



## Joint displays for mixed methods research in psychology

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### ABSTRACT

Mixed methods researchers use joint displays for integration at different phases of the research process in psychological research. Joint displays are visual displays that are used to integrate quantitative and qualitative data during data collection, analysis, and interpretation. We discuss different mixing purposes and how joint displays may help researchers integrate the quantitative and qualitative strands of a study. We provide examples of joint displays for data *collection* and for data *analysis*, including newer innovations. Finally, we discuss considerations, including benefits and challenges, of using joint displays during data collection and analysis.

Over the last several decades, the use of mixed research methods in psychology and other disciplines has steadily increased (Heyvaert et al., 2013). This has been attributed, in part, to the recognition that topics of interest to psychologists and social scientists are multilevel, dynamic, and influenced by social historical contexts (Headley and Plano Clark, 2020; McCrudden and Marchand, 2020). Thus, investigating complex psychological and social issues requires more complex research methods. The use of mixed methods has advantages over the use of single or multi-methods for conducting in-depth and nuanced research studies. In addition, the use of mixed methods is a powerful tool for leveraging the strengths of one method (e.g., qualitative in-depth narrative) to deal with the weakness of another set of methods (e.g., lack of participants voice in quantitative methods; DeCuir-Gunby & Schutz, 2017).

Mixed methods researchers use a variety of approaches, data sources, data collection methods, and/or strategies for analysis, which are integrated to achieve the purposes of inquiry (Bazeley, 2018). Here we define mixed methods as “research in which the investigator collects and analyzes data, integrates the findings, and draws inferences using both quantitative and qualitative approaches” (Tashakkori and Creswell, 2007, p. 4). As reflected in this definition, integration is a defining feature of mixed methods research. *Integration* involves the mixing of the quantitative and qualitative approaches such that they mutually inform each other throughout the research process (Creamer, 2018; Creamer and Reeping, 2020; Fetters et al., 2013). Integration of quantitative and qualitative approaches throughout the research process contributes to

the *inferential transparency* of a mixed methods research study, which is “a type of methodological transparency that explicitly links the contribution of the qualitative, quantitative, and mixing strands to the conclusions drawn from a study” (Creamer, 2018, p. 213). Researchers can integrate quantitative and qualitative approaches while conceptualizing a study, during data collection and analysis, and/or after data sets have been analyzed independently.

Joint displays can play an important role in helping researchers achieve integration and inferential transparency in a mixed methods research study. A joint display is “a table or figure that can be used for organizing mixed data collection and analysis” (Fetters, 2020, p. 194). When used for communication, what distinguishes a joint display from simply presenting research findings is that a joint display is used to explicitly integrate the quantitative and qualitative strands to show how they were mixed. Importantly, the scope of a joint display’s use extends beyond just communicating findings. Researchers can develop joint displays during the research process to help inform their decisions about data collection and analysis.

The focus of this article is to describe how joint displays can help researchers integrate the quantitative and qualitative strands of mixed methods research study to address the mixing purpose of the study. In the following sections, we describe how researchers can leverage joint displays in mixed methods research in psychology to identify meaningful findings and to communicate these findings to readers. First, we identify the different mixed purposes in mixed methods research. Next, we describe joint displays and how these displays are utilized to address

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the mixing purpose of a study. We then discuss specific uses of joint displays during data collection and analyses in psychological mixed methods research. We distinguish between the use of joint displays during data collection and the use of joint displays during data analysis, and how joint displays can help researchers conduct a study and to communicate their findings to readers. Examples of joint displays for conducting and communicating research are provided. Later, we identify some innovative and emerging uses of joint displays. Finally, we offer some considerations and recommendations for researchers and the field of psychological science about the use of joint displays in mixed methods psychological research.

**1. Mixing purposes in mixed methods research**

Integration of the quantitative and qualitative strands is crucial for any mixed methods study. However, having a clear mixing purpose can help researchers find ways to optimize integration. A mixing purpose is the rationale or justification for including and integrating quantitative and qualitative strands in a mixed methods study. Greene et al. (1989) identified five main purposes for mixing: triangulation, complementarity, development, initiation, and expansion (Table 1). We describe these purposes by using one general context to illustrate how the same topic can be investigated differently based on the mixing purpose. We use this brief overview of mixing purposes to set the stage for our later discussion about how researchers can use joint displays to integrate the different strands in mixed methods research studies. (Table 2)

With a *triangulation* purpose, researchers use both strands to

investigate the same elements of a phenomenon. For example, researchers could use an eye-tracking methodology to measure attention during reading and open-ended interview prompts with high school students to investigate strategy use while reading excerpts from a history textbook that includes excerpts about subjects like race, gender, immigration, sexuality, and the economy. Researchers might focus on how attention allocation patterns and responses to the interview prompts converge (or diverge). That is, if readers' explanations of their reading strategies correspond with differences in attention allocation at different junctures in the text. A perceived strength of triangulation is the intentional use of methods with counteracting limitations to corroborate data from the different sources (Greene, 2007). Thus, when designing a study, researchers can develop a plan for collecting data using different methods in a way that will allow them to integrate the findings from each method. For example, using an eye-tracking methodology and open-ended interview prompts to investigate the same phenomenon can facilitate integration because the two approaches have complementary strengths and non-overlapping weaknesses; eye-tracking is a non-intrusive methodology for gathering information about reading processes and interviews can provide insights about what readers were thinking at junctures in the text.

With a *complementarity* purpose, researchers can use one strand to illustrate, elaborate, or clarify the results from another strand. Each strand contributes to the understanding of the phenomenon by focusing on similar, as well as distinct, aspects of the same phenomenon. For example, returning to the eye-tracking example, there may be sections of the text in which some readers allocate high levels of attention, whereas

**Table 1**  
Mixing Purposes in Mixed Methods Research.

Mixing purposes	Description	Example
Triangulation	Use both quantitative and qualitative methods to investigate <i>identical</i> aspects of the same phenomenon to evaluate the extent to which the findings converge or do not converge	To what extent do readers' attention allocation patterns during reading overlap with themes identified in interviews about reading strategies?
Complementarity	Use one method to elaborate, enhance, illustrate, or clarify the results from the other method.	Some readers allocation high levels of attention at controversial junctures in a text, whereas other readers do not. In what ways do reader interviews help explain differences in attention allocation at critical junctures in a text?
Development	Use the findings from one method to inform decisions about the subsequent use of another method	Attention allocation data could be used to identify a purposeful sample of readers for open-ended interviews about what they were thinking and doing while reading.
Initiation	Seek contradiction or contrast between findings from quantitative and qualitative methods	In what ways can discrepancies between reader responses to differently worded textbook excerpts be used to inform textbook development, reading strategy instruction, or curriculum reform?
Expansion	Widen the scope and breadth of a study using both quantitative and qualitative methods to investigate <i>different</i> phenomenon	When investigating how high school students read and react to history textbooks, researchers may collect data from teachers about curriculum decisions, the process of selecting course readings, and the larger context in which these decisions are made (who has the authority, direct and indirect, on determining content and adoptions of curricular materials) to provide insights into what influences content coverage in high school history courses.

Note. Mixing purposes and descriptions based on Greene et al. (1989, p. 259).

**Table 2**  
Joint displays commonly used in psychological research.

Type of joint display	When commonly used in research process	Function	Examples
Participant selection display	During data collection	Identify the specific individuals or cases to be included in the purposeful sample	Igo et al. (2005)
Interview prompts display	During data collection	Shows the degree of alignment between some quantitative measures (e.g., closed-ended questionnaire items) or findings (e.g., result of an intervention) and open-ended interview prompts	Ogilvie and McCrudden (2017); Matthews and López (2019)
Instrument development displays	During data collection	Shows the connection between qualitative themes/categories and factors/items for a quantitative measure	Kumar et al. (2019)
Quantitative results matrix	During data analysis	Juxtapose statistical findings to look for individuals who differ systematically from the group to determine whether and how to proceed with subsequent data analyses	McCrudden et al. (2010)
Integrated visual display	During data analysis	Used to collect and visualize both quantitative and qualitative data during data collection	Cross et al. (2020)
Integrated results matrix	During data analysis	Shows quantitative and qualitative findings side-by-side which helps the researchers compare the findings and generate meta-inferences	McCrudden et al. (2016)

other readers do not, such as reading about White resistance to Black progress. Suppose one excerpt is: “Some people wished to escape the crime and congestion of the city” (Appleby et al., 2016, p. 436). Researchers could identify readers who show different patterns of attention to such excerpts and interview them to gain insights into what they were thinking during reading. This could shed light on the nature of students’ reactions to the readings and their reading strategies.

With a *development* purpose, researchers use the findings from one strand to inform decisions about a subsequent strand. Researchers who design a study with a development purpose may integrate at the point of sampling, whereby findings from one strand are used as a starting point to identify the appropriate participant pool for the next phase of the mixed methods study. For example, researchers could identify readers who spend more time focused on controversial statements in their history textbook and other readers who spend less time focused on those same controversial statements. They could use the eye-tracking results to purposefully sample groups of readers with divergent eye-tracking data for interviews. Or researchers could use the findings from one strand to develop materials, procedures, or an intervention for a subsequent strand. For example, suppose interviews indicate that students are unfamiliar with how to critically examine claims in their history textbooks. The researchers could develop an intervention that provides students with strategies for evaluating information presented in history textbooks and investigate the effect of the intervention on comprehension and critical thinking.

When researchers design a study to identify points of contrast or divergence from the findings of the two strands, they are designing for the purpose of *initiation*. Contrasting findings may help to demonstrate differences in experiences between individuals and initiate changes in theory or policy. For example, returning to the eye-tracking example, researchers could have students read excerpts from different textbooks about White resistance to Black progress. One textbook may include excerpts such as, “Movement of some white Americans from cities to suburbs was driven by a desire to get away from more culturally diverse neighborhoods” (Appleby et al., 2019, p. 505), whereas the other textbook may include excerpts such as, “Some people wished to escape the crime and congestion of the city” (Appleby et al., 2016, p. 436). Researchers could identify how students direct their attention when reading these different excerpts and interview them to gain insights into their reactions to the excerpts. It may be the case that the wording leads to different types of inferences, such that reading one excerpt tends to lead students to characterize Black progress more negatively. These findings could be used to support textbook reform or curricular design.

Finally, *expansion* involves broadening the scope of the inquiry using qualitative and quantitative methods to research different aspects of phenomenon. By investigating multiple different, but related, components of phenomenon, the researchers seek a wider understanding of the topic of interest. For example, when investigating how high school students read and react to history textbooks, researchers may also collect data from teachers about curriculum decisions, the process of selecting course readings, and the larger context in which these decisions are made (who has the authority, direct and indirect, on determining content and adoptions of curricular materials). This can provide insights into the larger systems that influences what content is covered in high school history courses.

A common challenge for researchers in each of these cases is that they need to make key decisions in the process of conducting a study. In some cases, these decisions need to occur during data collection, in other cases during data analysis, or potentially both. Further, these decisions need to be documented in the write-up of the study so that readers can evaluate the researchers’ decision-making process, including data-driven justifications for key features of a study, such as a purposeful sampling. We argue joint displays can help researchers make key decisions about integration while conducting an inquiry to better address the mixing purposes of a mixed method study, but also use joint displays to convey how they integrated the quantitative and qualitative strands to readers.

## 2. Joint displays as a tool in mixed methods research in psychology

Guetterman et al. (2015a) noted that researchers can use joint displays during data collection and data analysis, although instances of joint displays for these uses are perhaps less common compared to the use of joint displays during interpretation of findings. Importantly, researchers may leverage joint displays to facilitate their own data collection and analytic processes, or authors may use joint displays to communicate data collection and analytic processes to readers. The development of joint displays during the data collection and analyses process can provide researchers with an organizing framework to facilitate their own decision-making at key points during the research process. Further, joint displays can help scaffold readers’ understanding of the often somewhat complex process of integrating the data collection and analyses from qualitative and quantitative strands of a mixed methods study. In this way, the joint display itself serves as key tool to facilitate the “mixing” part of a mixed methods study.

In the following sections, we discuss some of the potential uses, and offer examples, for joint displays during the data collection and data analysis in a mixed methods study. The analytic descriptions include the integrative process of drawing meta-inferences during a final “mixing” phase of a mixed methods study. We draw upon examples from published literature, including our own work, as well as identify novel forms of joint displays. We discuss the different forms of integration served by joint displays for methods and analyses (Fetters et al., 2013), how the examples provided serve mixing purposes (Greene et al., 1989), and identify innovative forms of joint displays in psychological research.

## 3. Using joint displays during data collection in psychological research

The use of joint displays during data collection can help researchers make key decisions while conducting a mixed methods research study. In this section, we identify three key decisions during data collection researchers may encounter while conducting a mixed methods study in psychological research and a joint display that may be useful: 1) how to purposefully sample participants for a follow-up strand (participant selection display), 2) how to align data collection materials for different strands (interview prompts display), and 3) how to develop materials for a follow-up strand (instrument development display) (Guetterman et al., 2015a). We include examples to illustrate each type of display. While the examples in this section pertain to complementarity, triangulation, and development purposes for mixing, we encourage researchers to consider creative ways in which joint displays can address issues that emerge in their own research.

### 3.1. Participant selection displays

Mixed methods researchers tend to use a variety of sampling procedures, which are closely tied to the purpose of the study. When the mixing purpose is complementarity, researchers use one strand to illustrate, elaborate, or clarify the results from another strand. In psychological research, this traditionally involves the implementation of a quantitative strand, followed by a qualitative strand to explain some findings of interest. In this type of situation, the researchers may use purposeful sampling to identify individuals or cases that can illuminate the quantitative finding of interest.

Researchers can use a participant selection display to help them identify the specific individuals or cases to be included in the purposeful sample. For example, Igo et al. (2005), who had a complementarity purpose, used a participant selection joint display for purposeful sampling (Table 3). They investigated the effects varying the copy-and-paste function of an online notetaking tool on notes gathered and what effects that had on learning. Students read text online and took notes with a matrix notetaking tool with blank cells for key information from the text.

The researchers investigated whether restricting the copy-and-paste function would encourage students to make more evaluative note-taking decisions, which is related to learning. Students were randomly assigned to one of two groups. In the restricted condition, students could copy-and-paste up to seven words per cell. In the unrestricted condition, students could copy-and-paste an unlimited number of words per cell. After the experiment, the researchers divided the students into six different groups based on the notes that students had gathered. In the restricted condition, they organized students into two groups: students who pasted one intact word string per cell (i.e., copy-and-paste a string of consecutive words) and students who combined two intact word strings from disparate parts of the text (i.e., copy-and-paste two separate strings of consecutive words). In the unrestricted condition, they organized students into four groups: students who pasted one sentence, two sentences, three sentences, or four or more sentences per cell. Based on these groupings, the researchers purposefully sampled participants from “each qualitative group to describe how the two versions of the tool (a) affected students’ processing during the note-taking activity and (b) affected the participants’ decision making while taking notes” (Igo et al., 2005, p. 108).

Thus, the construction of a participant selection display helped the researchers identify a quantitative finding of interest and select participants for interviews to explain the finding. Participant selection displays are not limited to studies with a mixing purpose of complementarity. The basic idea is that researchers construct joint display to inform their sampling criteria for the follow-up qualitative strand.

### 3.2. Interview prompts displays

An interview prompts display shows the degree of alignment between some quantitative measures (e.g., closed-ended questionnaire items) or findings (e.g., result of an intervention) and open-ended interview prompts. As such, interview prompts displays can be used for multiple mixing purposes. For example, Ogilvie and McCrudden

(2017), who had a triangulation purpose, used an interview prompts display to show the connection between closed-ended questionnaire items and open-ended interview prompts. All participants completed the questionnaire and participated in an interview. Children with autism received a behavioral intervention. The researchers investigated their parents’ evaluations of the behavioral intervention with a closed-ended questionnaire and open-ended interviews (Table 4). The researchers used the joint display to help them triangulate the two data sources. In this case, the interview data provided depth for understanding and extending the close-ended questionnaire data.

Matthews and López (2019), who had a complementarity purpose, constructed an interview prompts display to show the connection between closed-ended questionnaire items and open-ended interview prompts (Table 5). They investigated the predictive power of teacher beliefs and asset-based pedagogies on mathematics achievement for Latino children in primary school. They used closed-ended questionnaires to measure teacher beliefs (e.g., expectancies for student success in mathematics) and asset-based pedagogies (e.g., teachers’ incorporation of cultural content in classroom instruction). The researchers used the findings from the quantitative analysis to purposefully sample teachers for follow-up interviews. Further, they used the items from the closed-ended questionnaire items to create interview questions to gain a deeper understand of the variables that did and did not predict student mathematics achievement. Thus, an interview prompts display can help researchers achieve integration by aligning closed-ended and open-ended data collection tools, but that are also grounded in different methodological traditions (e.g., quantitative questionnaire and qualitative interviews).

### 3.3. Instrument development displays

An instrument development display shows the connection between qualitative themes/categories and factors/items for a quantitative measure (e.g., closed-ended questionnaire). This type of display is typically used when the mixing purpose is development. For instance,

**Table 3**  
Participant selection display for complementarity purpose.

Qualitative Groups After Analysis of Notes and Dependent Measures Means							
Distinction	Restricted strings	Restricted combinations	U1	U2	U3	U4	
<i>N</i>	21	13	6	9	12	10	
Copy-and-paste selections	Pasted existing word strings from the text	Combined words from disparate areas of the text	Pasted one sentence per cell	Pasted two sentences per cell	Pasted three sentences per cell	Pasted four or more sentences per cell	
No. of words per cell	7	7	18	31	44	59	
<i>M</i>							
Cued recall	7.8	5.0	3.8	2.8	1.3	0.3	
Multiple-choice concepts	6.1	6.7	6.3	6.0	4.2	2.3	
Relational inferences	5.1	3.0	2.4	1.5	1.2	0.2	

Note. Copy-and-paste groups were based on general trends in individual participant’s selections. U = unrestricted; U1 = students who were highly selective, choosing to paste only one sentence (approximately 18 words) per cell in the matrix; U2 = students who pasted two sentences (approximately 31 words) in the majority of cells, with perhaps some three-sentence and/or one-sentence cells; U3 = students who generally pasted three sentences in each cell (approximately 44 words, with a few exceptions); U4 = students who tended to paste four or more sentences (averaging approximately 59 words) in the majority of cells.

Adapted from Igo et al. (2005, p. 108, Table 2).

**Table 4**  
Interview prompts display for triangulation purpose.

Category	Quantitative survey items	Qualitative interview prompts
Disruption/time	- How much time will be needed each day for you to carry out this treatment? - How disruptive will it be to the family (in general) to carry out this treatment? - How well will carrying out this treatment fit into the family routine?	- Did you find this treatment disruptive too disruptive in your daily life. If so, why? - If it was not disruptive, can you tell me why? - How can we make it less disruptive in the future?

Adapted excerpt from Ogilvie and McCrudden (2017, p. 2909).

**Table 5**  
Interview prompts display for complementarity purpose.

Survey items	Interview questions
<p>Critical awareness</p> <ol style="list-style-type: none"> <li>1. Tests, particularly standardized tests, have frequently been used as a basis for segregating Latino students.</li> <li>2. The traditional classroom has been set up to support the dominant (White) culture.</li> <li>3. Historically, education has been mono-cultural, reflecting only one reality and has been biased toward the dominant (White) group.</li> <li>4. Students living in ethnically isolated neighborhoods can benefit socially from participating in ethnically integrated classrooms.</li> <li>5. Students from lower socioeconomic backgrounds typically have fewer educational opportunities than their middle-class peers.</li> </ol>	<ol style="list-style-type: none"> <li>1. Can you tell me about the students in your class this year? (Whatever is most relevant or salient to teacher is fine.)</li> <li>2. Are your students this year typical of those you have had in the past?</li> <li>3. In your experience, which students are particularly challenging to work with? What is your role in helping them to succeed? (Try to get them to give specific examples of situations and their practices to address them.)</li> <li>4. What are some of the specific challenges that Latino students face in academic settings? What is your role in supporting these students?</li> <li>5. What do you believe would increase the achievement of your Latino students?</li> <li>6. What have you found to be the greatest difficulty for increasing the achievement of your Latino students?</li> </ol>

Adapted from Matthews and López (2019, p. 83–84).

researchers could collect and analyze interview data, use the qualitative findings to develop questionnaire items, and then evaluate the validity of a closed-ended questionnaire. Kumar et al. (2019) constructed an instrument development display to understand middle school students' perspectives about culturally inclusive and responsive learning environments (Table 6). They began by conducting focus group interviews (n = 57) with students (n = 333) from a range of cultural backgrounds. The researchers identified four general themes from the interview data. Based on these themes, the researchers hypothesized four factors and generated closed-ended questionnaire items for each factor. In the follow-up quantitative strand, a different sample of students (n = 2894) from the same schools and backgrounds as the students from the initial qualitative strand completed the closed-ended questionnaire. The researchers conducted a confirmatory factor analysis that resulted in three scales. Thus, an instrument develop display can help researchers achieve integration by using interview themes to generate items for a questionnaire.

**4. Using joint displays during data analysis in psychological research**

The use of a joint displays during data analysis can help researchers identify patterns within and between data sets. In this section, we identify three ways that researchers can use joint displays during data analysis in psychological research. Joint displays can help researchers use quantitative data to form different groups, which in turn can inform a subsequent qualitative strand (quantitative results matrix). Joint displays can help researchers collect and visualize quantitative and qualitative data during data collection (integrated joint display). Further, a joint display can serve as a tool for helping researchers compare quantitative and qualitative findings, which in turn can help them generate meta-inferences (integrated results matrix). We include examples to illustrate each type of display. While the examples in this section pertain to the mixing purposes of complementarity and triangulation, we

**Table 6**  
Instrument development joint display for development purpose.

Examples of quantitative survey items and scales development based on quotes and themes from qualitative data analysis.	
Themes and quotations from qualitative study	Corresponding level 1 factors with survey item in the quantitative study
<p><b>Theme: Perceptions of teachers as prejudiced and culturally insensitive vs. respectful and culturally responsive</b></p> <p><b>Quotes</b></p> <p>“They should talk to you with some respect that we talk to them with. Some teachers don’t have any respect for you even though you wouldn’t disrespect.”</p> <p>“We have like our own whole caste system going on that the teachers have like completely no idea about.”</p> <p>“They don’t say anything about it (political issues). Anytime someone tries bring it up, “it’s inappropriate. It’s too political. Shouldn’t talk about that here. It’s not for school.”</p> <p>“See both sides. Don’t make it that you’re talking about one side and not the other. Like all the teachers ...”</p>	<p><b>Factor: Promoting cultural openness and positive intergroup relationships</b></p> <p><b>Survey items</b></p> <ol style="list-style-type: none"> <li>1. Listen with an open mind to what students in the different groups are saying.</li> <li>2. Help students in each of the groups understand how students from the other group feel.</li> </ol>

Adapted from Kumar et al. (2019, p. 92, Table 4).

encourage researchers to consider creative ways in which joint displays can address issues in their own research.

**4.1. Quantitative results matrix**

Inevitably, data at the level of the individual differs from data at the level of the group. There are times when data at the level of the individual differs systematically from the data at the level of the group for a sub-set of participants. A quantitative results matrix is a tool that researchers can use to juxtapose statistical findings to look for individuals who differ systematically from the group, which may provide insights into individual’s nuanced experiences in an experiment or intervention, for example. This type of display is useful for determining whether and how to proceed with subsequent data analyses. In other words, it is used formatively. For example, McCrudden et al. (2010), who had a complementarity purpose, used a quantitative results matrix to compare reading time and memory data to inform purposeful sampling for the qualitative strand and the integration of quantitative and qualitative findings (Table 7). They investigated how pre-reading task instructions affect reading time and memory. The researchers used a quantitative results matrix to compare the reading time and recall data for a sub-set of readers whose reading time and recall data systematically differed from group means and analyzed their interview data. When the researchers integrated the quantitative and qualitative findings, they found that students’ reading behaviors (reading time data) corresponded to how they described how they read the text (interviews), which in turn was related to their recall of text information. Thus, the construction of a quantitative results matrix can help researchers visually compare and identify patterns within quantitative findings, which can aid purposeful sampling and the integration of quantitative and qualitative findings.

**Table 7**  
Quantitative results matrix for complementarity purpose.

Qualitative Groups and Dependent Measure Means and Standard Deviations					
Qualitative group	Pitcairn Narrowing	Pitcairn Broadening	Honduras Narrowing	Honduras Broadening	Familiarity
N	6	2	3	3	7
Dependent measures	M (SD)	M (SD)	M (SD)	M (SD)	M (SD)
Reading time: Pitcairn information	.372 (.05)	.394 (.06)	.250 (.03)	.371 (.07)	.390 (.05)
Reading time: Honduras information	.240 (.01)	.361 (.03)	.340 (.02)	.384 (.08)	.411 (.03)
Recall: Pitcairn information	.432 (.03)	.538 (.15)	.030 (.03)	.272 (.25)	.160 (.11)
Recall: Honduras information	.058 (.08)	.289 (.09)	.513 (.09)	.346 (.19)	.176 (.10)

*Notes.* All participants read an interleaved text about four remote countries, including Pitcairn and Honduras. Readers were randomly assigned to one of three experimental conditions and asked to focus in particular on either Pitcairn (Pitcairn group) or Honduras (Honduras group), or to read for understanding (control group). The label “narrowing” refers to readers who spent more time reading task-relevant information (i.e., above the group mean) and less time reading task-irrelevant information (i.e., below the group mean). For example, one student in the Pitcairn condition spent .41 s per word for Pitcairn sentences and 0.24 s per word for Honduras sentences. The term “broadening” refers to readers who spent more time reading task-relevant information and *more* time reading task-irrelevant information (i.e., above the group mean). For example, one student in the Pitcairn condition spent .42 s per word for Pitcairn sentences and 0.39 s per word for Honduras sentences. This group was labelled the broadening group. The term “familiarity” refers to members of the control group who spent more time reading both Pitcairn and Honduras information (i.e., above the group mean). In the interviews, these participants described primarily focusing on familiar information; hence this group was labelled the familiarity group.

Reading time is reported as seconds per word for each sentence type. A ratio closer to zero is equated with faster reading time. Recall is reported as the proportion of idea units recalled for each sentence type. A larger number is indicative of greater recall.

Adapted from McCrudden et al. (2010, p. 236, Table 3).

4.2. Integrated visual display

Like a quantitative results matrix, an integrated visual display is used formatively. However, unlike a quantitative results matrix, researchers can use an integrated visual display to collect and visualize both quantitative and qualitative data during data collection (Creamer, 2020). For example, Cross et al. (2020), who had a triangulation purpose, developed an integrated results matrix to compare closed-ended survey results with open-ended interview findings and to identify points of convergence and divergence (Table 8). They investigated how parents’ documentation status (undocumented vs. documented) informed their ethnic-racial socialization practices and the subsequent implications for the psychological adjustment of Latinx youth. The researchers constructed an integrated visual display during data analysis to search for convergent and divergent patterns between average responses on survey dimensions and qualitative interview themes for parents with differing documentation status. The display both served as an analytic tool for integration at the analysis phase, but also focused the researchers analyses on the sociopolitical context grounding the study.

**Table 8**  
Integrated visual display for triangulation purpose.

Quantitative	Qualitative				
	Theme 1: Cultural socialization			Analytical integration	
Variable	β	p	Undocumented		Documented
Cultural socialization How important is it for parents of your ethnic group to: (a) teach children about the history and traditions of your ethnic group; (b) to help their children feel connected to others in your ethnic group; (c) to make sure their children maintain your ethnic group’s values and beliefs?	.18*	.055	“To not forget their roots, never. They should know where they come from, to say they have their feet well planted on earth. Uh or like the phrase, too, that they can touch the sky, but without getting their feet off earth. They should always have respect for their origins, for something. Like me, I’m very proud of being Mexican. And the fact that we live in another country, we always have to represent where we come from very well. We should never deny who we are... feel proud of not having green eyes, or blue eyes... feeling always proud of where we come from, and everything we’re worth, and what our country is worth, and all of that.”	“I think that they feel proud of their roots. I had the opportunity to take them to Mexico, they’ve been to school over there, and I feel that it is very different from other people who have not had that experience. Many don’t value their language, or they’re embarrassed to speak it, and since they don’t want to speak Spanish anymore, as a teacher, I’ve seen many kids of Latino parents who don’t know how to speak Spanish. Or they know very little, and they’re embarrassed.”	<ul style="list-style-type: none"> <li>• No convergence across quantitative and qualitative findings.</li> <li>• In quantitative results, undocumented parents reported transmitting more cultural socialization than documented parents.</li> <li>• In interviews, both groups reported engaging in cultural socialization.</li> <li>• Documented parents relied more on trips to their native country alongside teachings about their culture, language, and traditions.</li> <li>• Undocumented parents reported transmitting their culture through teaching about their heritage, celebrating traditions, speaking the language, and sharing anecdotes from their own childhood.</li> </ul>

Adapted from Cross et al. (2020, p. 1462, Table 1).

4.3. Integrated results matrix

Data from mixed methods research studies affords meta-inferences, or inferences generated when researchers integrate findings from different methodological traditions. These inferences are more substantiated than if the data were from a single methodological tradition. An integrated results matrix shows quantitative and qualitative findings side-by-side, which helps researchers compare the findings and generate meta-inferences (Plano Clark and Sanders, 2015). Thus, they are summative in nature. For example, McCrudden et al. (2016), who had a complementarity purpose, constructed an integrated results matrix to compare results from performance tasks with open-ended interview findings to explain why participants performed a task differently under different circumstances (Table 9). Students were asked to select web pages that they would want to read to prepare for a class presentation on two different topics (i.e., climate change and nuclear power). The web pages contained author and content information such that they varied with respect to author expertise (higher vs. lower) and content relevance (more relevant vs. less relevant). The researchers used an integrated

**Table 9**  
Integrated results matrix for complementarity purpose.

Quantitative results	Qualitative results	Exemplar quote
When the topic was <i>more</i> familiar (climate change) and cards were more-relevant, participants placed <i>less</i> value on author expertise.	When an assertion was considered to be <i>more</i> familiar and considered to be general knowledge, participants perceived <i>less</i> need to rely on author expertise.	P144: "I feel that I know more about climate and there are several things on the climate cards that are obvious, and that if I sort of know it already, then the source is not so critical ... whereas with nuclear energy, I don't know so much so then I'm maybe more interested in who says what."
When the topic was <i>less</i> familiar (nuclear power) and cards were more-relevant, participants placed more value on authors with higher-expertise.	When an assertion was considered to be <i>less</i> familiar and <i>not</i> general knowledge, participants perceived <i>more</i> need to rely on author expertise.	P3: "[Nuclear power], which I know much, much less about, I would back up my arguments more with what I trust from the professors."

Adapted from McCrudden et al. (2016, p. 157, Table 3).

results matrix to provide a verbal summary of the quantitative and qualitative findings (including exemplar quotes), which enabled them to generate a meta-inference about participants judgements about the validity of scientific information on web pages.

## 5. Innovation in joint displays

Our examples in section 4 only begin to show the uniqueness and usefulness of joint displays. Thus, to be clear, joint displays can take many forms, including a figure, matrix, table, figure, graph, or even combinations of different forms. The examples provided in section 4 of this article reflect what is likely the most commonly used forms of joint displays in psychology, which is a tabular format. However, joint displays may include spatial features (e.g., side-by-side presentation of quantitative and qualitative findings) to facilitate the use and to enhance communication. Further, joint displays may be developed with more dynamic formats.

For example, Venn diagrams can be used to show the relationships between different dimensions of a construct. Usher et al. (2019) investigated sources of academic motivation self-beliefs with students from rural Appalachia. They created a joint display with quantitative analyses results on the central panel of a figure with student quotes in call-out boxes to illustrate those findings placed to the left and right of the primary quantitative findings (see Usher et al., 2019, p. 44, Figure 4). Similarly, Ling and Pang (2021) investigated the effects of financial literacy instruction on improving students' financial literacy. They used Venn diagrams to show how assumptions underlying financial education (autonomy, behavioral, and cultural) contribute to students' understanding of different aspects of financial literacy (e.g., spending and borrowing behaviors).

Bar graphs can be used to show differences in magnitude between dimensions of interest (e.g., degree to which students use instructional technology to solve problems vs. observe the presentation of course content). Bar graphs can be combined with other data (e.g., field notes) to provide depth. For instance, Haynes-Brown and Fetters (2021) investigated teacher beliefs about technology and their use of technology during instruction. Their data sources included classroom observations and field notes. They observed the teachers in their classrooms on multiple occasions and used bar graphs and field notes to examine the extent the qualitative data supported the quantitative scores from the classroom observation checklist. Their data analytic process incorporated the use of bar graphs for evaluating different cases of teachers based on their pedagogic orientation in using technology, which enabled them to visually depict differences in teacher use of technology across groups of teachers.

Other forms of joint displays include the use of network nodes in social network analysis to investigate social systems (e.g., Williams and Shepherd, 2017), state space grids to investigate relationships between space and behavior (e.g., Turner and Christensen, 2020), timelines (e.g., Monico et al., 2020), and the use of GIS (geographic information system) analysis and mapping to investigate micro- (e.g., social phenomena) and macro-level (e.g., policies and planning) influences on human interaction (e.g., Bhuyan and Zhang, 2019). Clearly, there is a growing use of

joint displays for data collection and analysis among researchers who use mixed methods to investigate topics in psychology.

Joint displays can also provide a process for researchers in formalize their mixing processes, a useful tool when coordinating a research team and communicating with individuals interested in potential replication of the study. For example, Hatta et al. (2020) used joint displays as an analytic tool to merge analyses with concurrent timing. The more common analytic path with concurrent mixed methods designs appears to be parallel and independent analyses for each strand that are then integrated after primary findings are derived from the strands. However, Hatta et al. (2020) describe their cross-over analytic approach as one where the analyses and findings are interleaved. The authors designed bridges at multiple points of the study, including a sampling crossover and analytic crossovers, with joint displays in a tabular format as the final analytic step during the integrative analytic phase (see Hatta et al., 2020, p. 99–100, Figs. 3–4). The joint displays they constructed depicted a temporal unfolding of treatment consent for patients with high and low motivation and interest in treatment. This type of display was effective in meeting the triangulation purpose of the study by indicating how the quantitative measure of motivation and interest for treatment was represented by participant reasoning while in conversation with their physician.

We encourage readers to seek examples of innovative uses in areas outside of psychology that could potentially be applied to psychological contexts. For instance, Peroff et al. (2020) used multidimensional scaling (MDS) and photo elicitation to investigate reactions to photos about landscape and sense of place for indigenous farmers in Guatemala. With joint displays (Peroff et al., 2020, p. 386–389), they show how they developed themes by integrating clusters from MDS analysis and corresponding quotes from the interview data.

## 6. Considerations for using joint displays during data collection and analysis

The use of joint displays has been explicitly noted as a tool to enhance the rigor of mixed methods research (Harrison et al., 2020). We identify several issues for scholars to consider for effectively leveraging joint displays to meet this promise in psychological mixed methods research. The first is consideration of the mixing purpose of the study. The second thoughtful consideration of the form of the joint display for clearly conveying the timing or implementation of the quantitative and qualitative strands of the mixed methods study. The third is to carefully consider design features of the joint display to facilitate comprehension. Finally, we encourage education and training programs to consider adding explicit education on effective use of visual displays as tool of research in graduate level coursework.

**Mixing Purpose.** The mixing purpose of a mixed methods study is the rationale or justification for including and integrating quantitative and qualitative strands in a study. We encourage researchers to first identify the mixing purpose of a study because this permeates and guides the overall research inquiry, including the study design. Further, mixed methods designs do not follow "well-established research protocol" (Creamer and Reeping, 2020, p. 2). A common challenge faced by

emerging mixed methods researchers is trying to fit a research idea into a study design based on a typology. This can be problematic because attempts to select a design from a typology may inadvertently direct researchers away from the main reason to use mixed methods: integration. The mixing purpose can provide a framework for determinations about when and how to achieve integration. The joint display is merely a tool for helping researchers achieve integration during a study and to communicate this to readers.

**Timing of Data Collection in Strands.** The form of a joint display may vary depending on the nature of the mixed methods design guiding a particular study (Guetterman et al., 2015a). When the study design involves concurrent timing (i.e., different strands implemented at the same time), the data collection for the quantitative and qualitative strands occur concurrently and the implementation of the strands occur independently of the results from their respective data analyses. Concurrent timing is commonly used when the mixed methods purpose is triangulation, but it can also be used when the purpose is initiation or expansion. Joint displays that present findings side-by-side may be effective for studies with concurrent timing. When the study design involves sequential timing (i.e., different strands implemented in succession), the data collection for the quantitative and qualitative strands (or vice versa) occur sequentially and the implementation of the second strand is dependent upon the results of the data analysis from the first strand. Joint displays that are used during data collection or analysis may be effective for studies with sequential timing. When designing a study, researchers can consider how the timing of the strands is related to the purpose of the study. This can help them pre-plan their use of joint displays, identifying potential points in the study when joint displays can be beneficial and identifying appropriate display designs.

**Design Features of Joint Displays.** The choice of the display design can be intentionally integrated at the planning phase of a study, may unfold in tandem with the needs of a research team during the production of a study, or emerge in response to communication/dissemination demands during a writing phase. Researchers should carefully consider effective forms of displays that align with the intended use of the display (e.g., during study production or for communication of findings), the form of the mixed methods study (e.g., sequential or concurrent timing), and the mixing purpose. A targeted and accessible discussion of effective features of joint displays is presented by Guetterman et al. (2015a) and Plano Clark and Sanders (2015). These chapters and a parallel publication reviewing the use of joint displays in health-related research (Guetterman et al., 2015b) provide excellent design examples for researchers considering the use of joint displays in their own mixed methods research. When considering design features of the display itself, Ivankova et al. (2006) offers 10 guidelines for creating a visual display of a mixed methods study design procedure. Many of these conventions can be easily extrapolated to joint displays for data collection and analyses. The use of arrows in a figure, for example, can clearly demonstrate a cascading process of analytic dependency in a sequential study. There are multiple alternative ways to communicate importance, including capitalized font in tables and figures, graphic placement, and graphic size (e.g., uses of bubbles or other graphics).

Joint displays may overwhelm the reader if the author(s) try to convey a complex data collection or analytic processes through the display (McCrudden et al., 2015). At the same time, insufficient detail threatens the rigor offered by a joint display (McCrudden et al., 2019). Instead of “getting into the weeds” in the form of a visual display, authors should carefully curate joint displays to include only those elements that are most critical to the inferences the joint display is meant to convey. Similarly, as with most visual displays, they should be able to stand on their own. Authors should avoid repeating the narrative information provided in the body of the manuscript text, yet contain enough information that readers can make sense of the information in the display without extensive explanation. Joint displays, like all other use of visual displays, are most useful when they act to complement the narrative information in the text.

**Training.** Joint displays are a visual form unique to empirical mixed methods research, thus scholars have only recently begun formalizing discussions about the expectations, parameters, and norms for the use, design, and implications of joint displays. Whereas journals and doctoral training programs may have clear guidelines for when and how to use tables, figures, and other visual displays in quantitative or qualitative studies, these guidelines are only just emerging for mixed-methods studies. Further, innovative examples of joint displays can be difficult to locate in the published literature. We surveyed journals in psychology, educational psychology, and related fields to locate exemplar and innovative uses of joint displays for data collection and analyses. Joint displays are rarely noted in titles, abstracts, or keywords of published journals. For example, the search term “joint display” with the limit for journal articles was entered for the *APA Psych Info* database, which returned 68 records at this time. A review of these records indicated 14 were relevant to the use of visual displays in the conduct of mixed methods research. We located other examples through reviewing published mixed-methods articles, and anecdotally observed that joint displays in the form of a table were only sometimes labelled as joint displays, whereas figures used during data collection and analyses of findings seemed to more often be termed a joint display.

Clearly, the emerging use of joint displays for psychological mixed methods research may mean that it can be challenging for students and researchers to find examples in the existing literature or style manuals to guide their own work. Graduate programs that include training on the production and use of visual displays, and joint displays for mixed methods research, may offer an advantage to students. Students trained in emerging and complementary methods may be more likely to stimulate innovation in their research fields of choice.

## 7. Conclusion

Researchers use joint displays in mixed methods research for data collection and analysis in several ways that support integration of quantitative and qualitative approaches. We conclude with recommendations for the use of joint displays in data collection and analysis and provide suggestions about ways to expand their use in mixed methods research. Creswell and Plano Clark (2018) recommend adding the words *mixed methods* to the title of a mixed methods research study and as one of the key words. This signals explicitly to the reader that a mixed methods study design was used and helps other researcher more easily locate your work. In a similar vein, we recommend including *joint display* as a key word so that other researchers can more easily locate your work and find examples of creative ways to use joint displays in their own work.

Second, when using joint displays to communicate analytic integration that is framed by a theory, consider looking to the visual representations of conceptual models guiding the work as a potential template or schematic for developing the joint display. This approach can help readers better appreciate how the integration maps onto existing theory and models and how the findings might serve the purpose of extending the theory or model. Next, we recommend greater use of innovative and novel visual forms of displays. Tables are effective ways to communicate information, but with advances in technology, we think alternative forms of visual displays can be equally as effective at communicating information. Further, we are interested in understanding how researchers using digital recordings may incorporate those into joint displays during analyses processes or even in supplemental online materials during publication. Finally, we encourage including joint displays that are built for the research team to help execute a mixed methods study during data collection and analyses in manuscripts and supplemental material submitted for publication. This step serves to enhance the inferential transparency of the methodological process and interpretation of findings. In closing, we hope that readers use this article to consider not only how researchers have used visual displays in published research, but also potentially new ways that visual displays



could be used in future research.

### Credit author statement

Matthew T. McCrudden: Conceptualization, Writing – original draft preparation, Writing- Reviewing and Editing. Gwen Marchand: Conceptualization, Writing- Reviewing and Editing, Paul Schutz: Conceptualization, Writing- Reviewing and Editing

### Declaration of competing interest

The authors have no conflict of interest to declare. The authors declare that there are no conflicts of interest with respect to this proposed manuscript.

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