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Introduction
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1. Decide what type of harmonization strategy to employ, taking into account that many harmonization ef require some combination of strategies.
2. When deciding which variables to harmonize, create an initial plan and define clear objectives about wh want to achieve. The plan should include making all data conversions reversible.
3. Focus on both the variable and survey levels in the harmonization process.
4. Develop criteria for measuring the quality of the harmonization process. This includes testing it with us knowledgeable about the characteristics of the underlying surveys, the meaning of source variables, and th transformation of source variables into target variables.
5. Provide the widest range possible of data and documentation products about the entire harmonization p
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Introduction *Harmonization* refers to all efforts that standardize inputs and outputs in multinational, multicultural, multiregional surveys, which we refer to as '3MC' surveys. Harmonization is a generic term for procedures used predominantly in official statistics that aim at achieving, or at least improving, the comparability of different survey measures collected. The term is closely related to that of standardization (see Sample Design and Questionnaire Des Harmonizing procedures may be applied during any part of the survey lifecycle, such as study design, choice of indi question wording, translation, adaptation, questionnaire design, sampling, data collection, data coding, data editing, documentation. The need to harmonize arises for all 3MC surveys, particularly when the goal is to combine the data single integrated dataset. There are two general approaches for harmonizing data—input harmonization and output harmonization:

1. **Input harmonization** aims to achieve standardized measurement processes and methods in all national or regic populations included in the 3MC survey. Comparability can be realized through standardization of definitions, indicators, classifications, training, and technical requirements.
2. **Output harmonization** begins with different national or regional measurements, possibly derived from nonstar measurement processes. These measurements are 'mapped' into a unified measurement scheme. Thus, only the s outputs are specified, and the individual countries/regions may decide how to collect and process the data neces achieve the desired outputs . It is also possible to incorporate output harmonization in the original planning to pr datasets for 3MC research, as the Luxembourg Income Study has done for many years with both individual and household level data collected from many countries since 1983.

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Guidelines Goal: To ensure that survey and statistical research teams follow accepted standards when creating harn data and documentation files, and use a harmonization strategy that best fits their basic source materials and the obje they wish to achieve.

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1. Decide what type of harmonization strategy to employ, taking into account that many harmonization effort require some combination of strategies:

Consider input harmonization when the survey process is centrally coordinated.

Rationale

'Input' harmonization, usually applied in a multinational context, seeks to impose strict standards and protocols fo whole survey process from the beginning, by which each national survey applies the same survey procedures and

common questionnaire (see Sample Design and Translation). Also known as 'prospective,' this strategy is meant
a high degree of comparability. Some adaptations may occur for individual data collection sites, but the goal is to
maintain comparability .

Procedural steps

1.1 Provide detailed specifications, protocols, and procedures for all aspects of the survey process. The differe
specifications (Data Protocol, Sampling, Translation, etc.) of the European Social Survey (ESS) and the
Demographic and Health Survey (DHS) are good examples .

1.2 Decide which items to standardize.

1.3 Consider if variations may be necessary to account for site-specific interests. This can either be due to site
research foci or resource limitations .

**Consider output harmonization, also known as retrospective harmonization, when the survey collection pr
largely determined at the level of individual countries or cultures and there is minimal or no agreement or
standardization**.

Rationale

'Output' harmonization is implemented through two main strategies: 'ex-ante' and 'ex-post.' In practice, a study m
utilize both strategies.

Ex-ante refers to measurements designed to be comparable and harmonized in data processing. When comparabi
been considered during survey planning, the understanding of concepts, common goals, and specific targets can l
established for the data collection process. The precise wording of the survey items may vary, but the items seek
capture the same concept (see Questionnaire Design and Adaptation).

The second variant is an ex-post strategy, by which statistical or survey data are deemed inferentially equivalent,
made comparable after the fact through a conversion process . The items to be harmonized were not designed to
comparable, but are assessed and edited to achieve commonality. An ex-post strategy can be used in situations w
existing repositories will be exploited for comparative research or where intensive early planning is not possible
of financial or policy constraints.

Procedural steps

1.4 Use an ex-ante strategy whenever possible. This enhances comparability since harmonization is addressed
planning stage of each national data collection, as well as at the end of the process when creating harmonize
files.

1.5 Implement an appropriate planning process.

1.6 Use an ex-post strategy only if no consideration regarding harmonization has been given by data collector
start of data collection(s), but researchers later believe (e.g., because of common concepts or similar questio
surveys) that a harmonized data file can be produced through a conversion process to create comparable var
statistics. The Integrated Public Use Microdata Series, International (IPUMS-I) and the are two such examp

1.6.1 For any ex-post plan, ensure that data access, intellectual property, and any other ethical or legal issu
resolved for all intended source studies prior to beginning harmonization with the source in question . I
study investigators have their data publicly available, it is advisable to obtain permission from them if
to harmonize their data with other datasets. An individual study's data use agreement may not apply, a
formal request to the respective research ethics or data access committees may be necessary .

1.7 Record all decisions about the 'conversion' process systematically. One option is to use two separate datab record all work: a production database, which stores the original and harmonized materials, and a user's data which provides the analysts access to the overall process.

1.8 Make provisions so that all data conversions can be traced back to the original data.

1.9 For any output harmonization technique, adopt a detailed 'data processing plan' that includes descriptions the producer(s) of the harmonized data deal with the following:

1.9.1 Differences in study design, such as panel or cross-sectional design, and/or in mode of data collectio

1.9.2 Differences across studies with regard to what is measured (e.g., definitions of study population, con variables).

1.9.3 Differences in how to measure (e.g., scale of measurement, wording and routing of questions, respor asked).

1.9.4 Differences in how estimates are generated (imputation, weighting, or nonresponse adjustments).

1.9.5 Procedures used to create and define harmonized variables, including any harmonized weights calcu

Lessons learned

1.1 Input harmonization involves adherence to appropriately standardized methodologies throughout the survey lifecycle. For example, the ESS seeks to collect high-precision data every other year using face-to-face intervi applies detailed sampling and fieldwork protocols, uses standardized translation protocols in all participating countries, aims to achieve standardized response rates, adopts consistent coding procedures, and creates and distributes well-documented datasets in a timely fashion. All of these procedures require greater organizationa capabilities and resources throughout the planning and data collection stages. The results are transparent, high and can produce more valuable public-use data files at the end.

1.2 Not all comparative research will be able to follow the same procedures, so it is important to decide which r are best given the actual resources, the survey process structure, and the intended level of precision. In additic creation of such common standards and their implementation at the local level requires considerable expertise may not be available in all 3MC contexts. The Generations and Gender Programme is a large longitudinal 3M survey that studies relationships between parents and children and also between partners. It is conducted using paper-and-pencil instrument (PAPI) as well as computer-assisted interviewing (CAPI), and seeks to follow co harmonization practices. While much harmonization work occurs centrally, individual country teams are urge follow certain procedures to improve comparability. This method requires considerable coordination among components of the survey teams at all levels .

1.3 Flexibility can be designed. Research sites in different countries may not be able to follow the same proced it is important to decide which methods can be adapted and define procedures for adaptation given the actual resources, the survey process structure, and the intended level of precision. For example, the Malaria Indicato is an optional component that can be conducted in the context of the Demographic and Health Survey with or biomeasure collection. The creation of such common standards and their implementation at the local level req considerable expertise, which may not be available in all 3MC contexts.

1.4 In a working paper, describes in detail the harmonization efforts surrounding the European Community Hou Panel (ECHP), an exemplary use of input harmonization. The survey was designed from the beginning to use harmonization with its design of uniform questionnaires as well as detailed definitions, rules, procedures, and to make comparability across nations easier. After the first phase of the project, a few countries decided to cea collecting national samples for the ECHP and instead conduct their own national surveys, resulting in the nee

ex-post harmonization. Those doing the harmonization work learned that this kind of ex-post harmonization v resource-intensive and required staff experienced in both the original source and target formats of the ECHP framework. They also had to know in detail how their national questionnaires differed. Common problems inc concepts heavily affected by national contexts as well as differences in scales of measurement, variable codin schemes, and definitions of concepts. Solutions to such problems were often found through ad hoc decisions a recoding, combining, or collapsing variables, and almost never through estimation techniques.

1.5 These harmonization strategies are almost never applied exclusively on any single statistical or survey data collection. Depending on specific cultural and national characteristics, data producers should consider strategi will enable them to collect their data in the most efficient manner. In some situations, they may want to combi strategies. For example, data producers may start with an input harmonization plan, but should be prepared to ex-post output harmonization to account for differences across cultures. For example, the has standardized instruments, but also provides a Standard Recode Manual.

1.6 Health researchers in particular emphasize the importance of ex-post output harmonization. Because of the of datasets generated by national governments and individual investigators which affect public health policies desire to pool cases cross-nationally to increase sample sizes is highly desired. To insure comparability, invest involved in this process developed a very systematic approach to harmonization and encouraged its use throug relevant research communities.

1.7 Output harmonization projects also generate copious amounts of metadata describing the source variables a variables and the entire harmonization process. This new metadata provides researchers with opportunities to this information and create additional linkages. For example, individual variables can be grouped into substan categories or concepts to enhance the analytical power of a new harmonized dataset.

1.8 An innovative approach to ex-post harmonization is the survey data recycling (SDR) project proposed by . S aims to create an integrated database drawing from multiple survey and non-survey data sources. Central to th concept is the goal of enabling researchers and data users to address methodological biases and potential erro survey data by providing two types of metadata: control variables related to survey quality and those related t post harmonization process. This way, researchers can use the control variables to assess, control, or possibly varying weights to account for the effect of these variables, thereby 'recycling' rather than throwing out data o varying quality .

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2. When deciding which variables to harmonize, create an initial plan and define clear objectives about what want to achieve. The plan should include making all data conversions reversible. ***Rationale*** Creating a harmoni plan from the beginning of the project allows data producers to document all of their decisions at the time they are n case errors occur or are identified by users at a later time, all data conversions should be reversible. ***Procedural step***

2.1 Before conducting fieldwork, consult with experts or an advisory committee on a systematic design process with methodology groups to investigate comparability issues. If pre-fieldwork coordination is not possible, fo advisory committee of researchers knowledgeable about the subject matter at the beginning of the harmonizat process, if possible, and consult with them regularly.

2.2 Show the advisory group results of the harmonization process at different points in the process to allow for changes in the rules used to create new variables.

2.3 Consider establishing a testing group of users knowledgeable about the subject matter, separate from the harmonization process, who provide feedback on the analytic usefulness of the data before they are released p

2.4 Implement a systematic conversion creation process with appropriate quality controls.

2.5 Identify and become familiar with software tools that facilitate a comparison of variables from different sur order to determine if and how these could be harmonized. Such tools often work from a common database tha all the information about each variable.

2.6 Establish partnerships with producers of harmonization tools. This may be more beneficial than creating ne which often requires costly programming efforts.

2.7 Where software tools are unavailable or impractical, use manual comparisons in making harmonization dec and consult with substantive and methodological experts in doing so.

2.8 Identify and become familiar with interactive documentation tools that allow for proper and transparent documentation. For example, Opal is a tool designed to harmonize epidemiological data.

Lessons learned

2.1 Realize that not all concepts measured in the survey process are equally amenable to harmonization efforts. example, cross-national harmonization of the number of births and marriages is a far easier task than compari divorce rates where local laws, customs, and data collection methods may differ substantially. Other concepts international population migration, may not lend themselves to harmonization at all, or only at the most basic due to a lack of precise definition and great variety in measurement criteria. Three characteristics that could ir harmonization potential are (i) the relative importance to the research intending to use the harmonized items, (individual the item targets (e.g., the participant, the participant's family members), and (iii) the period of time which the variable refers .

2.2 Good decision-making about the harmonization process will benefit from the use of software tools, as well from a diverse group of survey researchers who can offer advice on various procedures and techniques to use producing harmonized files. The ISSP Data Wizard was used by the International Social Survey Programme (was one of the first tools developed to support procedures that were previously performed manually to harmo at the cross-national level. The tool offered rule-based checks, automation of partial steps, and the visualizatic certain conditions to make the harmonization process more efficient, easier, and less susceptible to mistakes.

2.3 The European Values Study (EVS) formed a number of work groups, both before and after fieldwork. The a on the one hand to set standards at an early stage, and on the other to consolidate and merge data which had b cleaned by participating national survey teams. This project produced an integrated source questionnaire and a equivalency tables to assist secondary researchers. The project website makes all of this information easily ac These processes and products provide critical information to secondary users of these data.

2.4 The DataSchema and Harmonization Platform for Epidemiological Research (DataSHaPER) is one potentia for output harmonization. Fortier's 2011 paper showed that using the DataSHaPER across 53 studies, 64% of "essential" constructs from those selected could be harmonized completely or at least "partially." This estimat the most conservative criteria, and evaluation of harmonization potential would likely improve this statistic . A version of this tool is Opal.

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3. Focus on both the variable and survey levels in the harmonization process. ***Rationale*** Harmonization efforts concentrate on comparing and integrating information involving specific variables across data files. However, it is e important to consider the overall characteristics of the surveys that make them good candidates for harmonization, a report the decisions involving this process to end users. ***Procedural steps***

3.1 Recognize the different aspects involved in converting source variables, which might include variable conc scales of measurement, into target variables. The concept of citizenship, for example, presents significant cha to researchers who want to investigate this topic .

3.2 Describe similarities and differences between the source variables and the target variables, including discus universe statements, question wording, coding schemes, and missing data definitions. There may be an unavo loss of information resulting from harmonization, such as if a variable that was continuous is being harmoniz categorical variable .

3.3 Consider file-level attributes when creating the harmonized data file, including how survey weights, imputa procedures, variance estimation, and key substantive and demographic concepts will change in the process.

3.4 Pay particular attention to sampling designs and data collection methods in making assessments about the d comparability between different surveys. See Survey Quality for a discussion of how quality profiles can be d and used to assess comparability in a 3MC survey.

Lessons learned

3.1 Data producers must recognize the degrees of individual item or variable persistency when creating questio and collecting data. Item persistency over time is very important in generating harmonized data files. There ar considerable differences, for example, between an 'absolute' persistent variable, such as 'country of birth,' and persistent variable, such as 'country of citizenship.' The concept might mean different things in different coun subject to change, and could be reported validly for multiple countries by some respondents .

3.2 Quota sampling destroys comparability . Harmonization will not make data from quota sampling comparab data gathered via probability sampling. The ISSP is an example of a 3MC survey program that abolished quot sampling.

3.3 The European Social Survey (ESS) provides detailed insight into weighting issues and makes this informati available. See the ESS data site for each survey round for the latest version.

3.4 The created a harmonized data file from three comparable surveys on mental health. Data producers created pooled weight for the harmonized file based on race/ancestry groupings and on the geographic domains of the sampling frames of each individual survey. Understanding the specific characteristics of each input file was ar essential part of creating a harmonized output file . All of this information was provided to users in a compreh explanation of the original and harmonized weights.

3.5 distinguish between three strategies for harmonizing weights ex post: (1) recalculating weights using exter sources of information; (2) harmonizing the data instead of the weights; and (3) including weight components quality indicator of weights as independent variables in models to account for the original weight components authors analyzed 1721 national surveys in the context of the Survey Data Recycling (SDR) project and conclu only about 60% of the included surveys provided statistical weights. However, even among the surveys inclu weights, information on how the weights were constructed was missing for 25% of the surveys .

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4. Develop criteria for measuring the quality of the harmonization process. This includes testing it with users knowledgeable about the characteristics of the underlying surveys, the meaning of source variables, and the transformation of source variables into target variables. ***Rationale*** Researchers may analyze harmonized files in and unexpected ways. It is crucial to provide them sufficient information about the concepts and definitions presente the assumptions underlying the decisions made in their construction. ***Procedural steps***

4.1 Devise procedures to judge the quality of the harmonized outputs based on such quality criteria as consister completeness, and comparability.

4.1.1 Consistency can be judged by comparing the results from multiple independent efforts of harmonizing variable; completeness is assessed based on the degree to which the original information is preserved in

harmonized data; and comparability is the degree to which the harmonized outputs can accurately report important social or economic concepts over time or between countries or cultures.

4.1.2 The Statistical Office of the European Communities (EUROSTAT) proposed the following set of quali criteria when reporting statistics which also apply to harmonization outputs :

- Relevance of the statistical concepts.
- Accuracy.
- Topicality and timeliness of the dissemination of results.
- Accessibility and clarity of the information.
- Comparability of the statistical data.

4.1.3 Strictly speaking, these traits apply to official statistical data. However, many of them would apply equ academically produced survey data, particularly those regarding the comparability of social, economic, a demographic concepts in a 3MC context and the accuracy of estimates.

4.2 Be prepared to modify and update harmonized datasets after public release based on comments from the res community if errors are uncovered, or if certain variables need further explanation.

4.3 Prepare presentations at social science research conferences that describe the harmonization process to pote users.

Lessons learned

4.1 The usefulness of well-harmonized data is clearly recognized by many international organizations. The Uni Nations Economic and Social Council recognized the importance of harmonizing environmental data collecti activities in order to produce comparable indicators on the environment and its relationship to the economy. T determined to bring the System of Environmental-Economic Accounts (SEEA) to an international statistical s The SEEA now provides the first international standard for environmental-economic accounting (; see here fo information).

4.2 In the context of the Harmonization Project, a comparative project examining the relationship between dem and political protest by harmonizing data from 1721 national surveys contained in 89 waves of 22 internationa projects (see for extensive description), analyzed the edited data for seven target variables, ranging from socio demographic variables like respondent age and years of schooling to substantial variables like trust in various government entities. The authors developed the following classification of processing errors: illegitimate varia values, as defined by codebooks or similar metadata; misleading variable values due to inconsistent or incomp coding schemes; contradictory variable values between different metadata sources; variable value discrepancy between different metadata sources; and variable value labels not defined in any documentation source. In the analysis, found 20% of the source variables in the cross-national surveys under scrutiny to contain at least one five processing errors.

4.3 Also using data from the Harmonization Project (see for extensive description), proposed to use item metad as survey question properties (e.g. response options, use of show cards) or item nonresponse as so-called harmonization controls to study intersurvey reliability and validity of the ex-post harmonization process. Regr harmonization controls on target variables offers insight into levels of intersurvey variability regarding item nonresponse and the meaning of the source questions, their format, and response categories. For example, one regarding scales suggests that ascending scales compared to descending scales have a considerable effect on t variable trust in parliament, while the difference between unipolar and bipolar scales do not seem to have an e

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5. Provide the widest range possible of data and documentation products about the entire harmonization pro
Rationale Regardless of whether utilizing input or output harmonization as a strategy, all aspects of the survey plan collection, and dissemination process should be considered when producing harmonized data files or creating accon documentation. Users should have access not only to the harmonized end result, but also to detailed information abc steps taken by the producers, as well as source materials, in order for them to fully understand what decisions were during the entire process. ***Procedural steps***

5.1 Define the elements of the harmonization process and start documenting it from the beginning in order to e that all decisions are captured even before a definite plan to produce a public-use data file exists.

5.2 To the greatest extent possible, document each target variable with information from all source variables, transformation algorithms, and any deviations from the intended harmonized approach.

5.3 If possible, provide users with access to the original data files used in producing the harmonized file. If dire to original data is not permissible due to confidentiality concerns, implement procedures to assist users in pro check-backs or re-transformations. Also consider implementing some form of restricted-use data agreement t access under controlled conditions.

5.4 Prioritize providing users with the code or syntax used in creating new variables for the harmonized file.

5.5 Provide users with as-complete-as-possible documentation, including crosswalks, which describe all the relationships between variables in individual data files with their counterparts in the harmonized file. An interactive, Web-based documentation tool is often the best way to present such documentation.

5.5.1 Include original questionnaires and information about the data collection process whenever possible.

5.6 Report on as many of the following elements of the data lifecycle as it applies to the particular harmonizati process:

Study Design and Operational Structure:

5.6.1 Project planning.

Sample Design, Questionnaire Design, and Instrument Technical Design:

5.6.2 Sampling frame.

5.6.3 Sample size.

5.6.4 Sample design.

5.6.5 Duration of the field period.

5.6.6 Instrument construction and design.

Adaptation of Survey Instruments and Translation:

5.6.7 Translation and adaptation.

Data Collection:

5.6.8 Mode(s) of interview.

5.6.9 Respondent followup if panel survey.

5.6.10 Data collection methods (See Data Collection: Face-to-Face Surveys, Data Collection: Telephone Sur Data Collection: Self-Administered Surveys, and Survey Quality).

Data Processing and Statistical Adjustment:

5.6.11 Editing.

5.6.12 Item nonresponse.

5.6.13 Unit nonresponse.

5.6.14 Any special treatment given to demographic and country-specific variables.

5.6.15 Sample weights.

5.6.16 Variance estimation.

5.6.17 Data production, including both planned and ad-hoc decisions implemented during variable conversio

5.6.18 Documentation production.

Data Dissemination:

5.6.19 Dissemination.

This list is based on documentation provided in the . The IHIS is an effort to provide an assortment of varia from the core household- and person-level files from the National Center for Health Statistics' seminal data c effort on the health conditions for the U.S. population from 1969 to the present. It provides extensive user not FAQ pages to describe how their harmonization project coped with several of these components.

5.7 Consider archiving the original and harmonized data with a trusted data archive to ensure continued availab all data and documentation files and long-term preservation. See Data Dissemination for additional discussior regarding archiving.

Lessons learned

5.1 The , in operation since 1973, now includes several dozen cross-sectional surveys, all of which have been harmonized into single cross-national files before being made available to researchers. These surveys are rele initially with basic information about each study and the characteristics of all variables, and are then further p by the social science data archives, led by German Social Sciences Infrastructure Services, to include variable frequencies, more complete documentation, and online analysis services for researchers. Such partnerships be data producers and social science data archives encourage long-term preservation, enhance access, and make possible to continually improve services to the research community.

5.2 Some harmonization projects have gone to great lengths to describe their procedures in specific detail. For e the has a User Guide and a comprehensive description of its coding procedures used in creating its harmonize file. Similarly, the Generations and Gender Programme (GGP) of the United Nations Economic Commission Europe Population Activities Unit (UNECE-PAU) provides reports and guidelines about how the organizatior implements its harmonization decisions . These projects provide transparency to both creators and users of the and serve as an example for others to follow.

5.3 As part of the Harmonization Project (see for extensive description), propose a schema for evaluating surve through the accompanying descriptive documentation. Indicators cover the following stages of the survey life

and indicate the presence or absence of a particular type of information: sampling, response rate, questionnair translation, pretesting, and fieldwork control. The authors conclude that long-standing cross-national surveys 1990s have placed higher importance on documentation, which consequently led to increased documentation found higher levels of documentation within European cross-national surveys compared to those in to Latin A the Caucasus, and the Middle East .

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