and the MRQ Revised questionnaires as to their ability to discriminate between a direct selection and scanning task
- The consistency of their ratings were also analyzed across forms

	Direct Selection Task		Scanning Task	
	Original MRQ (2007)	MRQ Revised	Original MRQ (2007)	MRQ Revised
Diff of 1 or greater	7/17	9/17	7/17	7/17
Diff of 2 or greater	1/17	2/17	3/17	1/17
Median diff	0	1	0	0

Findings:

- Using a 5 point scale, experts were fairly consistent in their rating the involvement of specific modalities for each AAC task by 1 or less on the majority of questions for both versions. There did not appear to be a noticeable difference between versions.

Q2. For those questions identified by the experts to discriminate between the direct selection and scanning tasks, did the study participants rate these questions similarly?

Comparative rating of average differences for participants

Expert ID	Question #	Original MRQ (2007)	MRQ Revised
Diff by at least 1	Q6	0.39	0.70
	Q9	0.89	0.71
	Q10	1.48	2.53
	Q16	3.40	0.45
Similar	Q5	1.52	0.10
	Q7	0.09	0.70
	Q8	0.08	0.10
	Q11	0.80	0.50
	Q14	0.29	0.48

Findings:

- Although the median scores appear to to differentiate the direct selection from the scanning task (i.e., different > similar), the overlap in individual scores across conditions, indicates that the MRQ fails to provides sufficient discriminability for either the original or revised versions.

Discussion

- As a measure of workload assessment , the MRQ failed to adequately discriminate between AAC task ratings by participants. Experts rated tasks differentially, suggesting that more experience or guidance within the AAC domain may be necessary for the MRQ to be useful. It should be noted that each participant task was short, which may have contributed to the lack of consistency.
- The utility of the MRQ may be enhanced if coupled with the participants’ verbal explanations of their ratings. The revised MRQ has yet to be tested with individuals who read below a 10th grade reading level.

References

1. Boles, D.B. (1998). Relationships among multiple task asymmetries: II. A large-sample factor analysis. *Brain and Cognition*, 36, 268-289.
2. Boles, D., Bursk, J., Phillips, J., & Perdelwitz, J. (2007). Predicting dual-task performance with the Multiple Resources Questionnaire (MRQ). *Human Factors*, 49 (1), 32-45.

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 MRQ and QP software may be obtained at: <http://aac-merc.com/index.php/projects/show/id/8>