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The Reliability of Children's Survey Responses: The Impact of Cognitive Functioning on Respondent Behavior

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Abstract

Increasingly, children of all ages are becoming respondents in survey interviews. While juveniles are considered to be reliable respondents for many topics and survey settings it is unclear to what extend younger children provide reliable information in a face-to-face interview. In this paper we will report results from a study using video captures of 205 face-to-face interviews with children aged 8 through 14. The interviews have been coded using behavior codes on a question by question level which provides behavior-related indicators regarding the question-answer process. In addition, standard tests of cognitive resources have been conducted. Using visible and audible problems in the respondent behavior, we are able to assess the impact of the children's cognitive resources on respondent behaviors. Results suggest that girls and boys differ fundamentally in the cognitive mechanisms leading to problematic respondent behaviors.

Key Words: Children, behavior coding, Cognitive resources, Respondent behavior, Gender.

1. Background and scope of study

Children and juveniles are increasingly considered as respondents in standardized surveys. While previous studies have demonstrated that juveniles age 14 and over are capable to provide reliable data with respect youth-specific topics, this paper is concerned with the quality of data obtained form children who are below this age. In many studies elementary school children are surveyed themselves. The literature has pointed out that young children below the age of 14 consider standardized questionnaires based on limited cognitive capacities as compared to juveniles and adults (Borgers et al., 2000; Fuchs, 2005). Assuming a negative impact of the limited cognitive skills on the question answer process (Scott, 1997), the quality of data obtained from these children has been questioned. So far, mostly secondary analyses of existing data sets have been conducted in order to assess data quality in surveys with children (Vaillancourt, 1973; Hershey & Hill, 1976; Marsh, 1986; Amato & Ochiltree, 1987; Scott, 1997; Borgers, 2003). Generally, data quality is assumed to be significantly lower among children in comparison with juveniles and adults.

E. g., in a study conducted by Borgers and colleagues (2000), years of education (as a proxy indicator for age and, thus, for the cognitive-developmental stage) influenced the internal consistency in multi-item scales. In addition, poor reading skills also had a negative impact on data quality (Borgers et al., 2000). Both findings are in support for the hypothesis that data quality increases with cognitive growth. Consistent with these findings, in a previous study among children and juveniles aged 10 thru 21 the size of response order effects, scale effects, and the effects of the numeric values associated with response options decrease with age (Fuchs, 2004; 2005). In general, in each age group comparison, the response effect reached the highest level among the youngest group – which is assumed to be cognitively least developed. At the same time, question order effects were smallest for the youngest respondents who were more likely to ignore contextual information when decoding the question meaning compared to older respondents.

By contrast, with ambiguous response scales, younger children produced less item non-response compared to older children, which seem to indicate better data quality (Borgers & Hox, 2001). However, this contra-intuitive effect is

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likely to be related to the children's cognitive-developmental stage. It is assumed that younger children do not recognize the ambiguity of the response scale, which leads to more, however less reliable, responses.

Findings from the analysis of item non-response in several self-administered surveys among children and juveniles from age 10 on exhibit no differences of item non-response across age groups (Fuchs, 2003): Children of all ages show similar low item non-response rates. These findings suggest, that even though the children's limited cognitive resources might restrain their ability to answer survey questions, this very same constraint prevents them to recognize that they should have a problem with a particular question. As a result, those two contradictious consequences of the limited cognitive capacities counter-balance each other. In support of these results, deLeeuw and Otter (1995) found an interaction effect of age and clarity of a question with respect to data quality.

In sum, these findings provide some preliminary support for the assumed impact of the children's cognitive functioning on the quality of the question answer process. In our view, two effects are to be noticed: On the one hand, children have limited cognitive skills at their disposal. Thus, they develop a less extended question understanding and have problems retrieving the relevant information which in turn yields more problems when answering survey questions. On the other hand, those limited cognitive skill prevent children from recognizing that they do not fully understand a survey question which leads to more—however less reliable—responses.

These findings suggest a more detailed analysis of the social and cognitive processes that lead to a survey response provided by a child. So far, we were looking solely at indicators available in the final data set, which do not necessarily reflect any problems occurring in the interview situation. Accordingly, we are overestimating the quality of the data obtained from young respondents, which motivates the research reported in this paper.

2. Research question and hypothesis

Usually, methodological research regarding child respondents is a by-product of substantive studies on child-related topics. As a consequence, the design of the methodological research is limited by design decisions motivated by the scope of the underlying substantive research project. Thus, most studies are forced to focus on standard indicators for data quality and have to neglect the social and cognitive properties of the question-answer process. Some authors investigate item non-response (Borgers & Hox, 2001; deLeeuw & Otter, 1995; Fuchs, 2003), others made use of response stability (Vaillancourt, 1973) or deliberately generated response errors (Fuchs, 2004; 2005). However, these measures are in a way distant to the underlying response behavior. Thus, in many cases the social, communicative and cognitive processes leading to a survey response remain unobserved.

In our view, it would be desirable to observe the children's response behavior directly in the interview situation, which would allow a more detailed coding of their conduct. Accordingly, in this study we will make use of video recordings of interviewer administered face-to-face interviews with children. Using the video recordings we will be able to assess interviewer and respondent behaviors leading to a certain survey response in greater detail. Even though, this does not allow us to observe the question answer process directly, the data at hand provides us with a more detailed description of the behaviors that lead to a response collected from a child.

In the literature, the children's cognitive abilities are mainly assessed using age, years of schooling or educational achievement as proxy indicators. More detailed measures are usually not available. Under these circumstances lack of cognitive functioning in a more general understanding is held responsible for the increase of measurement error among children and young juveniles. This lack of data limits not only any detailed analysis, at the same time theoretical reasoning is restricted. A comprehensive understanding of the underlying social and cognitive processes leading to a child's survey response is not accessible given the less than optimal assessment of the children's cognitive abilities. In our view, it is essential to disentangle to cognitive capacities available to the respondents. Several components of the concept "cognitive capacity" come into play when a survey question is answered. In this study we will assess three components of cognitive functioning:

(1) In order to develop an appropriate question understanding, respondents need to hold the question text in memory. Thus, our first hypothesis assumes that children with more advanced short term memory capacities will

have less pronounced problems understanding the scope of the question. As a result they are less prone to problems related to question understanding.

(2) Once a question is held in memory respondents are able to decode its meaning. Even though, survey questions are worded using a simple vocabulary, children differ in their ability to determine the literal meaning of a particular questions due to more or less pronounced recognition vocabulary. Thus, children whose recognition vocabulary is less advanced will have more problems when decoding a question.

(3) Finally, once the meaning of a question is decoded respondents need to determine the response to this question which requires a thorough processing of the question content and a memory search. On this reasoning we assume that children with higher degrees of general intelligence are less prone to problems answering a particular question.

3. Methods

In 2007 and 2008 a convenience sample of 225 children and juveniles aged 8 through 14 was recruited from local elementary and secondary schools with an adequate representation in terms of gender, SES and immigrants. Face-to-face interviews were conducted in the children's home. On average the survey took 30 minutes. The questionnaire consisted of 120 items; it covered child and juvenile related topics like school, spare time activities, pocket money, media consumption, and the like. Most of the questions were taken from other youth studies or only slightly modified in order to fit the population; some new questions were developed from scratch. Parents or other primary caregivers were present in the dwelling at the time of the interview, however, preferable they were not attending the interview.

12 professional adult interviewers were recruited from the region (7 female and 5 male). They differed in terms of age and years of interviewer experience. Each interviewer conducted about 19 interviews; the maximum workload was 41 interviews conducted by one interviewer. All interviewers participated in two study related training sessions lasting 5 hours in total.

In addition to the face-to-face interviews, all children underwent extensive cognitive testing in order to assess different dimensions of the children's cognitive abilities: A language-free test of short time memory (Turner 2004), a comprehensive test for crystallized intelligence (CFT 20 test, also language-free) and a vocabulary test assessing the children's knowledge regarding German language (recognition vocabulary, Weiß 1997). The short term memory test was conducted prior to the interview, the intelligence test and the test of recognition vocabulary immediately thereafter. The whole session including the interview and all tests took about 90 minutes on average.

Written permission from the parents was obtained in order to video-tape the interviewer respondent interaction using digital video camcorders. The tapes were converted into mpeg-format and coded using transana coding software (www.transana.org). In order to cover interviewer behaviors and respondent behaviors, a coding scheme consisting of 47 behavior codes was applied (see Oksenberg et al. 1996 and Ongena 2005 for details on behavior coding). 4 coders were trained to review the video taped interviews and to code the visible or audible behaviors of interviewers and respondents on a question by question level. Codes covered not only verbal statements but also several non-verbal behaviors. In contrast to an earlier coding of part of this material (Fuchs, 2007) we coded each single turn or contribution to the interaction by either the interviewer or the respondent. In total, more than 78,000 turns or single behaviors were coded. Also, time stamps for each turn or behavior were collected (also using transana coding software). Reliability was assessed for multiple indicators using 10 percent of the cases which were double-coded. Reliability was determined for the number of turn per questions (reliability = 0.78; $p < 0.001$), for the time per turn or behavior (0.77; $p < 0.001$), for the general category of type of behavior (0.87; $p < 0.001$) and for the specific category of type of behavior (0.72; $p < 0.001$).

The data collected in this methods study is combined into a 3-level data set with the single question as the basic unit of analysis. Those units are clustered into cases (respondents), which by themselves are nested according to the particular interviewers. Because for some of the children we do not have complete data available – either the video

is incomplete or one of the cognitive assessments was not properly conducted – we had to drop a few cases from the analysis. The following results are based on 205 complete cases.

4. Results

Using the behavior coding data we were able to describe the prevalence of various problematic respondent behaviors. Table 4-1 provides an overview of behaviors that are either implicitly or explicitly problematic since they potentially cause poor data quality (see Fuchs, 2007 for an analysis into the correlation of problematic behaviors and the validity of the response). On average, in about 9 percent of all questions children provided inadequate answers. Often these inadequate answers are resolved later by interviewers probing, however, this proportion indicates that children have considerable problems answering standardized survey questions even if the questionnaire consists of questions deliberately designed for this young population. Facial uncertainty or unsureness in the voice occurred less often (1%). Also, the proportion of responses provided before the interviewer had administered the question completely is rather small (2%). Explicit refusals occured almost never. In total, 12 percent of all questions administered were prone to one (or multiple) of these implicit respondent problems. These behaviors are called implicit problems since the respondent does not openly and explicitly express the cause for his or her problem.

In addition, respondents also explicitly express their problems with particular questions. In 3 percent of the questions administered the young respondents explicitly asked of an explanation regarding the content of the question. Instances where respondents asked for a repetition of the question occurred less often (1%). Finally, explicit "don't know" responses are provided on 2 percent of the occasions. In total, about 6 percent of the questions administered are prone to one or multiple explicit problems. Taking implicit and explicit problem behaviors together 16 percent of all questions were accompanied by respondent behaviors indicating problematic deviations from the optimal question-answer process.

Table 4-1
Implicit and explicit respondent problems by age of respondents

	8 and 9 years	10 and 11 years	12 thru 14 years	Total
R provides inadequate answer (%)	11	9	7	9 ***
R shows uncertainty (%)	1	1	1	1
R provides early response (%)	2	2	3	2 **
R refuses (%)	0	0	0	0
Implicit problems (%)	13	12	10	12 ***
R asks for explanation (%)	4	3	3	3 ***
R asks to repeat question (%)	1	1	0	1 ***
R provides DK (%)	2	3	2	2 ***
Explicit problems (%)	6	6	4	6 ***
Total problems (%)	19	17	13	16 ***
Paradigmatic Q-A-sequences (%)	55	55	63	57 ***

+ $p < 0.10$; ** $p < 0.01$; *** $p < 0.001$.

Several of the problematic respondent behaviors decreased with age. For example, younger respondents age 8 and 9 showed significantly more inadequate answers than older children. In addition, older respondents asked less often for an explanation of the question concept and also less often for a repetition of the question. Even though some exemptions are to be noticed, overall the proportion of implicit and explicit problem behaviors was lowest in the oldest group. As a result of these age-related differences the proportion of paradigmatic question-answer sequences (= question-answer sequences where no deviation from standard procedures occur; Van der Zouwen & Smit, 2004) was considerable higher for the oldest group compared to the two other age groups.

Given the cognitive approach pursued in this paper, we assume that the noticeable age effects documented in Table 4-1 were due to the still developing intellectual resources of our young respondents. Since we administered standardized measures for three dimensions of the cognitive resources we were able to observe this increase in

cognitive functioning for the older children. Table 4-2 summarizes the findings. For all three measures that were standardized but nor normalized by age we observed larger values for older children, indicating better cognitive skills for older children in the respective domains ($p < 0.001$ for all three measures). Among the three measures the correlation of recognition vocabulary and age was most pronounced (pearson corr = 0.62; $p < 0.001$). The correlation of age and working memory capacity as measured by the digit memory test was considerably smaller (0.33; $p < 0.001$) however still noticeable. The correlation of age and the general intelligence score fell in between the values of the two other concepts (0.45; $p < 0.001$).

Table 4-2
Cognitive resources by age of respondents

	Score				
	8 and 9 years	10 and 11 years	12 thru 14 years	Total	Correlation with age
Digit memory test	13	14	16	15 ***	0.33 ***
Vocabulary test	16	19	25	19 ***	0.62 ***
Intelligence test	28	29	33	30 ***	0.45 ***

*** $p < 0.001$.
Note: Correlations were computed based on the exact age not based on the grouped age variable.

Given these results we assume that the effect of age on the occurrence of problematic behaviors should diminish once the cognitive resources are entered as control variables. In order to assess the joint impact of cognitive resources and age we performed regression analyses using the proportion of total problems per respondents as a dependent variable. Since the number of questions affected by any type of implicit or explicit problem resembled a count variable and thus did not meet normal distribution requirements, we performed poisson regression analysis.

Results are presented in Table 4-3. Model 1 indicates the age effect which has been demonstrated in Table 4-1 in greater detail. The older the children were the fewer problems occurred in a survey interview (-0.15; $p < 0.001$). When adding the gender variable (Model 2; 0 = female, 1 = male) the age effect remained unchanged highly significant, however, male students were prone to higher numbers of observed problems (0.21; $p < 0.001$). On these findings one could speculate, that differential developmental paths and typical cognitive setbacks of male children might be responsible for this effect.

In Model 3, we added the working memory capacity, the recognition vocabulary and the general intelligence score (all values standardizes but not normalized with respect to age). To our surprise and opposite to expectation the cognitive resources did not have a strong impact on the occurrence of problems in the interviewer respondent interaction. The working memory capacity did not reach statistical significance (-0.02; not significant), also the general intelligence score is does not meet the 0.05 level (0.04; $p < 0.1$). In addition, the effect was not in the expected direction: a more advanced intelligence increases the number of respondent problems in a survey interview. The only noticeable effect relates to the recognition vocabulary (-0.06; $p < 0.05$). As predicted, children with more advanced language skills showed fewer problems. Interestingly, the age effect decreased slightly when controlling for the cognitive resources, however, it was still clearly visible (-0.11; $p < 0.001$). Thus, the age effect was not only based on the still developing cognitive resources of the children but also on other competencies and individual characteristics, e.g. social and communicative skills. Also, the fact that male respondents produced more problems in a survey interview as compared to female respondents remained visible even when controlling for working memory, recognition vocabulary and general intelligence.

Given the strong gender effect and in light of the surprisingly small effects of the cognitive resources we differentiated the analysis further according to the gender of the respondents. While Model 4 presents regression coefficients for female respondents, the results for male respondents are summarized in Model 5. The two regression models differ strikingly: For female students a considerable age effect was observed (older respondents showed fewer problems; -0.21; $p < 0.001$), for male respondents no such effect occurred (-0.01; not significant). For female respondents advanced levels of working memory capacity (-0.07; $p < 0.05$) and general intelligence (-0.09; $p < 0.05$) led to fewer visible problems in the survey interview situation. Surprisingly, working memory capacity had no effect for male respondents (0.03; not significant) and a more advanced general intelligence seems to increase the number of problems in a survey interview (0.13; $p < 0.001$). An opposite effect was detected for the

recognition vocabulary. This cognitive resource decreased the number of problems in male respondents (-0.21; $p < 0.001$), while the same variable increased the likelihood of a problematic behavior in girls (0.09; $p < 0.05$).

Table 4-3
Poisson regression on the number of problematic behaviors by age, gender, and cognitive resources

	Regression coefficients				
	Model 1	Model 2	Model 3	Model 4	Model 5
Age	-0.15 ***	-0.14 ***	-0.11 ***	-0.21 ***	-0.01
Gender (male)		0.21 ***	0.22 ***		
Memory			-0.02	-0.07 *	0.03
Vocabulary			-0.06 *	0.09 *	-0.21 ***
Intelligence			0.04 +	-0.09 *	0.13 ***

+ $p < 0.1$; * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.
Note: Age and measures of cognitive resources were z-transformed. Measures of cognitive functioning reflect raw measures; they were not normalized according to the age of the respondent.

In sum, the cognitive resources had effects for male and female respondents that ran in opposite directions. While advanced levels of working memory and general intelligence increased the number of problematic behaviors in boys, a good recognition vocabulary clearly reduced the occurrence of problem behavior. For girls, opposite effects for recognition vocabulary and general intelligence were to be noticed. Thus, these contradictious effects counterbalanced each other leading to small to nonexistent effects when analyzing male and female respondents jointly (Model 3).

5. Discussion

So far, we have no compelling explanation for the gender differences reported in this paper. However, it might shade some light on these striking discrepancies to link the various cognitive resources to the stages or phases of the question-answer process (Sudman et al., 1996). Assuming, that the recognition vocabulary predominantly affects the first phase of the question-answer process, it is safe to say that the working memory helps increase question understanding in boys which lead to fewer problems. Thus, we speculate that boys show problematic behavior in the interview situation if they experience difficulty understanding the question wording because of a limited vocabulary. Further we assume that general intelligence affects all stages of the question-answer process however, predominantly the retrieval process. Thus, the positive effect of general intelligence on the number of problems indicates that boys run into problems, once they retrieve more information than necessary for a particular question which they might perceive confusing and contradictious.

By contrast, girls seem to experience more problems when decoding a question based on an advanced recognition vocabulary. This suggests that girls with an advanced recognition vocabulary are running into problems regarding the question meaning when they become aware of alternative meanings of the wording used which might lead to confusing situations. In contrast to boys, who seem to focus on one specific question meaning even if they posses advanced language skills, girls seem to vent alternative question meanings to a greater extend. In the retrieval process, girls seem to make use of their advanced general intelligence since female respondents with more developed intelligence show fewer problems. By contrast, boys show more problematic behavior even if they have a more advanced general intelligence at their disposal.

Beyond the unclear explanation for these differences, the results reported in this paper demonstrate that children show quite a lot of respondent behaviors indicating problems understanding and answering survey questions—even if the survey questions were deliberately developed for this young age group. Two thirds of the problems are implicit by nature, suggesting that children answer survey questions even if they have problems processing them. Only one third of the problem behaviors are explicitly stated by the children ("don't know", request to repeat the question, request for a definition). It should be noted, that children age 8 and 9 show considerable more problematic behaviors (19%) than older respondents; however even for children at age 13 or 14 13 percent of all questions administered are prone to problematic respondent behaviors.

The study reported in this paper is subject to several limitations: Given the small sample size (N = 205 fully coded cases) we are reluctant to generalize our findings—even though we reached statistical significance. In order to proof the effects found in this analysis it would be desirable to replicate the study in a larger survey. Of course, the video recording and coding is labor intensive, however, for a replication we could focus on a few key behavior codes. In a previous analysis of the data from the younger group of children analyzed here we could demonstrate that problematic respondent behaviors negatively affect data quality. We found hints towards a reduced validity of the responses in the presence of problematic respondent behavior (Fuchs, 2007). However, we need to replicate these analyses for the full data including the juvenile respondents.

Due to cost constraints, we have restricted the assessment of cognitive resources to three domains that have been identified as critical in previous analyses on data quality (O'Rouke et al., 1999): recognition vocabulary, working memory and general intelligence. However, the results presented in this paper indicate that the effect of age on the occurrence of problematic respondent behavior is not fully explained by these three domains. Other facets might also come into play and should be considered in the future. The fact that girls and boys differ considerably not only in the size of the effects of cognitive resources but also in the direction asks for further analyses in the social and communicative skills of young respondents.

So far, our analysis was focused on cognitive properties of the respondents and their impact on respondent behavior and data quality. However, other factors might also contribute to the problematic behaviors. Thus, in the future we will explore the effects of interviewer characteristics on the occurrence of problematic respondent behavior and also interaction effects of interviewer characteristics and respondent characteristics. In sum, the analysis reported here suggests that data quality in surveys with children relies on various factors. So far we have just begun to understand the impact of the children's cognitive resources.

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