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Mixed Methods Single Case Research: State of the Art and Future Directions

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Abstract

Mixed methods single case research (MMSCR) is research in which single case experimental and qualitative case study methodologies, and their accompanying sets of methods and techniques, are integrated to answer research questions that concern a single case. This paper discusses the historical roots and the distinct nature of MMSCR, the kinds of knowledge MMSCR produces, its philosophical underpinnings, examples of MMSCR, and the trustworthiness and validity of MMSCR. Methodological challenges relate to the development of a critical appraisal tool for MMSCR, to the team work that is involved in designing and conducting MMSCR studies, and to the application of mixed methods research synthesis for multiple case studies and single case experiments.

Keywords: case study research, single case experimental design, mixed methods research, mixed methods single case research, mixed methods research synthesis

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Mixed Methods Single Case Research: State of the Art and Future Directions

In recent decades, there has been an impetus towards applying a mixed methods approach, in which qualitative and quantitative research components are combined and integrated within a single study “for the broad purposes of breadth and depth of understanding and corroboration” (Johnson, Onwuegbuzie, & Turner, 2007, p. 123). Most empirical mixed methods studies as well as most methodological mixed methods literature concern large-sample or group-comparison research (e.g., Creswell, 2013; Tashakkori & Teddlie, 2010). In these studies, quantitative and qualitative methodologies are integrated to answer research questions that concern a larger population or a comparison of several groups.

In addition to this, some empirical mixed methods studies consist of a combination of large-sample research and case study research. Two classic examples are (a) the mixed methods sequential explanatory design, in which a quantitative large-sample phase is followed by a qualitative (multiple) case study (e.g., Ivankova, Creswell, & Stick, 2006), and (b) a mixed methods study in which a qualitative small-sample phase is used for developing a data collection tool, that is afterwards used in a quantitative large-sample phase (e.g., Maltseva, 2016).

In contrast, empirical literature and methodological guidance on how to conduct empirical mixed methods research exclusively at the single case level is scarce and discursive (see Heyvaert, Kuppens, Maes, & Onghena, 2010, and Hitchcock, Nastasi, & Summerville, 2010 for two earlier proposals). The present paper aims to fill this methodological gap, by focusing on this type of empirical research, which we call ‘mixed methods single case research’ (MMSCR). We define MMSCR as research in which single case experimental and qualitative case study methodologies, and their accompanying sets of methods and techniques, are integrated to answer research questions that concern one case. In this paper, we will consecutively present the historical roots of MMSCR and its distinct nature, the kinds of

knowledge MMSCR produces, its philosophical underpinnings, the kinds of MMSCR that are applied in the literature and current practice, and illustrate how MMSCR can be conducted and evaluated. We acknowledge that MMSCR can be extended to include more than one case, but the research focus should remain at the single case level to qualify as MMSCR. We will return to the issue of multiple MMSCR studies in the “Future Directions for MMSCR” section.

Historical Roots of MMSCR

Prototypically, research at the single case level is conducted using either a predominantly qualitative approach or a predominantly quantitative approach. We will refer to these two approaches as the qualitative case study and the quantitative single case experiment.¹

A qualitative case study can be used to conduct an in-depth and rigorous empirical investigation of a particular phenomenon by studying one identified “case” within its context. The “case” is supposed to contain a manifestation of the phenomenon and can refer to any unit: a person, a part of a person (e.g., a brain region), a group of persons (e.g., a family or a religious community), an organization (e.g., a company or a school), a set of procedures (e.g., a public program or a community intervention), an event (e.g., a political meeting), or an artifact (e.g., a building). Well-known examples of qualitative case studies are the studies conducted by Freud, Pavlov, Watson, and Piaget in the field of psychology, by Frederic Le Play and the ‘Chicago School’ in the field of sociology, and by Bronislaw Malinowski and

¹ As one of the reviewers of this manuscript pointed out, there is a potential ambiguity in the terms “case study” and “single case”. For example, in qualitative research, the term “single case” is sometimes used to refer to a “case study” (e.g., Donmoyer, 1990). Furthermore, “case study” research might also involve experimental interventions (see e.g., Hay, 2016; Maxwell, 2016; Weisner, 2005). Therefore, we added the qualifiers “qualitative case study” and “quantitative single case experiment”, emphasizing that we are first contrasting two extreme research positions and traditions, and next showing their compatibility, complementarity and mutual reinforcement.

Margaret Mead in the field of anthropology (Merriam, 2009; Stake, 1995; Swanborn, 2010; Yin, 2017).

Quantitative single case experimental designs can be used to study the causal relationship between the independent and the outcome variable for a single case, when an independent variable is experimentally manipulated and an outcome variable is repeatedly measured under the various levels of the independent variable for this case. Well-known pioneers of the single case experimental approach in the behavioral sciences include Fechner, Wundt, Ebbinghaus, Stratton, Skinner, and Sidman (Barlow, Nock, & Hersen, 2009; Gast & Ledford, 2014; Kazdin, 2011).²

Although case study research has a long tradition of including both quantitative and qualitative approaches, the history of science shows that most often one of the approaches is just given a subsidiary role and that the quantitative data and methods are commonly used to locate the case within a larger sample or a general population (for an overview see Kitchenham, 2010; Maxwell, 2016; Yin, 2017). Case studies in which quantitative and qualitative approaches are given an equal status, and in which experimental manipulations and statistical analyses are directed exclusively at the single case level are rare. However, this equal status mixed methods approach to research at the single case level dates back to, at least, the end of the 18th century, when narrative materials and descriptive interpretation were incorporated into single case experiments. Influential examples are the single case experiments of Edward Jenner at the end of the 18th century that contributed important

² “Quantitative single case experimental designs” can be conceptualized as a specific type of interrupted time-series designs (Shadish, Cook, & Campbell, 2002). In this article, we prefer to focus our terminology on the single case aspect of the design, rather than on the longitudinal data collection aspect, because the mixing is better served by the identification of the single case level than by the mere fact that repeated measures are taken. Furthermore, we can also draw on more current work by Shadish (2014a, 2014b) and Shadish, Kyse, and Rindskopf (2013) that is mainly concerned with quantitative single case experimental designs.

knowledge on immunization and the ultimate eradication of smallpox, starting with the case of James Phipps (Riedel, 2005).

The more explicit historical roots of MMSCR date back to the late 1970s and 1980s, in the field of psychotherapy. Whereas in the 1960s and early 1970s empirical psychotherapeutic research was often focused exclusively on either process or outcome, in qualitative case studies and quantitative single case experiments respectively, in the late 1970s and 1980s researchers started to jointly apply qualitative and quantitative approaches to focus on the integration of both process and outcome in the study of single cases in complex therapeutic situations (Gaston & Marmar, 1989; Kiesler, 1973). Such an MMSCR approach *avant la lettre* allowed practitioners and researchers to study change processes as well as outcomes in detail. In the same vein, methodologists such as Campbell (1979) and Howard (1983) stressed the importance of methodological pluralism in idiographic psychotherapy research and evaluation research. In his discussion of the case study approach, Campbell (1979) concluded: “Qualitative knowing cannot be replaced by quantitative knowing. Rather, quantitative knowing has to trust and build on the qualitative, including ordinary perception. We methodologists must achieve an applied epistemology which integrates both” (p. 66).

The Distinct Nature of MMSCR

The exploration of MMSCR, and its distinct nature, is important from the perspective of qualitative case study research, from the perspective of single case experimental research, and from the perspective of mixed methods research. We will take each of these perspectives in turn.

For qualitative case study research it is important to realize that quantitative and experimental research is not antithetical to idiographic research or to research with a focus on one case. In fact, single case experimental research has this focus on the case, and in terms of “unit of research” is located at exactly the same level as qualitative case study research. In this

sense, they might be naturally compatible partners. Furthermore, the addition of baseline measurements, time series data, controlled intervention, and formal data analysis might strengthen or enrich the understanding of “the case”, certainly if questions regarding efficacy, explanation, and prediction are involved (Barlow et al., 2009; Kazdin, 1981, 2011).

From the perspective of single case experimental research, the addition of an integrated qualitative case study might be crucial to give context, to put narrative flesh on the bones of the experimental and statistical analysis, and ultimately to provide a basis for replication and generalization. Integration of observations, interview material, and document information is especially relevant if the research question is not merely “Does it work?” but also involves issues of process, feasibility, appropriateness, and meaningfulness (Pearson, Wiechula, Court, & Lockwood, 2005). In handbooks on single case experimental research (e.g., Barlow et al., 2009; Gast & Ledford, 2014; Kazdin, 2011), cursory reference to the potential of additional qualitative data is given. For example, Kazdin (2011) argued:

The dominance and close-to-exclusive reliance on the quantitative tradition constrains our knowledge. The perspective and yield from a study are very much influenced by the methods we use. (...) The importance of multiple ways of examining phenomena is conveyed better by looking at other areas of science. As an illustration, most readers are familiar with the Hubble Space Telescope and its remarkable yield of information about space. The Hubble has been one of four orbiting observatories that look at space in a different light (visible, infrared, gamma rays, and X rays) (...) Each yields unique information and complements information provided by the others. (...) Our view of the cosmos has grown enormously by expanding the ways in which we look at it. Methodological ecumenicism that recognizes and utilizes quantitative, single-case, and qualitative traditions would have the same benefit. (pp. 399–400)

However, the presentation of qualitative methods and techniques in these handbooks is never elaborate, nor is it made clear how quantitative and qualitative research strands can be integrated. It is at this point that the mixed methods literature comes to bear.

From the perspective of mixed methods research it is important to thematize MMSCR as a distinct approach in order to disentangle the level dimension (case versus group level) and the methodological approach (qualitative versus quantitative). Too frequently, research at the case level is exclusively conceptualized as qualitative research and research at the group level is conceptualized as quantitative research, with the prototypical example of the mixed methods study as “cases within surveys” or “surveys within cases” (Yin, 2006, 2017). Also for mixed methods research, there is a growing awareness that the intensive study of a single case has its own merit, and yields evidence that an extensive study of a sample cannot provide (Van Ness, Murphy, & Ali, 2017). Mixed methods research can move beyond the discursive and isolated remarks about the necessity, the benefits or the expediency of combining single case experiments and qualitative case studies, and offer an organized and integrated conceptual framework and methodological toolbox (Creamer, 2018; Creswell, 2016; Mertens et al., 2016; Plano Clark & Ivankova, 2016).

What Kinds of Knowledge can MMSCR Produce?

An important epistemological question related to MMSCR is what kinds of knowledge MMSCR can produce. We distinguish three distinct kinds of knowledge that MMSCR can produce. First, MMSCR can produce answers to specific research questions concerning the case(s) under study. For instance, MMSCR can be used to quantitatively and qualitatively assess the effectiveness, feasibility, appropriateness, and/or meaningfulness of a treatment, program, or intervention for a single case. From a practical point of view, MMSCR can be preferred over group research when rare or unique conditions are involved, or when it is

impossible to obtain a large homogeneous sample of cases under similar conditions. For example, case studies are recommended in disability research if atypical disorders or uncommon comorbidities are under investigation (Zhan & Ottenbacher, 2001). This use of MMSCR is analogous to what Stake (1995) called an “intrinsic case study”. In this first type of MMSCR we have intrinsic interest in the peculiarities and particularities of the case under investigation, and the question of broader applicability or generality is irrelevant or only of secondary importance.

Second, MMSCR can be used for the development of new theory. According to Eisenhardt (1989), essential features of case studies aimed at theory development are: theoretical sampling, using multiple data collection methods, involving multiple investigators, conducting iterative within-case and cross-case analyses using divergent data analysis techniques, and applying replication logic across cases to develop, extend, and sharpen theory. These features particularly hold for MMSCR: Several methodologists argued that a mixed methods study can be strengthened by integrating multiple data collection and data analysis methods, and by involving multiple researchers in a single study (e.g., Fielding, 2012; Flick, Garms-Homolova, Herrmann, Kuck, & Röhsch, 2012). Furthermore, the ability to build strong theories improves when a multiple-case design is used and when literal or theoretical replications are involved (Yin, 2017). Stake called this the “instrumental case study” because the case is not studied for its own sake, but because it is instrumental for something else, namely theory development.

Third, MMSCR can be used for verifying existing theories and empirically testing specific hypotheses. Yin (2017) emphasized that case studies are not only useful for exploration but also for verification and testing. This goal can be accomplished by starting from theoretical propositions derived from or related to the research question and by linking the data to each of these propositions. In this sense, an MMSCR can falsify theoretical

propositions and stimulate theory building by identifying and studying a ‘black swan’ or a ‘critical case’ for hypotheses that may be hard to ‘prove’. An example is the case of Genie, who allowed testing the ‘critical period hypothesis’ formulated by Eric Lenneberg relating to children’s language acquisition. Genie was taken into custody at the age of 13 by social workers. Until then, she had spent much of her life chained to a chair in her bedroom, without much human interaction, and she could not speak, walk, or respond to other people. Her case attracted psychologists and linguists, who were interested in finding out whether she could still learn to speak (Kulkarni, 2012). Lenneberg’s ‘critical period hypothesis’ stated that the critical period for language acquisition lasts until the age of 12: After the onset of puberty, one is no longer able to learn and utilize language in a fully functional manner (Cherry, 2016). Genie’s case corroborated Lenneberg’s hypothesis: Despite being given an enriched learning environment from the age of 13 onwards, she was not able to learn to speak, because she had missed the ‘critical period’ (Cherry, 2016).

What are Possible Philosophical Underpinnings for MMSCR?

Integration of the quantitative and qualitative research strands in mixed methods research involves not only integration of methods and techniques, but also integration at the level of methodology and underlying philosophy (or paradigm) (Fetters & Molina-Azorin 2017). By defining MMSCR as research in which single case experimental and qualitative case study methodologies and their accompanying sets of methods and techniques are integrated, we already referred to the first two integration dimensions. In this section, we want to explore the third dimension and reflect on the way in which four philosophical stances (constructivism and interpretivism, critical-transformative-feminist approaches, pragmatism, and postpositivism) are compatible with MMSCR. Our position is that users of MMSCR should at least be aware of their dominant view on what reality is (ontology), what knowledge is (epistemology), what the underlying values are (axiology), and which research logic is

preferred (methodology). We agree with Hesse-Biber (2010b) that each of the philosophical stances will lead to a different approach of the research endeavor, but we do not rule out the possibility that two or more stances are taken by different members of a research team and that different assumptions prevail in different phases of the study (Creswell & Plano Clark, 2018). Furthermore, our exploration of the four philosophical stances is not meant to be limitative. Other stances, such as critical realism (see e.g., Maxwell & Mittapalli, 2010), or other combinations of stances can be connected to MMSCR.

Constructivism and Interpretivism

Single case studies conducted within a constructivist/interpretivist framework are aimed at understanding individual and shared social meanings and require the idiographic researcher to examine the phenomenon of interest from different perspectives (Crowe et al., 2011). Constructivism/interpretivism (a) ontologically asserts that there are multiple, constructed realities, and states that a study's 'reality' is co-constructed by the researcher(s) and the research participants; (b) epistemologically takes a subjective point of view and states that 'the knower' and 'would-be-known' are interactive and inseparable; (c) axiologically stresses that every inquiry or study is value-bound; and (d) methodologically emphasizes the credibility of the descriptions generated by the researcher(s) and using an inductive research logic (Guba & Lincoln, 2005; Teddlie & Tashakkori, 2009). With respect to the issue of generalization, the constructivist/interpretivist framework stresses that every theory and hypothesis is time- and context-bound, but encourages researchers to explicitly discuss to which specific settings and contexts the study results are transferable (Lincoln & Guba, 1985). A key proponent of constructivist/interpretivist case study research is Stake (e.g., Stake, 1995). Most single case studies that are conducted from a constructivist/interpretivist paradigm are qualitative case studies. However, within the constructivist/interpretivist framework, a researcher can also conduct a mixed methods case study that primarily aims to

answer a qualitative question related to one case, but that includes a minor quantitative sub-question that warrants the addition of single case experimental approaches (see e.g., Johnson et al., 2007).

Critical, Transformative, and Feminist Approaches

Single case studies grounded in the critical approach are aimed at questioning one's own and others' assumptions and taking into account the wider political and social environment and issues that relate to power and control (Crowe et al., 2011). Examples of case study researchers that work from a critical approach are Doolin (2004) and Blaikie (2007). The critical approach to conducting case studies shows a high degree of overlap with the transformative paradigm that recently has inspired many mixed methods researchers (see e.g., Mertens, 2007, 2012; Mertens, Bledsoe, Sullivan, & Wilson, 2010). This philosophical stance often guides researchers who aim to address issues of human rights, social injustice, oppression, and/or discrimination throughout the research process. Critical and transformative studies are usually conducted 'with' the research participants, instead of 'on' them. Hence, the individual(s) or group(s) that are the study participants are often actively involved throughout the research process, from the formulation and delineation of the research topic onwards, until the critical interpretation of the findings and the translation of the study's insights to concrete guidelines for policy and practice. The issue of 'power' is central in critical and transformative studies, not only for the formulation of the research purpose and topic, the data collection, the data analysis and interpretation, and the communications of the study results to the intended audience, but also within the relationship between the researcher and the research participant(s). Furthermore, the transformative approach (a) ontologically asserts that there are multiple realities that are socially constructed, but that it is necessary to be explicit about the social, political, cultural, economic, ethnic, racial, gender, age, and disability values that define realities; (b) epistemologically stresses the necessity of an interactive link between the

researcher and the study participants in order to know realities, and asserts that knowledge is socially and historically located within a complex cultural context; (c) axiologically builds on three basic principles that guide the entire research process: respect, beneficence, and justice; and (d) methodologically stresses the importance of an interactive link between the researcher and the participants in the definition of the problem, and states that research methods should be adjusted to accommodate cultural complexity, power issues should be explicitly addressed throughout the study, and issues of discrimination and oppression should be recognized (Mertens, 2007, p. 216).

Feminist approaches to research have much in common with the critical and transformative approaches to research. The feminist approaches are committed to social change and social justice on behalf of women and other oppressed groups, and center research on women's and other oppressed groups' concerns, experiences, standpoints, and issues (Hesse-Biber, 2010a, 2010b, 2012). Although many feminist researchers tend to prefer qualitative over quantitative research methods, there are many mixed methods studies conducted from a feminist point of view, for instance the studies of Buck, Cook, Quigley, Eastwood, and Lucas (2009), Hogdkin (2008), Katsulis (2009), Nightingale (2006), O'Neill (2009), and Vikström (2010). A mixed methods single case study, conducted from a feminist or transformative perspective, focusses on a particular woman or a member of an oppressed group as a case and integrates qualitative and quantitative evidence to study a certain phenomenon or test a theory with the purpose of removing or reducing the oppression, and increasing respect, beneficence, and justice.

Pragmatism

Many authors nowadays refer to pragmatism as the paradigmatic foundation for combining qualitative and quantitative research components (for an overview and discussion, see e.g., Tashakkori & Teddlie, 2010). Pragmatism is not new to the social and behavioral

sciences, and has been described as a general belief system for these sciences (see e.g., Ormerod, 2006), and as a specific justification for combining qualitative and quantitative research components (Morgan, 2007).

Pragmatism is an attractive philosophical basis for mixed methods researchers because it stimulates the combination and integration of divergent perspectives and approaches (Johnson et al., 2007). Foremost, pragmatism stimulates the combination of action and reflection (Biesta, 2010) and is aimed at solving ‘real world problems’ (Feilzer, 2010). Shaped through the work of philosophers such as Charles Peirce, William James, and particularly John Dewey, pragmatism (a) ontologically asserts that there is no structural gap between humans and their environments because we are participants in an ever evolving universe; (b) epistemologically states that knowledge can only be gained through action, and that because our knowing is always a result of our actions, knowledge can provide us only with information about possible connections between actions and consequences, and not with ‘everlasting truths’ about a world independent from our lived lives; (c) axiologically asserts that research is only worthwhile when action and reflection are combined throughout the research process; and (d) methodologically promotes the use of inductive, deductive, as well as abductive research logic (Biesta, 2010; Teddlie & Tashakkori, 2009).

As pointed out by Biesta (2010), philosophical pragmatism is not a self-evident or off-the-shelf philosophical justification for mixed methods research. It is not a “paradigm” as such but rather a collection of insights that helps us to discuss the strengths and weaknesses of mixed methods research. A prototypical mixed methods single case study from a pragmatic perspective looks for a solution to a particular problem for the case, uses single case experimental and qualitative case study methods and techniques related to the research question, and most importantly, uses a pragmatic lens to ask questions about the strength, status, and validity of the knowledge claims derived from the study.

Postpositivism

Single case studies conducted from a postpositivist philosophical perspective are primarily aimed at testing and refining hypotheses and theories (Crowe et al., 2011). This paradigm (a) takes the ontological position of critical or transcendental realism (i.e., there is a 'real reality', but it can only be imperfectly and probabilistically understood); (b) the epistemological position of modified dualism (i.e., 'the knower' and 'the would-be-known' can be separated); (c) axiologically acknowledges both the value-ladenness and the theory-ladenness of facts, and encourages researchers to enhance the internal and external validity of their conclusions; and (d) methodologically emphasizes the use of a deductive research logic (Guba & Lincoln, 2005; Teddlie & Tashakkori, 2009).

At the level of the single case, the postpositivist paradigm is most strongly connected to quantitative single case experimental research. A single case experimental researcher a priori formulates a causal hypothesis concerning the relationship between an independent and an outcome variable (e.g., whether there is a causal relationship; what is the direction of this relationship) for one specific case, and subsequently experimentally manipulates the independent variable and repeatedly measures the outcome variable under the various levels of the independent variable, in order to empirically test this hypothesis and study the causal relationship between both variables for the case(s) under study. Hence, the postpositivist paradigm with its aim of testing and refining hypotheses and theories seems to more closely align with quantitative single case experimental designs than with qualitative case study designs. However, as for instance elaborated by Yin throughout various handbooks and publications, researchers can take a postpositivist stance when they are conducting a qualitative case study or a mixed methods single case study. For example, by applying analytical strategies such as 'pattern matching', 'time-series analysis', or 'logic models' researchers can conduct a qualitative case study or mixed methods single case study that

pursues the testing and refining of hypotheses and theories aimed at explanation, prediction, and control (Yin, 2017).

What Kinds of MMSCR Have Been Applied in the Empirical Literature?

So far, two kinds of MMSCR have been applied in the empirical research literature: qualitative case studies in which quantitative research components are brought in, and single case experiments that are complemented with qualitative data. With regard to the first type of MMSCR, in 1981 Kazdin explicitly promoted to bring in quantitative research components in qualitative case studies. Moreover, Kazdin (1981) argued that the collection of qualitative as well as quantitative data is what enables researchers to draw valid inferences from case studies. He for instance stated that a case study without quantitative data “usually precludes drawing firm conclusions about whether change occurred” (Kazdin, 1981, p. 188). In addition to Kazdin’s work, other influential examples of quantitatively informed case studies are Strupp’s studies on time-limited psychotherapy (e.g., 1980a, 1980b, 1980c, 1980d, 1990).

Second, single case experimental researchers have argued that in addition to collecting quantitative data to document changes in the outcome variable(s) caused by the manipulation of the independent variable, qualitative data can be collected to document the feasibility, appropriateness, and/or meaningfulness of the treatment or intervention under study (e.g., Kellett & Hardy, 2014). Furthermore, in addition to assessing the statistical significance of an intervention effect by means of collecting quantitative data and conducting statistical analyses, qualitative data can be collected to additionally study the practical significance of the intervention (Kirk, 1996; Pearson, Wiechula, Court, & Lockwood, 2005; Thompson, 2002). Practical significance refers to the size of the improvement in the outcome variable(s) as well as to the practical importance of this improvement (Kazdin, 1999; Perdices & Tate, 2009). In 1977 already, Kazdin advised single case researchers to assess the practical importance through social validation: He recommended supplementing quantitative single

case experiments with qualitative data on whether clinical, social, or applied importance had been achieved. A recent example of a single case experiment complemented with qualitative data is the study of Kellett and Hardy (2014): The authors conducted a single case experiment on the treatment of paranoid personality disorder with cognitive analytic therapy (CAT), but supplemented the experiment with the collection of qualitative data on the participant's experiences with CAT. In addition, qualitative research components were used to study whether clinical change had taken place, and to further study the identified change mechanisms.

MMSCR in Current Practice and Applications

Whereas the single case experimental and qualitative case study methodologies typically appear to exist on 'separate islands' in the methodological literature, in practice they are often combined. For instance, in the domain of challenging behavior among persons with intellectual disabilities, a practitioner can quantitatively measure the amount of challenging behavior shown by a client before, during, and after implementing an intervention (e.g., teaching alternative skills), plot the collected data on the challenging behavior level over time, and evaluate whether the intervention has an effect on the challenging behavior of the client, thereby applying visual and/or statistical analysis techniques (see e.g., Heyvaert, Wendt, Van den Noortgate, & Onghena, 2015; Zhan & Ottenbacher, 2001). However, when defining the challenging behavior and selecting an appropriate intervention, 'quantitative' *and* 'qualitative' information is taken into account that relates to the history, present behavior, and context of the client (e.g., previous interventions with this client and their effects, contextual factors that appear to influence the challenging behavior, contextual factors that might impede or facilitate certain interventions; e.g., Heyvaert, Saenen, Maes, & Onghena, 2014, 2015). In addition, perceptions about the 'effects' of the intervention might be qualitatively expressed: *Does the client and the caretakers and family feel that the intervention is 'helpful', 'effective',*

'desirable', 'feasible', and 'useful in day-to-day practice'? How do they believe the intervention can be optimized? Furthermore, practitioners may qualitatively link data points of noteworthy clinical change (whether in the direction of improvement or deterioration) to their notes on the course of the intervention, which may provide a basis for evaluating the impact of specific components of the intervention, as well as the impact of external events (Dattilio, Edwards, & Fishman, 2010). In addition to this MMSCR example in the field of special education, practitioners in many other applied fields combine qualitative and quantitative data and methods at the case level, but most commonly without looking at the mixed methods literature for a methodological justification or optimization (see e.g., Gannotti, Gorton, Nahorniak, & Masso, 2013).

How to Conduct MMSCR?

A large diversity of mixed methods designs have been applied in actual empirical research and even a large diversity of typologies have been proposed for organizing these designs (Creswell & Plano Clark, 2018; Leech & Onwuegbuzie, 2009; Tashakkori & Teddlie, 2010; Teddlie & Tashakkori, 2009). All these mixed methods designs can be used for the combination of qualitative case studies and single case experiments or for the integration of qualitative case study components and single case experimental components. It is beyond the scope of this article to explore all possibilities, critiques, and alternatives (see e.g., Maxwell, Chmiel, & Rogers, 2015; Maxwell & Loomis, 2003), but we will focus on one recently published mixed methods single case study that demonstrated the versatility of integrating qualitative and quantitative research components at the case level.

Van Ness et al. (2017) gave an example of a mixed methods sequential single case study about the effectiveness and acceptability of a humming intervention for an older person with moderate dementia. The aim of the intervention was making caregiver feeding more effective and making patient eating more enjoyable. Van Ness et al. (2017) opted for a mixed

methods approach for this single case study because they wanted to test the effectiveness of the intervention while attending to the preferences and concerns of the person involved. Their research design is depicted in Figure 1.

Insert Figure 1 about here

Figure 1 shows that the research design was constructed in three stages, with qualitative case study components in the first and third stage, and a single case experiment in the second stage. In the first stage, they interviewed the person in an open-ended qualitative fashion to determine his musical preferences. In a second stage, a caregiver feeding the person was videotaped for 30 noon mealtimes over the course of a calendar month: 12 consecutive days without intervention, followed by 18 consecutive days with the humming mealtime intervention. The video observations were subsequently converted into measurements using the Edinburgh Feeding Evaluation scale, with smaller scores indicating fewer feeding/eating problems. The starting day of the intervention was randomly determined, with a restriction that there should have been at least 5 days in each phase. The humming intervention took into account the musical preferences determined in the first stage of the study.

Data analysis consisted of presenting the data in tabular format, calculation of descriptive statistics, and the performance of a randomization test. Results showed that the average score during the preintervention phase was 14.3 and the average score during the humming phase was 9; which represented a statistically significant reduction in problems according to a 5% level randomization test.

In a third stage, a qualitative interview was conducted to inform the degree of belief that the researcher should give to assessing the weight of evidence against the null hypothesis that there was no difference in means between the preintervention and intervention phases.

Questions were asked regarding key experimental assumptions and regarding the quality of the experience of eating, about how well the musical preferences were satisfied, and related qualitative questions.

Van Ness et al. (2017) explicitly framed their approach in the pragmatic tradition, with abundant references to William James, John Dewey, and Charles Sanders Peirce, and with the latter as the main guide:

Peirce's variety of pragmatism, though, provides the philosophical basis for this effort to integrate mixed methods with n-of-1 trial designs in a way that will both attend to individuals' interest in treatments beneficial for themselves and to the social desideratum of research programs leading to replicable and generalizable knowledge. (p. 344)

Whereas Van Ness et al. (2017) framed their approach as “especially appropriate for early-stage research interventions intended to generate explanatory hypotheses” (p. 342), we want to join Stake (1995), Eisenhardt (1989), and Yin (2014) in their advocacy for the valid use of a case study to answer specific research questions concerning the particular case under study, to develop theory, or to test theory (see section “What Kinds of Knowledge can MMSCR Produce?”).

Variations on the basic design as in Figure 1 can easily be constructed. Variations are possible within each stage or between stages. For example, within the single case stage it would have been easy to gain design power by randomly alternating days with and without humming if it is assumed that the intervention has an immediate, concurrent, and temporary effect (Manolov & Onghena, 2017; Onghena & Edgington, 1994). If a design with one large intervention phase is preferred, it would have been appropriate to include a posttreatment

phase (Barlow et al., 2009; Gast & Ledford, 2014; Kazdin, 2011). Other choices can be made between stages: Stages can be in different orders (e.g., QUAN → QUAL → QUAN) or stages can be added (e.g., QUAN → QUAL → QUAN → QUAL).

Because qualitative case studies and quantitative single case experiments are both located at the single case level, we reckon that there is substantial potential to design fully integrated mixed methods studies (Creamer, 2018; Fetters & Molina-Azorin, 2017). For example, the single case experimental design components could be completely nested within a qualitative case study, in the sense that the experiment is just part of a larger case study, and that qualitative observations and interviews with peers continue while the experiment is running. In order to emphasize this potential for integration we prefer the research stages as proposed by Nastasi, Hitchcock, and Brown (2010). Figure 2 provides a six-stage summary of these stages. In the first stage the context is given: the theories, research, practice, policy and worldviews that guided the research. In the second stage, the purpose of the study is delineated and the specific research questions are formulated. The third stage pertains to the data collection: sources, instruments, duration, and number of measurement occasions. The collected data are analyzed, evaluated and interpreted in the fourth and fifth stage respectively. Finally, in the sixth phase the study is reported and the conclusions loop back to theory, research, practice, and/or policy (and makes part of the first stage of follow-up studies). The most important elements of this design are the two-pointed arrows at each stage. These arrows represent the potential for mixing the qualitative and quantitative components at each stage of the research process.

Insert Figure 2 about here

Trustworthiness and Validity of MMSCR

Because MMSCR is not (yet) part of a well-established methodological canon, researchers who consider this approach may have to anticipate skeptical readers and fellow scientists. Therefore, we recommend paying special attention to trustworthiness and validity issues while planning, conducting, and reporting the study. Before embarking on an MMSCR study, it is wise to reflect on the methodological quality of the single case experimental component, the qualitative case study component, and on the added value of the mixed methods approach.

First and foremost, it is crucial to check whether the proposed approach is aligned with the research questions and the envisioned results and implications. Although the arguments for trustworthiness and validity will differ from study to study, it is recommended practice to match the research design and analysis to the research questions and ambitions (Creswell, 2013, Creswell & Plano Clark, 2018).

Second, the single case experimental component should conform to current standards and guidelines for designing and analyzing single case experiments. An example of standards and guidelines for the domain of special education can be found in Kratochwill et al. (2010, 2013). These standards and guidelines assign the categories of “Meets Standards”, “Meets Standards With Reservations”, and “Does Not Meet Standards” to each single case experimental design. Furthermore, outcome measures that meet the design standards (with or without reservations) can be categorized as demonstrating “Strong Evidence”, “Moderate Evidence”, or “No Evidence” (see also Smith, 2012).

Third, the qualitative case study component can bolster the trustworthiness and validity by incorporating the participant’s sense making and perspective on the effect of the intervention, by the addition of an in-depth description of the characteristics of the participant and the context (and thereby facilitating transferability), by guiding the choice and interpretation of the intervention and outcome measures (as demonstrated in the study by Van

Ness et al., 2017), and by critically examining the researcher's role using qualitative techniques such as member checks, negative case analyses, audit trails, and prolonged engagement (Hitchcock et al., 2010; Nastasi & Schensul, 2005).

Fourth, the added value of the mixed methods approach can be demonstrated by concentrating on the use of multiple sources of evidence as a tactic for addressing concerns regarding trustworthiness and validity (Heyvaert, Hannes, Maes, & Onghena, 2013). As Kitchenham (2010) concluded: "The combination of qualitative and quantitative techniques enhances legitimation as the qualitative analyses involve descriptive precision and the quantitative analyses ensure numerical precision" (p. 562). If the single case experimental component is properly conducted, then the addition of a qualitative case study component can only increase trustworthiness and validity. MMCSR borrows strength from both quantitative and qualitative research traditions to build a convincing case.

Future Directions for MMSCR

Throughout this paper, we consecutively discussed the historical roots and the distinct nature of MMSCR, the kinds of knowledge MMSCR produces, its philosophical underpinnings, the kinds of MMSCR that can be found in the literature and in current practice, and illustrate how MMSCR can be conducted and evaluated in terms of trustworthiness and validity. To address complex and multifaceted research questions that involve both quantitative and qualitative empirical research components related to a single case, researchers can combine elements from the single case experimental and qualitative case study methodologies in a mixed methods single case study. Mixed methods single case studies can be used to answer research questions that relate to particular cases, but also to develop and to test theories from individual cases.

In this section, we want to point to three remaining methodological challenges for MMSCR. A first challenge pertains to the development of a critical appraisal tool for

MMSCR. The section on “Trustworthiness and Validity of MMSCR” already presented some general considerations and principles that are crucial for the evaluation of quality and evidence in MMSCR, and the next step would be to organize these considerations and principles in a critical appraisal instrument that allows a rating of specific studies in terms of quality and validity. Solid building blocks for such an instrument can already be found in the methodological literature: (1) in the guidelines for conducting single case experiments and *n*-of-1 trials provided by Tate et al. (2008, 2013, 2016a, 2016b), Shamseer et al. (2015), and Vohra et al. (2015), (2) in the discussion of the quality of qualitative research in Burns (1989), Mays and Pope (2000), Morse, Barrett, Mayan, Olson, and Spiers, (2002), and Hannes, Lockwood, and Pearson (2010), and (3) in frameworks for evaluating the integrative quality of the mixed methods approach (Heyvaert et al., 2013; O’Cathain, 2010; Pluye, Gagnon, Griffiths, & Johnson-Lafleur, 2009). In our opinion, the availability of a critical appraisal tool geared towards MMSCR would be an asset for researchers who consider this approach. The development of such an appraisal tool would be an interesting direction for further methodological research.

A second challenge relates to the team work that is involved in conducting mixed methods single case studies, analogous to the team work that is involved in many mixed methods studies in general (see e.g., O’Cathain, Murphy, & Nicholl, 2008). Various people might be involved when designing, conducting, validating, and reporting on an mixed methods single case study. First, methodologists as well as researchers with substantive expertise on the phenomenon of interest might be involved in order for the mixed methods single case study to be methodologically sound and trustworthy as well as topically rich and well-grounded in the existing knowledge base on the phenomenon. Second, methodologists specialised in qualitative case studies as well as methodologists specialised in single case experiments might be part of the research team. Third, stakeholders and practitioners might

enrich the research team with their real-life experience with the phenomenon of interest and with the case(s) included in the study that represent the phenomenon. They might show themselves indispensable members of the research team in for instance the formulation of relevant research questions and hypotheses, and critically interpreting the study's findings (Torrance, 2012).

In the context of health sciences research teams, Curry et al. (2012) suggested several guiding principles to deal with differences within the team, to trust the other members of the team, to create a meaningful group and develop a common language, to handle conflict and tension, and to treat leadership as a role rather than an individual characteristic, balancing issues of relationship and task. In addition, Bowers et al. (2013) pointed out that funding agencies and teams should take into account the additional cost of coordination, schedule dedicated time for planning and collaborating across researchers, fund support for in-person meetings, and make optimal use of resources. Furthermore, as Maxwell (2016) observed, sometimes the close involvement of the complete team with the collection and analysis of both the qualitative and quantitative data, rather than seeing these as separate “strands” of the research, might be beneficial for the integration of the two approaches. We would speculate that the integration of the single case experimental approach and the qualitative case study approach is function of the quality of collaboration, communication, and integration of the team, but in the end, this is an empirical question. From our own experience, the coordination and integration of divergent assumptions regarding research, different worldviews and philosophical orientations of the different team members is an important consideration. It would be interesting if future research addressed this challenge of working in teams when conducting MMSCR.

A third challenge for further research is the application of mixed methods research synthesis (Heyvaert, Hannes, & Onghena, 2017; Heyvaert, Maes, & Onghena, 2013) for

multiple case studies and single case experiments (see Stake, 2006). Cases can be recruited and integrated in one encompassing MMSCR study or cases can be (theoretically or literally) replicated, possibly reported by different research teams and synthesized based on the reports (Yin, 2017). A decision on the number of cases to include in such a multiple MMSCR study depends on a number of factors that may be given different weights in different research domains and for different topics: the size and stability of the phenomenon under investigation, the availability of cases, the research resources, the feasibility, standards and guidelines within research domains, and the purpose of the replication (replication until convergence and saturation is reached, falsification or corroboration, aggregation and/or generalization). Examples of sequential analysis and statistical power analysis guiding the decision on the number of cases to include, can be found in Kuppens, Heyvaert, Van den Noortgate, and Onghena (2011) and Heyvaert et al. (2017). The use of meta-analytical tools for MMSCR, and the use of mixed methods research synthesis in particular, might be particularly promising to reach the goal, set by Van Ness et al. (2017): the development of “research programs leading to replicable and generalizable knowledge” (p. 344).

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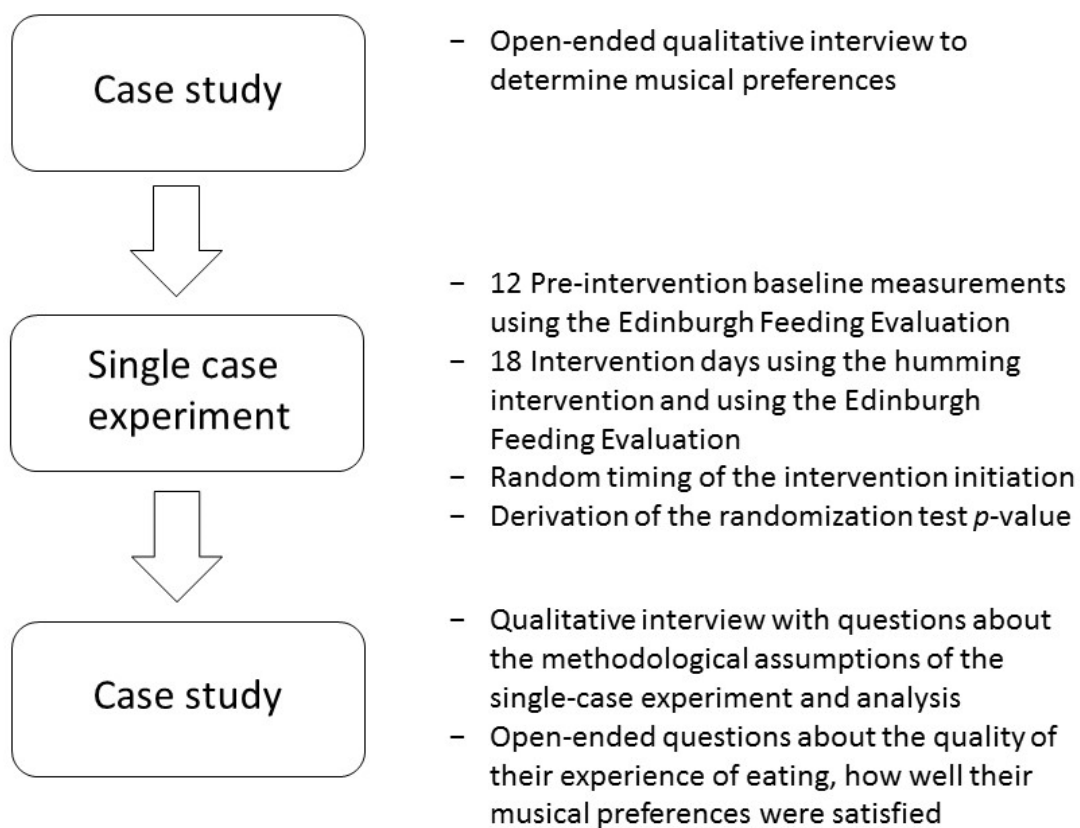


Figure 1. Schematic Representation of the Mixed Methods Sequential Design Combining Qualitative Case Study and Single Case Experimental Components in the Example of Van Ness, Murphy, and Ali (2017).

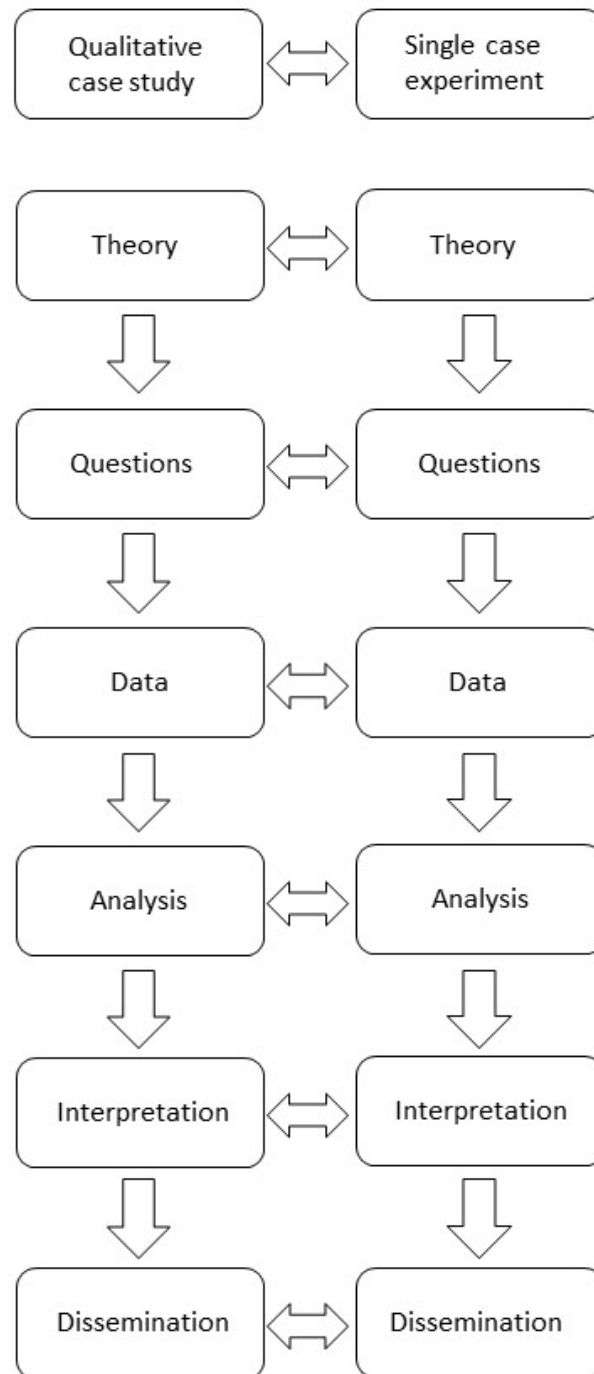


Figure 2. Six-Stage Summary of Mixed Methods Design, proposed by Nastasi, Hitchcock, and Brown (2010). [The two-pointed arrows represent the potential for mixing the qualitative and quantitative components at each stage of the research process].