The Undercount of Young Children

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TABLE OF CONTENTS

LIST OF TABLES AND FIGURES

EXECUTIVE SUMMARY

This report includes a high-level review of the issue of the undercount of children age 0-4 in censuses and surveys. It summarizes possible causes for that undercount and highlights areas that the task force was able to investigate to assess the validity of some of our hypotheses. The primary product is a list of recommended research (pages 17 - 19). This executive summary includes a broad set of observations and suggestions for Census Bureau managers; suggestions that we feel could move us in the right direction in addressing this problem in the future.

1. The undercount of children under age five in the decennial census, and in surveys like the American Community Survey (ACS), is real and growing. The task force believes that Demographic Analysis (DA) provides the best measure of this undercount in the 2010 Census at 4.6 percent, nationally. ***This is not a new problem and has been present in decennial censuses for many decades.*** The differential undercount of this population across geography and demographics makes this a larger problem for some racial and ethnic groups and some parts of the country.

2. Both DA and Census Coverage Measurement (CCM) are valuable tools to measure coverage and managers should use **both** sets of results to understand the areas warranting improvement in future censuses. In 2000, DA found that children age 0-4 had higher levels of undercoverage than most populations with the exception of black males age 20-59, a group historically recognized as having high levels of coverage error. These results should have led to efforts to address coverage of young children in the same spirit as efforts to address coverage of black men.

3. The task force found that many of the managers working on the development of methods and the design of experiments and evaluations in 2010 were largely unaware of this undercount problem and especially the degree to which the problem existed in 2000. This may be due in part to a reliance on CCM to identify coverage concerns. As a result, the methods employed in 2010 did not address the issue in ways that might have been possible and the 2010 research and evaluation program provides no formal or even informal assessments of the likely causes. Staff responsible for designing the 2020 evaluation program should embed appropriate evaluations and experiments specific to the quality of the enumeration of young children. After 2020, we should not find ourselves in the position we are today, with limited knowledge of what happened.

4. Census Bureau managers need to understand and communicate the reality of this problem with staff responsible for data collection operations in both the census and in surveys such as the ACS. Staff working on 2020 planning need to ensure that development work this decade includes a more conscious effort to address this problem. Testing in the next few years should reflect a greater understanding of how to reduce this undercount. Ideally, 2020 managers should establish a planning group with this as their focus and possibly with an external advisory group to support this effort. At the very least, there should be someone in the 2020 Research and Planning Office designated to be the point person for this issue.

5. The task force is convinced that there is no single cause for this undercount, so there will be no single solution. Planners should explore multiple avenues to be confident that we can reduce the undercount of young children in 2020 from the levels found in 2010. Demographic and decennial surveys should be a part of the discussion and work with 2020 to research the problem and develop improved methods.

6. There is a strong relationship between observed differences in population estimates for young children and census counts of young children in the largest and most densely populated areas. Minority children in these areas are most at risk of being undercounted. Additional analysis of these correlates of undercoverage can help us to understand possible sources and solutions.

7. The census requires substitution methods to account for households that enumerators cannot interview. Research suggests that areas with the lowest levels of cooperation have higher levels of coverage and nonresponse error. The growing number of hard-to-count households, as evidenced by increases in household substitutions, can contribute to the risk of miscounting young children. Without a plan to reduce the noninterviews and proxies and collect better data for these hardest-to-enumerate populations, the 2020 Census will include nonresponse error that will add to the undercount of young children. In particular, research that will document, profile, and target the growing number of "complex households" can set a strong foundation for new methods to improve their enumeration.

8. Additional research using existing 2010 datasets, such as DA, population estimates, the planning database, census control and response files, and CCM, holds promise to provide greater insights into causes and possible solutions. Staff involved in 2020 planning should be mining these data to understand this problem. This work must look below the national level to determine if certain areas, populations, or census operations were more likely to have these errors. Our report makes several specific suggestions. It also notes areas unlikely to be a significant cause (e.g., missed housing units).

9. Administrative records matching with 2010 census data and ethnographic research are other valuable tools that we believe could shed light on the characteristics of these missed young children and their households.

10. The task force believes there could be value in directing outreach and promotion for the 2020 Census to agencies working with parents and young children, especially minority children. It is possible that advertising that highlights the importance of all children being included in the census could have a positive impact.

BACKGROUND

There is a well-documented undercount of young children (defined here as ages 4 and under) in decennial censuses (Robinson et al, 1993; O'Hare, 1999; West & Robinson, 1999; Edmonston, 2001; Adlakha et al, 2003; Daponte & Wolfson, 2003; Pitkin & Park, 2005; Zeller, 2006; O'Hare, 2009; Hernandez & Denton, no date). Societies as varied as China, South Africa, Laos, the former Soviet Union, and Canada experience this high net undercount of young children (Anderson & Silver, 1985; Anderson, 2004; Statistics Canada, 2004 and 2010; Goodkind, 2011). This coverage error is not unique to decennial censuses. Evaluations have shown that Census Bureau surveys like the American Community Survey, the Current Population Survey, and the Survey of Income and Program Participation also undercount young children, which can result in biased survey estimates. In addition, these surveys will never fully correct for this undercoverage, given the use of decennial census counts with known undercoverage as inputs to final survey controls.

Federal agencies, state and local governments, and advocacy groups make critical assessments of the well-being of children and distribute funds to support programs for young children based on these surveys' estimates (e.g., The Annie E. Casey Foundation, 2012.) Census undercoverage for this population therefore, has far-reaching implications.

Census Coverage Measurement (CCM) and Demographic Analysis (DA) rely on different approaches to evaluate coverage and each can provide insight into both historical and current issues surrounding our success in counting young children in decennial censuses. Vintage 2010 population estimates are an additional source of information that is useful for evaluating coverage by age, especially for young children.

Population Division bases DA estimates for this population group entirely on estimated births, deaths, and migration, so we expect those estimates to be accurate. Figure 1 shows selected 2000 net undercount rates based on DA by race, sex, and age.

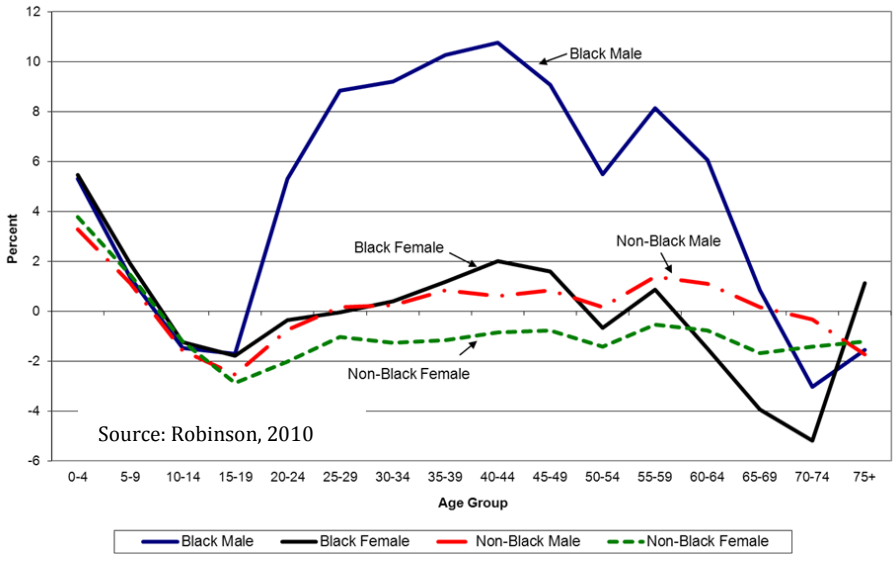


Figure 1. Demographic Analysis Estimates of Percent Net Undercount by Race, Sex, and Age: 2000

This figure clearly demonstrates that young children share some of the highest net undercounts with young black males, a group that has received a lot of attention in coverage measurement and improvement efforts in the past several decades. Despite these high rates of undercoverage for young children, this problem has not received the same attention as the undercount of black males. Decennial censuses have developed special coverage improvement procedures to address the coverage of black males, something needed for young children.

In 2010, DA estimated an undercount of almost 1 million children, ages 0 to 4 (about 4.6 percent). Table 1 summarizes these results by single year of age highlighting that the youngest ages have some of the greatest estimated undercounts among all children.

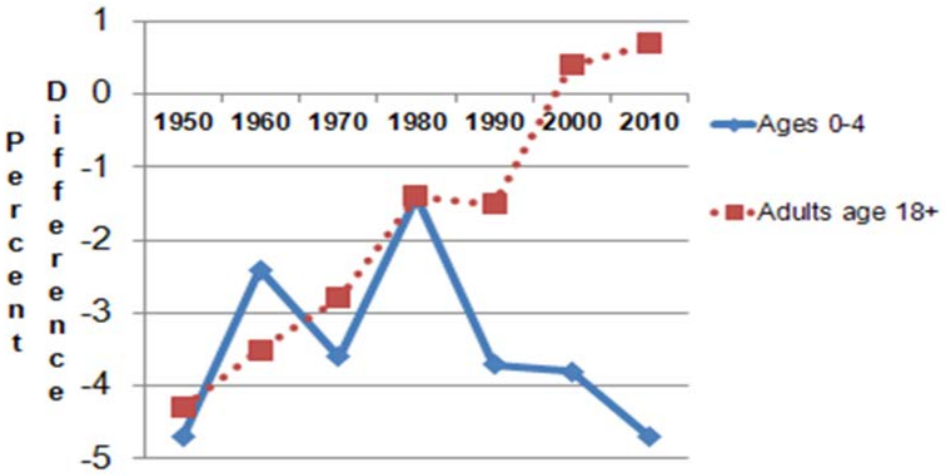
Table 1. Demographic Analysis Estimates for 2010 by Single Year of Age, for Children

Age	2010 Census Population (000s)	Revised Demographic Analysis Estimate (000s)	Net Undercount (000s)	Percent Net Undercount
0	3,944	4,083	139	3.4
1	3,978	4,210	232	5.5
2	4,097	4,338	241	5.6
3	4,119	4,326	207	4.8
4	4,063	4,214	151	3.6
Total 0 to 4	20,201	21,171	970	4.6
5	4,057	4,170	113	2.7
6	4,066	4,190	124	3.0
7	4,031	4,126	95	2.3
8	4,046	4,133	87	2.1
9	4,148	4,185	37	0.9
Total 5 to 9	20,348	20,804	456	2.2
10	4,173	4,206	33	0.8
11	4,114	4,155	41	1.0
12	4,106	4,119	13	0.3
13	4,118	4,112	-6	-0.1
14	4,166	4,142	-24	-0.6
15	4,243	4,170	-73	-1.8
16	4,316	4,246	-70	-1.6
17	4,395	4,322	-73	-1.7
Total 10 to 17	33,631	33,472	-159	-0.5
Total 0 to 17	74,180	75,447	1,267	1.7
U.S. Total	308,746	308,346	-400	-0.1

Source: U.S. Census Bureau, 2012

Notes: Middle Series DA Estimate. A positive estimate denotes a net undercount and a negative estimate denotes a net over count.

O'Hare (2012) shows that the net undercount rate for young children has increased substantially since 1980, while the net undercount rate for adults has decreased to the point that there were net over counts in the 2000 and 2010 U.S. Decennial Censuses (Figure 2). The net undercount rates for young children in the U.S. Decennial Census increased from 1.4 percent in 1980 to 4.6 percent in 2010, while the net undercount rate for the adult population (age 18+) went from an undercount of 1.4 percent in 1980 to an over count of 0.7 percent in 2010. The rapid rise in the undercount rate of young children underscores the importance of examining this population in more detail.



Source: O'Hare, 2012

Figure 2. Comparison of Census and DA Counts for Adults and Young Children: 1950 to 2010

While DA can point to national-level undercoverage, we need to use population estimates to look at lower levels of geography. Here we see the problem become especially concerning. Table 2 summarizes state-level differences between Vintage 2010 population estimates and 2010 Census counts, distinguishing between children 0-4 and children age 5 and older. From this comparison, we see that relatively large differences exist for young children in nearly every state. Pages 12-13 include additional details on state-level differences based on Vintage 2010 population estimates.

Table 2. State Differences between 2010 Decennial Counts and Vintage 2010 Population Estimates by Age Group - State Population Quintiles

	Difference Between Population Estimates and Census Counts (Census-Estimates)			
	Numeric		**Percent Difference**	
	Age 0–4	**Age 5 and older**	**Age 0–4**	**Age 5 and older**
Smallest Quintile	-8,538	143,811	-1.5	1.7
Second Smallest Quintile	-60,414	179,549	-3.6	0.9
Middle Quintile	-88,402	253,790	-3.5	0.7
Second Largest Quintile	-193,210	136,685	-4.0	0.2
Largest Quintile	-705,111	643,089	-6.1	0.4
Total	-1,055,675	1,356,924	-5.0	0.5

Source: O'Hare, 2013.

Dual system estimates from the CCM program also provide coverage estimates for young children. CCM estimated the 2010 net undercount for children aged 0-4 to be about 146,000 (see Table 3). Despite reductions in net coverage error as measured by CCM for some population groups in the 2010 Census, CCM estimates that the undercount of children aged 0-9 grew from an overcount of 0.46 percent in 2000 to an undercount of 0.20 percent in 2010. In 2010, when CCM derived separate estimates for the youngest children, CCM estimated that group to have an undercount of 0.72 percent. CCM staff believes that correlation bias in the CCM could overstate true coverage for young children, suggesting that DA estimates are a better measure of coverage for this population. Pages 11-12 include additional CCM results that the task force reviewed.

Table 3. Dual-System Estimates of Net Coverage for Children: 2010 and 2000 Censuses

Characteristic	Census Count (000s)	Net Undercount (000s)	Standard Error	Percent Net Undercount	Standard Error
2010 Census					
U.S. Total	300,703	-36	429	-0.01	0.14
Aged 0 – 17	73,902	-242	164	-0.33	0.22
0 – 9[a]	40,472	80	119	0.20	0.29
0 – 4	20,158	**146**	81	**0.72**	0.40
5 – 9	20,315	-67	62	-0.33	0.31
10 – 17	33,430	**-322**	96	**-0.97**	0.29
2000 Census					
U.S. Total	273,643	**-1,332**	542	**-0.49**	0.20
Aged 0 – 17	71,905	NA	NA	NA	NA
0 – 9[a]	39,588	-180	130	-0.46	0.33
0 – 4	19,138	NA	NA	NA	NA
5 – 9	20,450	NA	NA	NA	NA
10 – 17	32,318	**-422**	129	**-1.32**	0.41

Source: Davis and Mulligan, 2012 and U.S. Census Bureau, 2000 - Table PCT013.

Notes: A positive estimate denotes a net undercount and a negative estimate denotes a net overcount. Estimates are presented in thousands and are rounded. The 2010 census population count in this table excludes persons in Group Quarters and persons in Remote Alaska.
a. For the 2000 Census Accuracy and Coverage Evaluation Revision II, the "0-9" Age/Sex group was a single group.
NA = not available.
BOLD - Estimate is significantly different from zero at the 90-percent confidence level.

INTRODUCTION

In 2013, staff at the Census Bureau with an interest in the issue of undercoverage of young children assembled as an informal task force to review existing information about the undercount of young children in the decennial census, identify possible causes of this problem, and investigate available information within the Bureau that might allow us to evaluate those causes. Bill O'Hare, a Census Bureau Fellow, also was a member of this group.

This report is the only deliverable from the task force and it includes a list of ideas identified as possible causes, the results of several investigations undertaken by the task force, a set of research recommendations, and a summary. We hope that 2020 planners will consider this set of research recommendations as they define the research agenda leading to the 2020 Census. There was strong agreement within the task force that the Census Bureau has several untapped data sources that would allow us to understand this problem. Mining those data is critical to developing strategies to reduce these coverage errors in the 2020 Census.

POSSIBLE CAUSES

The task force brainstormed possible causes of a net undercount of young children in the 2010 Census. Net undercount is the product of two different forms of coverage error – over counting and under counting. Most of the possible causes that the task force identified involved under counting – explanations for why the census misses young children. It may be useful for additional brainstorming to identify causes of erroneous enumerations such as duplicates that may mask total coverage error. While our primary concern was the 2010 Census, we tried not to focus on unique 2010 issues given that surveys and past censuses also include this undercoverage problem. Appendix B includes the results of brainstorming about causes.

In this section, we organize the possible causes by source of survey error. We used the following five major sources of nonsampling error defined by Biemer & Lyberg (2003) –

- **specification error** – when the concept implied by the survey question and the concept that should be measured in the survey differ;
- **frame error** – error that arises from the construction of the sampling (or in the case of the census, enumeration) frame;
- **nonresponse error** – error introduced when a sampling unit does not respond to any part of the survey, partially completes the survey, or provides incomplete responses to open-ended questions;
- **measurement error** – when respondents deliberately or unintentionally provide incorrect information, interviewers falsify, influence, or misrecord responses, or questionnaires are poorly designed and lead to misunderstood questions; and
- **processing error** – errors that arise during editing, data entry, coding, weighting, or tabulation.

Specification errors would be a source of undercounted children if the choice of methods, such as the rostering instructions, did not match the intended design concept that the census should include the total resident population, including young children. We did not identify any possible causes due to specification errors. While greater clarity in the rostering instructions may reduce error, we account for those under measurement errors.

Frame errors contribute to this undercount when we do not include the place where a child is living on the frame used for data collection. We identified the following potential causes of undercounting young children due to frame errors:

- The Master Address File (MAF) does not fully represent all Group Quarters (GQ) facilities that include young children. The census is more likely to miss small GQs, for example. If young children are living in these small GQs, we may miss them.
- Housing units with young children are not included on the MAF. This might be true for single-unit structures in rural areas or units within multi-unit structures in more urban areas.
- Our "frame" is a list of addresses and does not always correspond to housing units.

Nonresponse errors can cause an undercount of young children when we are unable to collect complete data for an address with a child. Processing errors occur when the methods we use to correct for unit or item nonresponse fail to account for the child (see below). We identified the following possible causes due to nonresponse error:

- Addresses with young children are census noninterviews (due to access problems or lack of cooperation).
- A proxy provides incomplete information about household members and their ages.

Measurement errors contribute to the undercount of young children when we collect data for an address but the methods we used resulted in excluding a child who should have been included. Measurement errors include respondent, interviewer, and questionnaire design errors. We identified the following potential causes of undercount due to measurement error, and summarize them by these three specific sources.

Respondent error:

- The distinction between addresses and living quarters and a respondent's interpretation of these concepts can result in misreporting.
- Unclear or counter-intuitive residence rules result in respondent error in creating an accurate roster that includes all children. Household respondents complete the roster in error due to the complexity of the residence rules for complex and large households that may include young children.
- If census questionnaires with incomplete addresses are misdelivered, the wrong household may receive and complete the questionnaire, leaving uncounted the intended household with a child.
- If a child is living in a household that moves around the time of the census, the respondent may neglect to include them.
- If a child is living with a parent who has joint custody, they may not be included on the roster. (More likely, though, they will have been included on both rosters – a potential source of overcount.)
- Fear of government, political factors, or respondent fatigue may cause a household respondent to intentionally leave a child off the roster (this may include completed mail forms without young children or uncooperative respondents during nonresponse follow-up).
- Large households choose to report only the first six people who will fit on the form and they leave off the youngest children (who they traditionally list last).
- Language or literacy limitations cause the respondent to report in error, leaving young children off the form.
- Respondents misreport complex households (doubled up families, temporary living arrangements) especially subfamilies with young children.
- Household respondents misreport ages of young children due to recall error or due to a misunderstanding of how to answer the age question for children under 1 (e.g., entering 11 for 11 months).

Interviewer error:

- If interviewers conduct follow-up interviews at the wrong address, they may miss the intended household that included a child. Initial misdelivery of census questionnaires can cause this type of error.
- Interviewer falsification contributes to this undercount if the actual household included a child and the interviewer fabricated a case without a child.
- Interviewer misunderstanding of rules of who to include (especially in complex households) and no incentive to probe for additional persons could result in an interviewer erroneously leaving a child, or a subfamily with a child, off the form.
- Reliance on proxies when repeated attempts cannot contact a household member may result in incorrect or incomplete information about young children living in the household.

Questionnaire design error:

- If a child is born before census day, but after the respondent completed the mail form (given the early mailing of forms), we will undercount the newborn child.
- The design of the questionnaire with limitations of space for large households could lead a respondent to truncate a household, leaving the youngest children off.

- We optimize the questionnaire design for traditional families and it may not work well when multiple families live at the same address or when subfamilies with young children are temporary residents.

Processing errors will contribute to the undercoverage of young children when children who are enumerated (mail forms, nonresponse follow-up, coverage follow-up) are lost during capture or processing of census materials. This can also occur if the imputation or substitution methods used in the census fail to account for young children correctly. We identified the following as possible causes due to processing error:

- Children listed on continuation forms that we do not properly link are lost.
- Local Census Office staff mishandles nonresponse follow-up forms resulting in lost questionnaires requiring substitution methods.
- Addresses that cannot be interviewed in the census and require whole household substitution may use substitution methods that undercount young children.
- When the primary selection algorithm detects multiple forms, it may choose the wrong form, leaving a child uncounted.
- Efforts to improve coverage using coverage follow-up identify potentially missed young children but we cannot confirm them due to coverage follow-up limitations.
- If we use administrative records data for young children in GQs, ages may be incorrect.
- Our imputation methods (allocating for missing ages, missing person characteristics) are based on traditional household structures and relationships and do not properly account for young children living in complex households.
- A young child's age or date-of-birth is missing from the record and the imputed age is over four.
- Imputation of age in GQs is limited due to lack of relationship data. If we enumerate young children in GQs without ages, imputation may not account for them.

SELECTED INVESTIGATIONS

This section summarizes some of the investigations that the task force pursued to learn more about available sources of information about possible causes of undercoverage. We did not intend this to be an exhaustive list of potential investigations, only those we were able to explore given our limited available resources.

Age edits, allocations, and substitutions

Staff from the Population Division briefed the task force on the age edits and summarized 2010 allocation rates and imputed age distributions. Population Division also created a detailed spreadsheet with additional information that might shed light on operations with high age allocations and where allocated age distributions for young children are especially high or low. Specifically, the files include counts and distributions of age, age allocation, person number crossed by the field operations code and form type and unedited reported age crossed by person number and field operations code.

The 2010 Census used a two-part age question, which asked, "what is your age and what is your date of birth?" The 2010 Census age edit evaluated the reported information and determined a final age for each enumerated individual. For most of the population, minimal editing, if any, was necessary to determine a final age. When this was not the case, we used hot deck allocation to determine a final age. In the 2010 Census, hot deck allocation accounted for 3.6 percent of final ages. Note the discussion below does not include any of the 1.9 percent of final ages that we assigned when all household members were missing and the data required substitution.

Looking at the 2010 Census age distribution by allocation status (allocated final age/not allocated final age) does not point to a systematic non-assignment of ages 0-4 when allocation was necessary. Table 4 shows that for persons listed on the form as the first six persons (persons 1-6) the age distributions for those with a not allocated age and those with an allocated age show similar patterns, although younger ages are slightly under-allocated relative to the reported distributions. While 6.3 percent of the not allocated ages were 0-4, only 5.0 percent of the allocated ages were 0-4. For both groups most persons were age 18+ and of those below 18, children 5-13 accounted for the largest group followed by ages 0-4 and 14-17.

For persons listed as the 7th person, 8th person, etc. on the form (persons 7 and greater), a slightly different pattern emerged in that about 1.6 times as many persons with an allocated age were age 18+ compared to those with a reported age. For the under 5 population the reported distribution was over 30 percent while less than 10 percent of the allocated ages were 0-4. This, at first glance, seems to imply a possible allocation issue. However, looking at the hot deck allocation matrix for some of these 39,403 persons with an allocated age of 18+ revealed that they primarily came from a matrix that handled persons that were non-relatives and persons that were family other than the householder. The relationships of these persons were roommate, boarder, housemate, aunt/uncle, and grandparents and thus an age 18+ may be reasonable.

These findings showed no evidence that the hot deck systematically allocated ages other than 0-4 thus contributing to an undercount. Further, it was determined that the size of the one group in question, 39,403 persons allocated an age of 18+ with person numbers 7 and greater, was not of the magnitude of the estimated undercount. The task force posed the question of whether finding similar distributions is sufficient to rule out age imputation error. Is it possible, for example, that young children are more likely to have a missing age? Some amount of age imputation error may exist and the task force suggests further research to understand the true age characteristics of the persons with missing ages (perhaps a matching study) and the optimal imputation method and allocation rules.

Table 4. Selected Ages by Person Number and Age Assignment Flag

	Person Number 1-6				Person Number 7 and greater			
	NOT Allocated		Allocated		NOT Allocated		Allocated	
Age	Number (000s)	Percent	Number (000s)	Percent	Number (000s)	Percent	Number (000s)	Percent
0-4	18,167	6.3	537	5.0	1,057	30.3	6	9.6
5-13	34,274	11.9	925	8.7	929	26.6	9	15.9
14-17	16,167	5.6	418	3.9	212	6.1	4	6.9
18+	219,840	76.2	8,800	82.4	1,296	37.1	39	67.6
Total	288,449	100.0	10,681	100.0	3,494	100.0	58	100.0

Source: 2010 Census CUF/CEF, special tabulation by POP

Nonresponse and Proxies

Population Division provided information about imputation rates, noninterviews, proxies, and other nonresponse problems. Table 5 summarizes national-level distributions of records with missing age data, by type of form and type of allocation for the total population and for the population age 0-4. The task force made the following observations:

- The inconsistent and "missing data" rates are not disproportionately high for the young child population (compare first and second rows.). For example, hot deck allocation accounts for 2.7

percent of children under age 5—compared to 3.5 percent for the total population. Records substituted or imputed by edit represent 2.1 percent for children under 5 and 1.9 percent for all records. These 6 million "dummy records" where the demographic data were substituted with essentially no information to work with are perhaps the most suspect records regarding the accuracy of the imputed characteristics. We questioned if the rates should be higher for young children, especially for the substituted by edit ("dummy") records. More detailed classification of the data might be able to shed more light on this issue.

- Two-thirds of all records come from mail return forms (204.6 million) and the inconsistent/missing data rates are relatively low (e.g., overall hot deck allocation of 0.7 percent compared to 3.5 percent for all records). The edit/allocation rates for Coverage Follow-up Interviews (16.1 million, or 5 percent of all records) are also low. The possibility of under allocation of young children may be less suspect in these "higher quality" census forms.

- Enumerators in the nonresponse follow-up (NRFU) operation completed almost 70 million census forms. The overall missing data rates are significantly higher than for mail or coverage follow-up. Hot deck allocation of age accounted for 12.3 percent of all NRFU records—more than three times higher than the rate of 3.5 percent for all records. In terms of numbers of allocations, the records with age hot decked in NRFU account for 79 percent of all hot deck allocations. In geographic areas with lower levels of mail response and higher NRFU workloads, we would expect to see higher rates of imputed ages.

- While the overall hot deck allocation rates are high for NRFU records, the rates are not disproportionately high for young children (e.g., the hot deck allocation is 7.7 percent for children under 5 and 12.3 percent for the overall population). The task force questioned this and suggested that more detailed classification of the data such as the NRFU records classified by person number, race and Hispanic origin, and "hard-to-count" characteristics may explain why this rate appears low.

Table 5. Selected 2010 Age Edits, Allocations, and Substitutions by Form Type

Operation/Form Type	Population	Total	Age/DOB Consistent (%)	Hot Deck Allocation (%)	Imputed or Substituted by Edit (%)
ALL Records	Total	308,745,538	89.2	3.5	1.9
	0-4	20,201,272	89.4	2.7	2.1
Mail Returned Forms	Total	204,599,181	95.7	0.7	NA
	0-4	12,023,046	94.5	0.6	NA
Nonresponse Follow-up Forms	Total	69,602,342	77.7	12.3	NA
	0-4	5,977,733	84.3	7.7	NA
Coverage Follow up Interview	Total	16,104,842	95.4	0.5	NA
	0-4	1,367,102	95.4	0.2	NA
Group Quarters	Total	7,434,076	76.2	6.3	NA
	0-4	35,029	67.3	14.9	NA

Source: Tabulations from the 2010 CUF/CEF by Julie Meyer.
NA – Distribution of substitutions by form type is not available

Census Substitutions and PNUM

Staff from the Population Division and the American Community Survey Office discussed information with the task force about the persons with no person number in the POP tallies by age. The Decennial Systems and Contract Management Office was the primary source of information about these cases. In the

2010 Census, about 6 million person records lacked a person number (no PNUM value). These are "dummy records" created for GQs and households that were either noninterviews or cases with lost data. The census uses a substitution process to determine the number of persons in occupied households without a population count and in households allocated as occupied when the status also could not be determined. Table 6 summarizes some basic information about these persons. We estimate that we substituted about 4.6 million persons into households with a known population size and substituted about 1.2 million persons when we also had to impute the status and/or the household size. From Table 6 we see that the greatest number of persons with no person number were on forms with incomplete enumerations (missing person records). We created close to 5 million of these persons and imputed their ages.

Table 6. Persons Lacking PNUM by Form Type

Form Type/Origin	Count of persons	Percent of Total PNUM Missing
No return received, count determined from OCS pop count or from OCS and status variables (530 and 531)	35,592	0.6
GQ ICR, MCR, SCR included in GQE universe, no return received (532)	19,351	0.3
MAFID count imputed as vacant or occupied and all persons imputed (534)	1,210,954	19.7
Dummy person records created when determined to have incomplete number of person records; e.g., pop count is 3 with 1 person record means 2 dummy records created (537)	4,784,612	77.9
Dummy person records created when reconciling GQPOP (count review adds) (539)	50,682	0.8
Dummy person records created for continuation form linking fix (540)	42,200	0.7
Total PNUM missing	6,143,491	100.0

Source: Preliminary data in email from Dan Philipp, DSCMO
Note: Numbers in parentheses under form type/origin correspond to outcome codes

Published tables for 2010 (Table P44) indicate that 5,770,791 persons (1.9 percent) were substituted in the 2010 head count; in Census 2000 3,441,154 persons required substitution (Table P039) a rate of 1.2 percent (U.S. Census Bureau, 2013). County-level tabulations of population substitutions indicate the variability in substitution rates across the nation. The areas with rates above 5 percent (e.g., Blanco County, TX at 9.9 percent and Rio Arriba, NM at 9.6 percent) may be especially prone to undercounts of young children. Census staff could determine if there is a relationship between areas with high rates of substitutions and areas with suspected undercoverage of young children.

Census Coverage Measurement

Staff from the Decennial Statistical Studies Division briefed the task force on the CCM results and provided answers to many questions about potential uses of CCM data to explore this undercount problem. In 2010, the CCM program used Duel System Estimation (DSE) to produce population estimates and estimates of the net coverage of the household population. The CCM estimates do not cover the GQ population, but this should have little impact on the coverage estimates for young children since so few young children live in GQs. For the 2010 Census, the CCM program estimated a small net undercount (0.72 percent) for children aged 0 to 4. This estimate is noticeably lower than that from DA. A possible explanation for the difference is correlation bias in the DSE. Correlation bias can lead to an underestimate of the true population level if persons missed in the census are more likely to be missed in the CCM survey than persons captured in the census (i.e., the assumption of independence between the census and CCM survey fails).

For 2010, the CCM program also produced estimates of the components of census coverage, shown in Table 7. The estimate of duplication for children 0 to 4 (3.2 percent) and rate of whole-person imputations (2.2 percent) are consistent with those of the total population (3.0 percent and 2.0 percent, respectively). The rate of omissions is 6.6 percent. The task force saw value in understanding the characteristics of these omissions.

Table 7. Components of Census Coverage by Age and Sex Groupings

Age and Sex Group	Census Count (000s)	Correct Enumerations (%)	Erroneous Enumerations (%) Duplication	Other Reasons	Whole-Person Census Imputations (%)	Percent Undercount (%)	Omissions (%)
U.S. Total	300,703	94.7	2.8	0.5	2.0	-0.01	5.3
	(0)	(<0.1)	(<0.1)	(<0.1)	(0)	(0.14)	(0.1)
0 to 4	20,158	94.0	3.2	0.6	2.2	0.72*	6.6
	(0)	(0.2)	(0.2)	(<0.1)	(0)	(0.40)	(0.3)
5 to 9	20,315	94.8	3.0	0.2	2.0	-0.33	4.9
	(0)	(0.1)	(0.1)	(<0.1)	(0)	(0.31)	(0.3)
10 to 17	33,430	94.7	3.2	0.3	1.9	-0.97*	4.4
	(0)	(0.1)	(0.1)	(<0.1)	(0)	(0.29)	(0.3)
18 to 29 Males	23,982	91.8	4.0	1.2	2.9	1.21*	9.3
	(0)	(0.2)	(0.2)	(<0.1)	(0)	(0.45)	(0.4)
18 to 29 Females	23,912	92.2	4.2	0.8	2.8	-0.28	7.6
	(0)	(0.2)	(0.2)	(<0.1)	(0)	(0.36)	(0.3)
30 to 49 Males	40,256	94.9	2.3	0.6	2.2	3.57*	8.5
	(0)	(<0.1)	(<0.1)	(<0.1)	(0)	(0.20)	(0.2)
30 to 49 Females	41,815	95.5	2.1	0.3	2.0	-0.42*	4.1
	(0)	(<0.1)	(<0.1)	(<0.1)	(0)	(0.21)	(0.2)
50+ Males	44,886	95.5	2.5	0.5	1.5	-0.32*	4.2
	(0)	(<0.1)	(<0.1)	(<0.1)	(0)	(0.14)	(0.1)
50+ Females	51,950	95.7	2.5	0.4	1.4	-2.35*	2.0
	(0)	(<0.1)	(<0.1)	(<0.1)	(0)	(0.14)	(0.1)

Standard errors are in parentheses below the estimate.
The 2010 Census count excludes persons in group quarters and persons in Remote Alaska.
(*) denotes a percent net undercount that is significantly different from zero.

Source: Mule, 2012

Due to methodological limitations of DSE, it is difficult to provide estimates of net coverage for characteristics such as whether the census enumerated a household via a mail return or Nonresponse Follow up (NRFU). With these limitations in mind, we could use the CCM data to investigate gross person nonmatches (or gross misses) by variables of interest, such as whether the housing unit matched

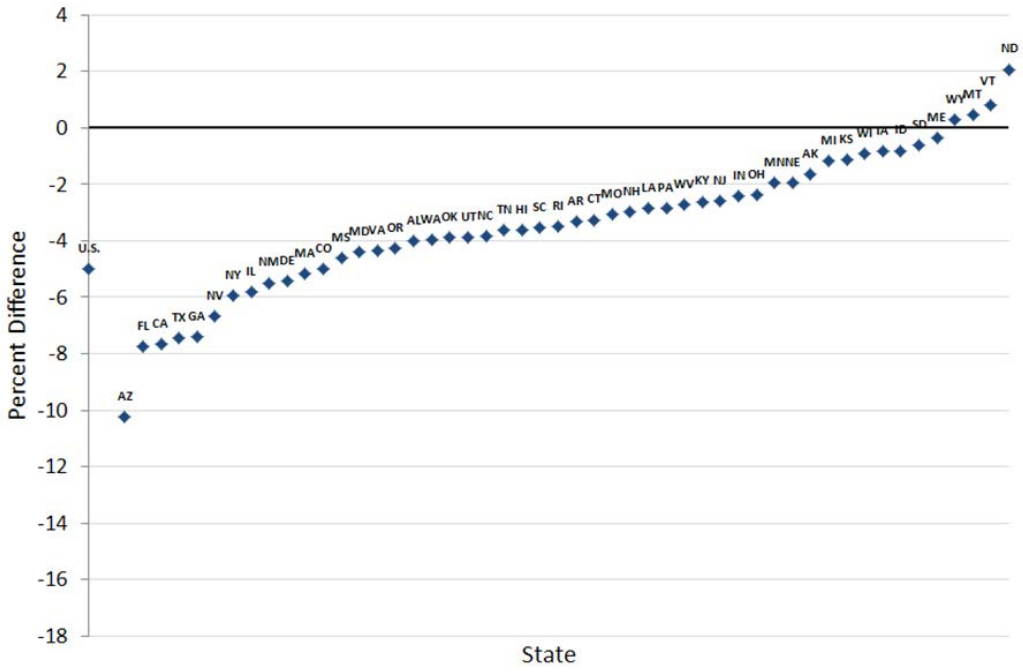
and whether there was a whole household or partial household of person nonmatches. These and other explorations of the CCM data could provide useful information regarding the undercount of young children; however, the Census Bureau has not conducted any such analyses.

The CCM data also contain a sample of movers and shows that young children make up a larger proportion of the mover population than the nonmover population. Given differences in coverage error for movers and nonmovers, this could have an impact on the coverage of young children in the census. We should examine this aspect further.

Vintage 2010 Population Estimates

We can compare Vintage 2010 Population Estimates with 2010 Census Counts for young children at lower geographic levels to study the distribution of undercoverage. These yearly population estimates from the Census Bureau provide estimates of young children that are independent of the previous census using a methodology very similar to that used in DA. As is true with the DA method, the Census Bureau bases the yearly population estimates on a simple demographic accounting equation that uses number of births, deaths, and net migration. A review and analysis of subnational results, supplemented with other geographic characteristics can reveal potential correlates of undercoverage.

Staff from the Population Division shared research using these population estimates to assess differential undercounts of young children across states. Figure 3 sorts the states on the size of the estimated percent net undercount.



Source: Appendix A.

Figure 3. Percent Difference of 2010 Census Counts and 2010 Estimates by State for the Population Ages 0-4

O'Hare (2013) uses these population estimates to examine county-level and state-level differences, noting that the national net undercount rate for the population age 0 to 4 varies substantially across counties.

Appendix A provides state-level undercount estimates for young children indicating that AZ, CA, FL, TX, and GA have some of the highest estimated undercounts of young children (O'Hare, 2013). O'Hare finds that larger counties account for the vast majority of the national net undercount for the population age 0 to 4. This analysis identifies major undercounts of young children in places such as Los Angeles County, CA and Miami-Dade County, FL. The 128 counties with more than a half million total population in 2010 account for more than 90 percent of the national net undercount of the population age 0 to 4.

This type of information serves two important purposes – (1) it can help us to focus our attention on the areas most affected by undercoverage and (2) it can reveal characteristics that can point to causes and potential solutions.

Continuation forms

One concern was that young children enumerated on continuation forms in Nonresponse Follow-up or Update Enumerate fieldwork might have been lost if the continuation forms were not properly completed or linked to the parent questionnaire. A staff member from the Decennial Statistical Studies Division shared research by Jackson (2013) that showed that unlinked continuation forms were included in the final census counts for 717 housing units, enumerating 1,252 people. It is unknown exactly how many unlinked continuation forms were not included in the final census count. It is also unknown how many continuation forms were lost and not data captured, thus requiring imputation of the lost person records. Anecdotal evidence suggests that this may have been an issue in some local census offices.

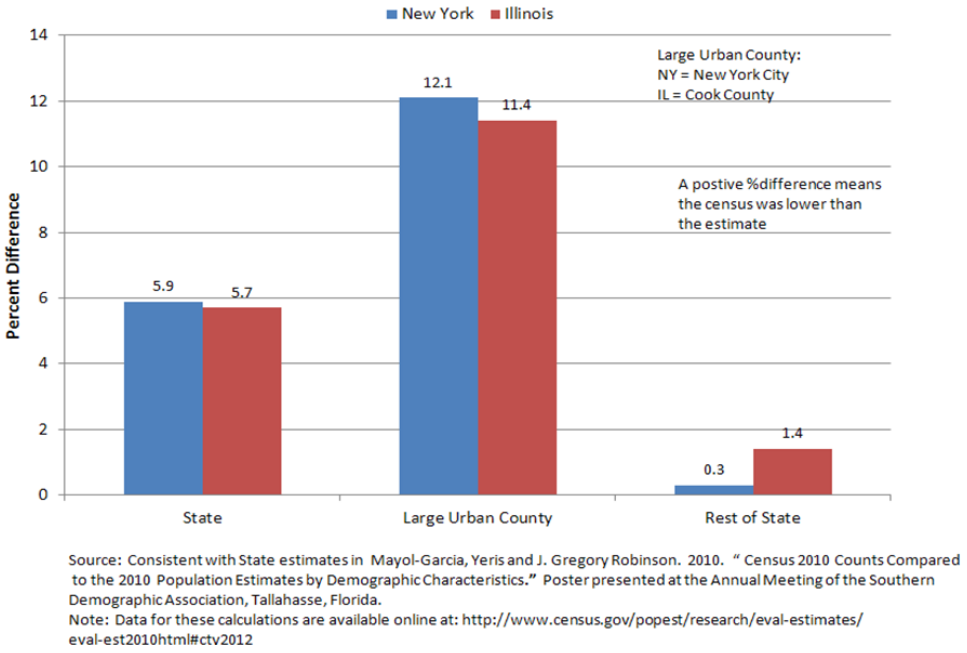
Case Studies

A staff member from the Population Division also summarized some research that reveals strong differentials in the net undercount of young children across geographic areas. One example (see Figure 4) illustrates the striking differences between the 2010 census counts and population estimates in two urban areas (New York City and Cook County, IL) and the rest of each state. He found the overall state average (5.9 for NY, 5.7 percent for IL) masks large within-state variations just like the national averages in Table 1 masks wide variations across states shown in Figure 3 and Appendix A. Previous research demonstrates that these large net undercounts of young children in urban areas like New York City, Cook County (Chicago), Philadelphia, and Wayne County (Detroit) are longstanding over recent censuses (Robinson et al, 1993).

The pattern of the percent differences within each state is highly correlated with the minority concentration in the state, as is the association with the mail return rate. Over two-thirds of children under age 5 in New York City and Cook County are minority, compared to less than one-third in the "rest of state." But perhaps more relevant are the much higher rates of "hard-to-count" attributes in the two urban counties compared to state averages, such as poverty rates, percent of households in renter-occupied units, and percent in "not husband-wife" families. The Planning Database contains these and other "hard-to-count" variables that can aid the investigation of factors affecting coverage of young children (Robinson et al, 2007).

The data for these places would provide useful "case studies" to examine the components of error that may bear on the undercount of young children in the census and surveys. Appendix C presents a prototype of such a case study, using the New York City and rest of New York state data as the example. In addition to documenting the hard-to-count characteristics that may contribute to the differential undercount of young children in New York City, the case study also examines the differences in the

imputation and substitution rates across the geographic areas (related to the discussion on pages 7-10). Robinson noted the possibility that the allocation procedures under-assign ages to young children in a "hard-to-count" area like New York City.



Source: Consistent with State estimates in Mayol-Garcia, Yeris and J. Gregory Robinson. 2010. " Census 2010 Counts Compared to the 2010 Population Estimates by Demographic Characteristics." Poster presented at the Annual Meeting of the Southern Demographic Association, Tallahasse, Florida.
Note: Data for these calculations are available online at: http://www.census.gov/popest/research/eval-estimates/eval-est2010html#ctv2012

Figure 4. Percent Difference between 2010 Census Counts and Vintage 2010 Estimates for Population under Age 5: New York and Illinois

Coverage Follow-up

The task force identified the Coverage Follow-up (CFU) operation as one special effort to improve the coverage of young children in the 2010 Census. A staff member from the Decennial Statistical Studies Division reported that in 2010 the CFU added a total 350,901 persons to the final census count, of which 15.6 percent (54,695) were age 0 to 4. This suggests that the CFU operation is useful in reducing the undercount of young children. The 2010 evaluation also found that we could have added additional young children to the census if more cases had completed CFU interviews. Of the 396,330 cases sent to CFU because they marked the 'children' undercount category, only 164,975 completed a CFU interview (Source: Govern et al, 2012; Table 44, and Tables 13 & 26).

Duplicate Study

One theory regarding the undercount of young children is that the undercount could be due to a lack of duplication of young children. By design, the 2010 Census did not remove the majority of identified person duplicates. A staff member from the Decennial Statistical Studies Division shared results from the Duplicate Person identification operation, an evaluation undertaken in 2010 to understand the characteristics and scale of person duplication reflected in final census data.

The Duplicate Person Identification algorithm found 7,454,171 million duplicates in the census. Table 8 displays age distributions for these duplicates and for the total 308,745,538 person records enumerated in

the final 2010 Census records. Note that this study used the age data reported on the questionnaire without imputation or editing for the duplicates, and the ages for the final census results after edit and imputation, so there are no inconsistent or missing data for that column. There is a large over-representation of persons aged 15 to 24 among the population of duplicates, as compared to the population at large. The population aged 0 to 4 years old does not appear to suffer from a 'lack of duplicates' as much as other age groups, such as persons in their 30s and 40s.

Table 8. Age of Duplicates Compared to Age of All Enumerated Persons – 2010 Census

Age in Years	Duplicates Found in the Census		All Persons Enumerated in the Census	
	Number	Percent	Number	Percent
Under 5 years	447,959	6.0	20,201,362	6.5
5 to 9 years	526,291	7.1	20,348,657	6.6
10 to 14 years	580,662	7.8	20,677,194	6.7
15 to 19 years	853,916	11.5	22,040,343	7.1
20 to 24 years	878,278	11.8	21,585,999	7.0
25 to 29 years	465,653	6.2	21,101,849	6.8
30 to 34 years	353,585	4.7	19,962,099	6.5
35 to 39 years	325,561	4.4	20,179,642	6.5
40 to 44 years	335,884	4.5	20,890,964	6.8
45 to 49 years	383,374	5.1	22,708,591	7.4
50 to 54 years	399,302	5.4	22,298,125	7.2
55 to 59 years	378,233	5.1	19,664,805	6.4
60 to 64 years	354,145	4.8	16,817,924	5.4
65 to 69 years	280,943	3.8	12,435,263	4.0
70 to 74 years	212,999	2.9	9,278,166	3.0
75 to 79 years	170,811	2.3	7,317,795	2.4
80 years and over	323,127	4.3	11,236,760	3.6
Inconsistent	171,474	2.3	NA	NA
Missing	11,974	0.2	NA	NA
Total	**7,454,171**	**100.0**	**308,745,538**	**100.0**

Source: Heimel & King, 2012

Ethnographic Research

A staff member from the Center for Survey Measurement gave the task force an overview of the ethnographic studies she conducted as part of the 2010 Census. This research determined that across all test sites, the 0-4 age cohort had some of the highest proportions of persons with possible coverage error. The research also had reviewed a few case studies to see if they might shed any light on the reasons for these potential errors. Many of the coverage errors appeared to be due to whole household omissions, rather than rostering errors within a household. For more details on this research, see Schwede & Terry (2013).

Complex Households

A staff member from the Center for Survey Measurement shared 1990 and 2000 census data on "complex households." She worked with staff in Population Division to define a set of household types based on the relationship data reported for all persons living within a housing unit. This categorization distinguished between "noncomplex" and "complex" households and identified the following types of complex households:

- Complex family households –
    - Blended families (with spouse)
    - 2-generation ascending
    - 2-generation in-law descending

    - 3-generation: own kin only
    - 3-generation: includes in-laws
    - Skip generation (e.g., householder plus grandchild)
    - Laterally extended (e.g., householder plus sibling)
    - Family household with nonrelatives
- Complex nonfamily households
- Other combinations

This tabulation showed, for example, that "complex" households grew from 18.4 percent to 21.0 percent of all households between 1990 and 2000 (a 2.7 percent increase). She also explained that she was working with Population Division to produce similar distributions based on the 2010 Census. The task force discussed the value of these data and proposed that if she requested this type of tabulation that it would be useful to identify complex households with young children.

Since her briefing to our task force she has received preliminary tabulations of 2010 data by complex household types and race and is beginning to review it. She is expecting a further breakdown of these data by the presence/absence of young children in early 2014.

Qualitative Testing

A staff member from the Center for Survey Measurement had several observations from her cognitive testing of coverage questions on census forms and from the NRFU qualitative evaluations. She felt that this line of research could help to identify causes for undercoverage of young children. She noted that she was aware of instances with multiple families, for example, where the household respondent did not include children in the second family. It may be possible to oversample these types of households for future cognitive testing. She commented that no one had highlighted this issue of undercounted young children as something worth studying so researchers did not optimize previous work to answer these questions.

Staff from the Center for Survey Measurement identified the following general factors that they have seen while conducting qualitative work over the years that could contribute to errors in counting young children – respondent and interviewer behavior, question wording, housing unit nonresponse, imputation, cultural factors, and language factors. They provided the task force with the following list of specific ideas:

- respondents deliberately not mentioning kids for fear of some reprisals or bad outcomes from landlords, immigration agencies, social service agencies, etc.,
- respondents not identifying young kids because the roster question asks for "people" and babies and infants may be considered too young to include,
- nonrelative or proxy respondents who don't know the ages and birthdates of the kids in household (some of these proxy people have also reported feeling that they don't have "permission" to give personal information about other people's minor children),
- greater mobility and difficulty of counting families with kids ages 0-5, but better counting of them when the kids are more tied to a household due to school,
- totally missed households,
- enumerators not reading questions as worded in Nonresponse Follow up and Update Enumerate,
- cultural factors, such as delays in naming babies until they are a certain age to make sure they live,
- cultural patterns of calculating age (e.g., a newborn baby is 1 year old, not 0), and the lunar calendar is used, and
- general distrust of the government – none of the government's business.

Statistics Canada Research

Statistics Canada uses a reverse record check (RRC) to study the characteristics of undercoverage. Preliminary results reported at the 2013 Joint Statistical Meetings indicate that the highest levels of undercoverage for young children were in nonobserved dwellings in Canada. This includes both non-responding and missed dwellings. They also reported that undercoverage of young children was especially high in 2-person families (when the child lived with a single parent). This could include subfamilies missed entirely or young children missed when living in these settings. This type of information is very useful. We recommend greater collaboration with Statistics Canada, as their findings using a RRC may provide insights into reasons for the undercoverage we observe. Two reports from Statistics Canada (Statistics Canada, 2004 and Statistics Canada, 2010) provide additional information about their coverage research.

Reverse Record Check

Currently, the United States is at a disadvantage in understanding the issue of coverage of young children. DA provides accurate numbers but only aggregate net undercounts with quite limited detail on sub-groups. Post-enumeration surveys such as the CCM do not seem to measure the coverage young children accurately. The Canadian RRC combines the best of both. In the 1980s, the Census Bureau experimented with RRC in the Forward Trace Study (Hogan, 1983; Mulry and Dajani, 1989). This study showed that the RRC was unlikely to work for a number of reasons, including the 10-year gap between censuses and the large number of undocumented immigrants. However, there is no reason why the United States could not use a RRC for young children. Indeed, for this group, a RRC reduces to a match of births to the current census. Since the Census captures names and date of birth in the Census, the first stage of matching would be relatively simple and the needed tracing and field follow-up reduced. Further, since the issue is understanding and evaluating, not census adjustment, the sample size need not be large. This is a technique well worth revisiting for understanding the coverage of young children.

Match Study Results

A member of the task force talked with staff in the Center for Administrative Records Research and Applications (CARRA) about the possibility of using administrative records matching work (Census match study, for example) to try to identify the types of households and situations when young children are missed. CARRA staff had some great ideas of how to supplement existing match study results with additional administrative records to target this population. CARRA was enthusiastic about pursuing this form of research, if resources were available.

RESEARCH RECOMMENDATIONS

This list includes research questions that the task force thinks are critical to understanding factors that contributed to the undercount of young children (under age 5) in the 2010 Census. The issue of undercoverage is not unique to either the 2010 Census (compared with other Censuses) nor to censuses alone. Surveys, like the ACS, also undercount young children. Much of the proposed research involves the 2010 Census - examining the 2010 Census results to understand details about the characteristics of the undercounted young children. We also encourage using the ACS to possibly embed research to gather

additional information that may identify possible causes. We propose that decennial staff integrate this research into the 2020 Research and Testing plan as examples of how we are (1) using existing data to learn more about changes that the Census Bureau should make in the 2020 design and (2) leveraging the ACS to develop plans for 2020**.**

Characteristics of Missed Young Children

This set of research questions uses CCM results, DA, population estimates and administrative records to determine where and when the 2010 Census missed young children. Administrative records hold the greatest promise to add to our current knowledge. While the U.S. lacks a RRC like that used in Statistics Canada, we might be able to develop a RRC approach for this population group. We see the following as important questions to answer:

1. Are the undercounted young children missed due to missed housing units (frame errors), whole households (occupied housing units) being missed, misclassified housing units (classified as vacant when it should be occupied) or within household undercoverage (occupied units enumerated with missing individuals)? [administrative records matching]
2. What are the characteristics of these missed households (missed housing units, households with missing children)? Is the census more likely to miss young children when they are part of a non-family household, a household with subfamilies? Are these complex households, large households, single-parent households? Are there certain characteristics that are especially predictive of missed young children? [administrative records matching, modeling]
3. What do CCM estimates tell us about populations like movers, movers with young children, age of householder? Can we use gross miss rates to assess variables or characteristics associated with high levels of missed young children?
4. Which counties have the largest differences between Vintage 2010 Population Estimates and 2010 counts of young children? Do they have anything in common? Is this undercoverage an urban issue, clustered in metropolitan areas, for example?
5. What other cross-tabulations of DA or population estimates compared with 2010 counts shed light on the characteristics of population groups most vulnerable to undercoverage?
6. Were some of the missed young children correctly enumerated but with an incorrect age? [administrative records matching]
7. Were missed young children in households that completed a mail-returned form or on forms completed in NRFU? Are they in housing units that we enumerated by proxy or addresses that we could not interview? [CCM nonmatch analysis, administrative records matching]
8. What do comparisons of Vintage 2010 Population Estimates and ACS tell us about patterns of undercounted young children in the ACS and if these patterns are similar to those seen in the census?

Complex Households and Hard-to-Count Areas

This series of research questions involves tabulations of 2010 (and/or ACS) data to assess the growth of different types of households that include young children. It also includes analysis of hard-to-enumerate populations. Staff tabulated 1990 and 2000 Census data into a set of detailed types of households to study the growing complexity of living arrangements and the challenges that they suggest for data collect. A similar, but even more detailed, summary that incorporated the presence or absence of young children may identify important changes in household structures that warrant enumeration changes.

1. How many households are “complex” and of those, how many include young children?
2. Are young children disproportionately living in the kinds of households that are associated with being hardest to enumerate?

3. Are young children (specifically Black and Hispanic young children) disproportionately living in the kinds of areas that are hard-to-enumerate? Is there a relationship between differences in DA estimates and Census counts of young children and hard-to-enumerate scores?
4. What is the relationship between Census (or ACS) mail response rate and the presence of young children in the household?
5. How do the numbers and distributions compare with previous censuses?
6. Are there growing types of living arrangements that may be associated with coverage error?

Measurement Errors

We should consider these projects if descriptive evaluations suggest potential response errors.

1. If we conclude that people in some complex households tend to leave young children off their forms (within household coverage), we could conduct cognitive testing of persons from complex households or use vignettes to assess reasons for these errors and possible fixes. We could field test alternative wording on Internet and mail instruments.
2. What can we do about the young children identified as potentially missed in CFU but never confirmed, and therefore never added? What can CFU tell us about reasons for these coverage errors?
3. How accurately do enumerators include all children that they should be including?
4. Does the existing age question cause problems for persons with young children, leading them to report in months, rather than years? Content testing an alternative age question that asks for age in months for young children might improve reporting. Research into possible misreporting of age in months may also be possible using CIRA (Census Image Retrieval and Analysis system).

Nonresponse and Processing Errors

These projects would focus on the units that we were unable to enumerate in 2010 (and possibly in the ACS) starting with descriptive statistics about the frequency and distribution of nonresponse. This research would assess the effectiveness of our current imputation methods to address both unit and item nonresponse. Project #6 could use CIRA to review a sample of records.

1. How many addresses did we enumerate in 2010 by proxies or as "noninterviews" requiring substitution?
2. What types of housing units and household compositions are most likely to include people with missing ages?
3. What operations and form types (and other operational variables like proxy) were most likely not to collect full ages and dates-of-birth?
4. What are the real age distributions for the 6.1 million people that required substitution methods? How accurate is our substitution methodology and is it likely that whole household imputations are not accounting for young children?
5. How well do we allocate age for the 10.8 million people that are missing both age and date-of-birth?
6. How accurate are reported ages when the respondent does not provide date-of-birth? Could an entry of 18 really have meant 18 months?
7. Should we consider mode of data collection in designing the hot-decks used for allocation of age? (e.g., allocate ages from other NRFU cases to the NRFU cases missing ages)
8. Should we have allocated a higher proportion of the persons on continuation forms with missing age values as young children?

DISCUSSION

This task force analyzed the undercount of young children from several perspectives. We initially considered the survey lifecycle and opportunities within each stage of the cycle for the methods and procedures to lead to undercounted young children. We also studied this problem from a total survey error perspective – discussing each form of survey error as a possible source. We attempted to address possible causes by examining existing 2010 Census research and evaluation. We found limited summarized data with a focus on young children and no evidence that the 2010 research agenda included any 2010 evaluations designed to address this issue. We suggest the following as a framework for researching the major causes for these coverage errors.

- ***Are most young children found, and potentially missed, in GQs or housing units?*** While undercoverage of young children may exist in GQs, we assume that errors in our enumeration of the population living in housing units drive this undercoverage due to the small numbers of young children living in GQs. *This suggests that we focus on the methods associated with enumeration of the population living in housing units.*

- ***Are missing young children in housing units that are not on our frame or in housing units that we include on our frame but fail to enumerate correctly?*** The CCM estimates very low net housing unit undercoverage (0.6 percent) but the components of housing unit coverage indicate that this net undercoverage comes from 4.3 million omissions and 3.5 million erroneous enumerations. We should use CCM results to determine if young children are more likely to be in missed housing units and older children more likely to be in duplicated housing units. *We generally believe that the data will support a conclusion that this undercoverage is due to the methods we use to enumerate persons in housing units* ***included*** *on our frame.*

- ***Are we missing young children in housing units for which we obtained a response (suggesting response error) or in housing units that we were unable to enumerate (nonresponse error)?*** *Existing research does not point us clearly in one of these two directions.* We recommend that 2020 Census planners pursue research to understand the relative contribution of response and nonresponse errors to this undercount. Statistics Canada found that nonresponse was a major factor in the undercount of their young children. The growth in the numbers of proxy-enumerated households and census noninterviews (substitutions) in 2010 suggests that how we treat nonresponse is critically important. We also believe that tabulations of "complex" households based on 2010 relationship and age data would be very useful in understanding if these types of living arrangements grew since 2000. Attempts to use administrative records or CCM data to assess coverage error by household type could be especially revealing.

CONCLUSIONS AND RECOMMENDATIONS

The undercount of children under age five in the decennial census, and in surveys like the ACS, is real and growing. The methods employed in 2010 did not address this undercount in ways that might have been possible and the 2010 research and evaluation program provides no formal or even informal assessments of the likely causes. This needs to change as we approach 2020. Census Bureau managers need to understand and communicate the reality of this problem with staff responsible for data collection operations in both the census and in surveys such as the ACS.

The task force is convinced that there is no single cause for this undercount, so there will be no single solution. Planners should explore multiple avenues to be confident that we can reduce the undercount of young children in 2020 from the levels found in 2010. Research suggests that minority households in urban areas are most at risk, making targeted coverage improvement methods worth pursuing. The growing number of hard-to-count households contributes to the risk of miscounting young children. Research that will document, profile, and target the growing number of "complex households" can set a strong foundation for new methods to improve their enumeration.

This report identifies five components of error (specification, frame, nonresponse, measurement, processing) that contribute to the net undercount of young children and provides a list of research recommendations. We clearly need research to determine the magnitude and relative size of each error component to determine which ones account for most of the net undercount of young children. It would be very useful to assess if these error components changed over time, contributing to the increase in the measured net undercount of young children and the growing gap between the coverage of young children and adults (Figure 2).

Research using existing 2010 datasets (such as CCM, Population Estimates, the Planning Database, Hard-to-Count Scores, and the 2010 Census control and response files) holds promise to provide greater insights into causes and possible solutions. One way to do this is to study the characteristics of populations where the estimated net undercount of young children varies widely. The substantial differences in coverage of young children across states (Figure 3) and the extreme discrepancy in the estimated net undercount of young children within states (e.g., New York City and the rest of New York State - Figure 4) are good examples and serve as an excellent starting point.

Administrative records matching with 2010 census data is another valuable tool that we believe could shed light on the characteristics of these missed young children and their households.

The task force believes there could be value in directing outreach and promotion for the 2020 Census to agencies working with parents and young children, especially minority children. It is possible that targeted advertising that highlights the importance of all children being included in the census could have a positive impact.

Among the research projects identified in this report, the task force suggests that 2020 give priority to the following:

- Continued analysis of census, DA, Population Estimates and CCM to determine correlates of undercoverage for this population group.
- Case studies to acknowledge the geographic areas and population groups most at risk and to search for additional correlates of undercoverage.
- Consideration of a RRC to improve our understanding of the characteristics of undercounted young children.
- Administrative records matching to determine if we miss these young children in a household or subfamily that we miss or if they are missing from an enumerated household.
- Evaluations and research around the methods used to impute the characteristics of substituted persons and ages for persons enumerated by proxy or with incomplete age data.
- Tabulations and analysis of 2010 and ACS data on "complex households."

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Appendix A

State Census Counts Minus Population Estimates for the Population Age 0 to 4

State	Vintage 2010 Population Estimate	2010 Census Count	Numeric Difference (Census-Estimate)	Percent Difference ((Census-Estimate)/Estimate)*100
ALABAMA	317,716	304,957	-12,759	-4.0
ALASKA	54,888	53,996	-892	-1.6
ARIZONA	507,581	455,715	-51,866	-10.2
ARKANSAS	204,509	197,689	-6,820	-3.3
CALIFORNIA	2,741,458	2,531,333	-210,125	-7.7
COLORADO	362,049	343,960	-18,089	-5.0
CONNECTICUT	208,901	202,106	-6,795	-3.3
DELAWARE	59,098	55,886	-3,212	-5.4
FLORIDA	1,163,423	1,073,506	-89,917	-7.7
GEORGIA	741,568	686,785	-54,783	-7.4
HAWAII	90,687	87,407	-3,280	-3.6
IDAHO	122,759	121,772	-987	-0.8
ILLINOIS	887,157	835,577	-51,580	-5.8
INDIANA	444,854	434,075	-10,779	-2.4
IOWA	203,842	202,123	-1,719	-0.8
KANSAS	207,830	205,492	-2,338	-1.1
KENTUCKY	289,924	282,367	-7,557	-2.6
LOUISIANA	323,481	314,260	-9,221	-2.9
MAINE	69,779	69,520	-259	-0.4
MARYLAND	381,289	364,488	-16,801	-4.4
MASSACHUSETTS	387,055	367,087	-19,968	-5.2
MICHIGAN	603,376	596,286	-7,090	-1.2
MINNESOTA	362,611	355,504	-7,107	-2.0
MISSISSIPPI	221,144	210,956	-10,188	-4.6
MISSOURI	402,489	390,237	-12,252	-3.0
MONTANA	62,143	62,423	280	0.5
NEBRASKA	134,530	131,908	-2,622	-1.9
NEVADA	200,843	187,478	-13,365	-6.7
NEW HAMPSHIRE	71,949	69,806	-2,143	-3.0
NEW JERSEY	555,419	541,020	-14,399	-2.6
NEW MEXICO	153,402	144,981	-8,421	-5.5
NEW YORK	1,228,587	1,155,822	-72,765	-5.9
NORTH CAROLINA	657,178	632,040	-25,138	-3.8
NORTH DAKOTA	43,689	44,595	906	2.1
OHIO	738,494	720,856	-17,638	-2.4
OKLAHOMA	274,800	264,126	-10,674	-3.9
OREGON	248,107	237,556	-10,551	-4.3
PENNSYLVANIA	750,821	729,538	-21,283	-2.8
RHODE ISLAND	59,523	57,448	-2,075	-3.5
SOUTH CAROLINA	313,334	302,297	-11,037	-3.5
SOUTH DAKOTA	59,998	59,621	-377	-0.6
TENNESSEE	423,204	407,813	-15,391	-3.6
TEXAS	2,083,265	1,928,473	-154,792	-7.4
UTAH	274,529	263,924	-10,605	-3.9
VERMONT	31,699	31,952	253	0.8
VIRGINIA	532,874	509,625	-23,249	-4.4
WASHINGTON	457,757	439,657	-18,100	-4.0
WEST VIRGINIA	106,985	104,060	-2,925	-2.7
WISCONSIN	361,741	358,443	-3,298	-0.9
WYOMING	40,085	40,203	118	0.3
US TOTAL	21,263,340	20,201,362	-1,061,978	-5.0

Source: O'Hare, 2013

Appendix B

BRAINSTORMING RESULTS - Possible Causes of "Net Undercount of Young Children"

Frame-related

- GQ omissions
- HU omissions – including detached, single-unit structures (e.g., in rural areas) and missing units within a structure/property (e.g., in multi units)

Data collection-related[1] (Access and delivery)

- Non delivery of forms, incomplete follow-up
- Incorrect delivery of forms/apartment or other mix-ups leading to duplication of one unit and omission of another
- Access problems due to gated communities, other "gate-keepers" resulting in either nonresponse or poor data (e.g., from proxies like resident manager)

Data collection-related (Self response)

- Response and coverage error due to language, literacy, fear of reporting correctly (e.g., if illegally residing, if subfamilies should not be living at address, etc.), other reasons for young children to be left off of the form
- Conceptual errors (misunderstanding of the residence rules, who to include)
- Form completion errors due to complexity of rules, how to handle large households, instructions being unclear, etc. (form design shortcomings)
- Response errors caused by age misreporting on form (e.g., young children reported as being 11 years versus 11 months)
- Inconsistent information provided on household size (count discrepancies)
- Respondent fatigue (stop completing form after first set of members, leaving youngest off the form)

Data collection-related (Enumeration)

- Interviewer errors due to falsification
- Interviewer error due to poor training on how to enumerate complex households, unusual living situations; no incentive to probe for additional persons (young children, subfamilies)
- Response error – respondents providing incomplete or inaccurate data to enumerators
- Response errors – respondent misunderstanding or barriers in communication due to language, literacy
- Continuation forms may lead to misreporting including decision to "truncate" family to fit on form
- Large households required (in 2010) the use of 2 paper questionnaires that had to be linked (see processing)
- Reliance on proxies that may be a poor source of information, especially for young children
- Gaining cooperation, getting respondents to provide complete information
- For GQs, some admin recs may be in error

[1] All data collection causes assume the addresses were on the frame

Forms-related

- Specific concerns about the 2010 enumerator form (last minute redesign, need for manual check-in and other handling that could have introduced error) – see processing
- Poor forms design
- Lack of clarity about who to include
- Language and literacy barriers (non-English speakers doing their best but completing nonetheless in error)
- Mail form limitation in household size
- Design of age question
- Age only being collected on enumerator forms for first 5 people on main form (no extended roster on main form like on the census and ACS mail forms)

Processing-related

- Linking of continuation forms
- Coverage follow-up only contacted by phone (limitation of CovFU)
- Check-in and control errors in LCOs for enumerator forms (lost forms, mismatched continuation forms)
- PSA errors (handling of multiple forms for a given ID)
- GQ age allocation – harder without relationship
- HU age allocation – how we allocate ages for persons with missing values (could imputation understate true characteristics, especially of young children?)

Environment-related

- Language and literacy barriers
- Irregular housing, unusual living situations (joint custody)
- Movers
- Poverty
- Homelessness
- Distrust of government, political environment (e.g., immigration concerns)

Summary of Causes

	Forms/materials	Environment
Frame errors		Housing unit omissions and duplications due to complex housing, hidden units
Response Error	Unclear instructions, complicated forms and rules,	Language and literacy barriers, fear of government, political factors
Delivery error	Reliance on mail	Incomplete addresses, USPS error, gated communities and locked access gates to multiunit buildings
Nonresponse error	Complicated form, age left blank	Lack of cooperation, unit nonresponse leads to use of proxies, missing items such as age; movers make it harder to collect census day information ; language/literacy
Coverage error	Unclear instructions, complicated forms and rules	Lack of trust, hard to gain cooperation, people left off
Interviewer Error	Training shortfalls, poor forms, unclear guidance on handling complex situations	Production pressure can lead to falsification, use of proxies; respondent cooperation can be a problem; language and other barriers contribute
Processing Error	6-person mail form and need for coverage follow-up for large HHs; 5-person enumerator form and need for continuation forms (all must be linked correctly)	Missing age data, missing whole person characteristics due to lack of respondent cooperation, unmatched continuation forms from NRFU

Appendix C

Implementing Recommendations from the Task Force on the Undercount of Young Children: A Case Study

The task force report includes a recommendation for additional case studies to understand patterns of undercoverage that could help identify causes and solutions. This appendix includes the types of questions that we could ask and the types of analyses we could pursue to develop those case studies. One way to do this is to study the characteristics of populations where the estimated net undercount of young children varies widely. This case study would systematically bring existing data to bear on "explaining" significant differentials in the measured net undercount of young children and help advance overall research efforts.

The ideas listed below are initial observations based on available and preliminary tabulations of the 2010 census classified by age and edit, allocation, or substitution status. We should develop more detailed demographic and geographic cross-classifications of the census records. With this information we can begin to understand the impact on the age distributions. It would be ideal if a collaborative interdivisional group (including 2020 planners) worked on this.

1. ***Does New York City contain more "hard-to-count" populations and complex households, and are young children disproportionately affected?***

   We could use the Planning Database, Hard-to-Count Scores, and other census and survey data to study the differences in the characteristics of New York City and the rest of the state. This work would address research recommendations on (1) Characteristics of missed young children and (2) Complex households and Hard-to-Count areas. The documentation of differences between the two areas could shed light on the relative effect of factors contributing to the undercount of young children. We could extend the case study to more areas and use modelling to statistically differentiate the factors.

2. ***Are the imputation rates, noninterviews, proxies, and other nonresponse problems much greater in New York City and perhaps help explain why the estimated net undercount is so much higher in the city compared to the rest of the state? Do the NRFU allocations have an even greater impact on the age data for New York City? What do the results look like for New York City (a "hard-to-count" area) in comparison to the rest of New York State ("easier-to-count" in aggregate)? Do the "dummy" records substituted by edit represent an even greater share of the age data for New York City and could this account for some of the sharp shortfall of the census count relative to the estimates for the rest of New York State?***

   This investigation would address the research recommendation on nonresponse errors. For example, given the hard-to-enumerate characteristics in the city (from item 1), we would expect the substitution and hot deck allocation for New York City to be higher than for the rest of state. What is the difference in the New York City/rest of State proportion of young children being assigned an age, especially for the "hot deck allocation" and "substituted by edit"? Are the results for New York City suspect?