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*College of Education & Human Sciences
University of Nebraska–Lincoln*

**Age-sensitive instrument design for youth:
A developmental approach**

Ann M. Arthur

Michelle Howell Smith

Andrew S. White

Leslie Hawley

Natalie A. Koziol

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Technical questions and general correspondence should be directed to at The Nebraska Center for Research on Children, Youth, Families and Schools (CYFS), University of Nebraska-Lincoln,
216 Mabel Lee Hall, Lincoln, NE 68583-0858
cyfs@unl.edu | 402-472-2448

Abstract

Designing instruments for children and youth that result in reliable and valid data requires consideration beyond calculating grade-level equivalence of the text. Very little methodological research has been conducted on the survey response processes of children and youth and there are no comprehensive guidelines informing instrument development for this population. This paper reviews and integrates theories from the fields of cognitive, developmental, and educational psychology, as well as survey methodology, to consider how children's cognitive, language/reading, and social/moral development impacts their progression through the four stages (comprehension, retrieval, judgment, and reporting) of the survey response model. Based on this review, a set of theoretically-based recommendations is proposed for designing or adapting instruments for children and youth that are 9 to 18 years old. These recommendations aim to minimize developmentally-related measurement errors within each stage of the response process.

Introduction

When conducting research on children and youth, the reliability and validity of the data can be questionable. Although proxy respondents (e.g., parents, caregivers, teachers) have traditionally been used for very young children, over time children become more able to answer questions about themselves and provide information that their parents do not know (Scott 1997). Unfortunately, there is little empirical evidence to guide decisions for collecting data from children and youth directly and there are no comprehensive guidelines informing instrument development for a young target population. This leaves researchers in the precarious position of collecting data with instruments that may not be appropriate for children and youth.

Methodological research with children and youth is scarce for several reasons. In many countries across the world, minors are a protected class of research participants. In the United States, research with minors may involve additional scrutiny by institutional review boards, restricted access to participants, and parental consent. When sampling children through child care centers and schools, it may also be necessary to obtain consent from districts, schools, and/or teachers. These factors make research with children more challenging.

Survey respondents are assumed to have basic abilities in three domains: cognition, language/reading, and social/moral systems. Yet, this assumption may not hold with young respondents whose abilities are still developing. Although previous researchers have discussed how cognitive development affects survey research with children and youth (e.g., Borgers, de Leeuw, and Hox 2000), few practical recommendations are available to guide instrument design with young populations. In terms of language and literacy, government surveys for adults are designed to meet a 5th grade reading level (Biemer and Lyberg 2003). Although social and moral skills provide context for responses, no previous research could be found on how lower social skills affect the response process in adults, much less in children or youth.

Several disciplines offer literature and theories that can inform instrument design with children and youth, including cognitive psychology, developmental psychology, educational psychology, and survey methodology. These literatures and theories should be integrated to better understand how underdeveloped skills in youth may result in survey response errors, and how to reduce such errors. To integrate these resources, this paper has four sections. First, the survey response model by Tourangeau, Rips, and Rasinki (2000) is described, which serves as a framework to lend context to further sections of the article. Second, an overview of the development of cognitive, language and reading, and social and moral abilities is provided with detail as to how these skills interact. Next is a discussion of how underdeveloped skills in the three areas should theoretically affect survey responses. Finally, a set of theoretically-based recommendations is proposed for designing or adapting instruments for children and youth that are 9-18 years old to minimize developmentally-related measurement errors. For the purposes of this paper, an instrument refers to a survey, questionnaire, measure, or scale measuring beliefs, attitudes, or behaviors.

The Survey Response Model

The most commonly accepted theory of measurement error is based on the survey response model of Tourangeau and colleagues (2000). This model states that when answering survey questions, people progress through four cognitive stages: comprehension, retrieval, judgment, and reporting. If all goes well, the true answer matches the reported answer. Otherwise, measurement error results.

In the first stage (comprehension), respondents perceive the question and attempt to understand its meaning. Measurement error can occur during this stage if the question contains unfamiliar language or content and respondents proceed with an incomplete understanding of what they are being asked. In the second stage (retrieval), respondents attempt to recall the relevant information. Measurement errors during retrieval occur when respondents are unable to remember or retrieve the wrong information. In the third stage (judgment), the respondent performs additional actions on retrieved information such as judging the adequacy of retrieved information, evaluating its accuracy, integrating it into a summary answer, or performing calculations. Measurement errors occur during judgment if respondents use a strategy to compensate for incorrect or incomplete retrieval, such as guessing, estimating, or relying on schemas and stereotypes. In the final stage (reporting), respondents determine how to report their answers. Measurement errors occur during reporting when an acceptable answer is not provided or the answer is edited to be socially acceptable.

Ideally, respondents complete all four stages carefully and completely, and seek to address problems. For example, respondents might seek clarification, reattempt retrieval, or use outside information to supplement retrieval. Less attentive or motivated respondents will be more accepting of errors or even skip one or more steps, resulting in poorer data quality and response fidelity. As the next section will show, youths' ability to complete these stages is dependent on their level of development in three domains: cognition, language/reading, and social/moral systems.

Developmental Literature

To inform developmentally-appropriate instrument design, this section provides a brief review of relevant literature from three key domains: cognition, language/reading, and social/moral systems. From each area, the key theories are summarized with associated ages or grade spans where possible. Readers are referred to the cited sources for more comprehensive explorations of these models.

Cognitive Development

The stages of cognitive development have implications for collecting data from children and youth because response quality is undoubtedly influenced by the developmental capacity to respond (Borgers, de Leeuw, and Hox 2000). The most widely-known and accepted model of cognitive development is Piaget's stages of development (Feldman 2004; Piaget 1948). Piaget's model of cognitive development consists of four sequential stages (see Figure 1). For the purpose of this paper, the focus is on the two latter stages.

Figure 1. Piaget's (1948) stages of cognitive development

The *concrete operational* stage is most common for children ages 6 to 12 years old. In this stage, children are characterized by their understanding of the surrounding world in dichotomous, "black and white" terms. They begin to analyze things using more "adult-like" logic, although grounded in concrete systems (Piaget 1954). Children in this stage demonstrate the ability to follow logical operations in their mental processes, though they may have difficulties grasping concepts such as justice or fairness (Inhelder and Piaget 1964). The final stage, formal operational, begins between the ages of 12 and 18. In this stage, youth begin to use abstract reasoning to explore hypothetical scenarios that are unrelated to their own personal experiences (Inhelder and Piaget 1958). Youth entering this stage are better able to elaborate on their experiences and connect them to other situations.

Concurrent to this cognitive skill development, children also incrementally improve their own understanding of these skills (Pillow 2008). Working memory capacity—the ability to hold information in one's head while completing a task (e.g., Cowan 2008)—increases with age until it is fully developed around the age of 12 (Demetriou, Mouyi, and Spanoudis 2008). Additionally, as youth proceed through adolescence, they improve considerably in their ability to utilize metacognitive strategies for cognitive self-regulation (Huizinga, Dolan, and van der Molen 2006).

Language and Reading Development

Survey instruments consist of questions or items for respondents to answer by themselves or with the aid of an interviewer. As such, the use of instruments assumes that respondents have minimally sufficient language skills to engage in the question-answer process. Because instruments are largely designed to be completed independently, a certain level of reading proficiency is also assumed. For this, theory on language and reading development are relevant.

Language development theory. Language consists of socially-shared rules for the meaning of words, conjugating new words, combining words into meaningful phrases, and situational appropriateness (American Speech-Language-Hearing Association 2016). Language acquisition is a meaning-making process that progresses throughout the lifespan (Halliday 1993). Children unconsciously interpret patterns throughout their language experiences and develop mental representations that can be applied in novel contexts (Gee 1994). Thus, language development is

a process of generalizing “rules” learned in one context to situations beyond what can be explicitly taught (Gee 1994). This development follows a predictable pattern, moving from a reliance on the literal meaning of words to applying an increasingly complex set of implicit, irregular rules to interpret the true meaning of a statement (Chomsky 1972). Factors known to influence language development include socio-economic status (Hart and Risley 1995) and the amount of reading materials in the home environment (Becher 1984). Vocabulary knowledge, fueled by language exposure, is a significant and constant predictor of overall reading comprehension (Yovanoff et al. 2005).

Nippold (1998) summarized several emerging linguistic concepts that are particularly relevant when developing instruments for youth. Although the ability to order descriptors of magnitude such as “slightly” and “extremely” develops early, finer distinctions such as between “quite” and “decidedly” are not consistent even in adults. The understanding of analogies, metaphors, and similes also develops throughout childhood and adulthood; indeed, not all adults demonstrate mastery. Perceiving the difference between factive verbs (e.g., know, notice) which signal the truth of the clause that follows and non-factive verbs (e.g., think, believe) where the truth of the following clause is uncertain emerges relatively late, making it difficult for school-age children and adolescents to comprehend these differences. Likewise, understanding figurative meanings of idioms, proverbs, and humor begins to emerge in the early teen years with mastery typically reached in adulthood. Appropriately interpreting conjunctions (e.g., “but,” “if,” and “unless”) are problematic for youth even in eighth grade (approximately ages 13-14).

Reading development theory. Reading is a complex, language-based process, with lower-level skills such as decoding, vocabulary, phonetic awareness, and print knowledge preceding higher-level skills such as grammar and reading comprehension (Gough 1996; Share and Stanovich 1995; Whitehurst and Lonigan 1998).

With appropriate scaffolding, children can attend to text that is above their current reading level but within their zone of proximal development (Vygotsky 1987), especially if the content is relevant. A struggling reader may persevere through interesting text at a higher reading level, but abandon less engaging text that is theoretically at his or her level (Shiefele 1999). When the text is too far beyond their comprehension, it will be ignored (Halliday 1993). Although word recognition does not ensure good reading comprehension, it does appear to be a prerequisite for comprehension (Share and Stanovich 1995). Fluent readers have more available resources to concentrate on understanding. Larger vocabularies enable better comprehension and learning, and domain-specific knowledge affords readers even more fluency and vocabulary which further facilitates comprehension (Hirsch 2003).

Although there are several available models describing how people learn to read, one of the more commonly accepted is Chall’s (1983) model of reading development. This theory posits that children progress through five stages as they begin to read: pre-reading (birth to approximately age 6); initial reading and decoding (approximately ages 6-7); confirmation and fluency (approximately ages 7-8); reading for learning (approximately ages 9 through 14); multiple viewpoints (approximately ages 14 through 18); and construction and reconstruction (approximately age 18 and up). Figure 2 provides additional detail about Chall’s (1983) model of reading, along with associated abilities and challenges.

Figure 2. Stages of Reading Development (Chall 1983)

Reading development progresses through a series of continuous and overlapping stages (Chall 1983). Some youth begin to transition to the confirmation and fluency phase as early as first grade (approximately ages 6-7), although the majority of fourth graders (approximately ages 9-10) have not mastered these skills (Treiman, Goswami, and Bruck 1990). As the curriculum shifts from “learning to read” to “reading to learn,” it is not uncommon for previously fluent readers to experience the “fourth grade slump” in their reading skills (Chall 1983). The slump may be due in part to the shift in reading assessments from decoding and fluency to comprehension (Hirsch 2003), but youth typically emerge with reading comprehension skills equivalent to their listening comprehension skills. This pattern holds until about 10th grade (approximately ages 15-16), when reading becomes more efficient for learning new material (Chall 1983).

Social/Moral Development

Collecting data is an inherently social encounter that is influenced by social norms and expectations. Children and youth differ in how they approach surveys and instruments according to their social and moral abilities. Theories about social and moral development are helpful for understanding how youth differ in their perceptions and interactions with others, as well as how they interpret and manage social and moral challenges.

Social/Moral theories. Social reality is believed to consist of three broad domains: psychological, social, and moral (Turiel 1983a, 1983b). The psychological domain represents conceptual knowledge about personhood, such as the idea of a “self” and “others,” as well as psychological characteristics, such as feelings and personality traits. The social domain includes understanding of social rules and conventions and how people tend to act across situations. The moral domain involves justice and similar moral principles to demonstrate understanding of right from wrong. The two models of social development that are relevant to the survey response process are Selman’s (1980) model of perspective taking and Kohlberg’s (1976) model of moral reasoning. Perspective taking and moral reasoning skills develop sequentially, with no skipping of stages or regression once obtaining a particular stage (Walker 1982), and in parallel because gains in one domain support growth in the other (Colby et al. 1983). Figure 3 describes the stages of these two models. For the purpose of this paper, the focus is on the latter stages.

Figure 3. Stages of Perspective-Taking (Selman 1980) and Moral Reasoning (Kohlberg 1976)

Around ages 7 to 12, children become able to reflect on their own thoughts and actions from the viewpoint of another person, while realizing that others have this same ability (Selman Level 2). Children also understand that they may be unable to know others’ true thoughts and feelings, and are better able to recognize the potential for deception. Up until about 10 years of age, they view “morality” as following externally determined rules that do not require justification (Kohlberg Stage 1). Children begin to engage in a “tit for tat” morality where they

recognize the needs and interests of others but only as it relates to their own, and seek fairness in interactions to prevent retaliation (Kohlberg Stage 2). From about ages 10 to 15, youth can “step outside” of the two-person dynamic and consider both perspectives simultaneously (Selman Level 3). This process allows youth to consider not just the perspectives of themselves and others, but also to realize the implications of those perspectives for societal and legal contexts (Selman Level 4). These skills help youth understand how to successfully fill social roles (Kohlberg Stage 3). As adolescents continue to develop into adults, they begin making moral determinations from the perspective of society as a whole, rather than from personal interests. This reasoning seeks to preserve whichever social system is most important to the individual (Kohlberg Stage 4). Morals become the responsibility to preserve the social institutions above the individual (Kohlberg 1976).

Integration of Developmental Stages

Although cognitive, language/reading, and social/moral development occurs at different rates across children, there is considerable overlap across these domains. In particular, cognitive and language abilities are jointly involved with the perception, storage, and retrieval of information (Miller and Lenneberg 1978). Meanwhile, social skills inform comprehension and social norms and expectations that translate to the survey setting. For example, as youth begin to develop greater third-person perspective-taking skills (i.e., Selman’s Level 3), they are simultaneously experiencing a shift toward more sophisticated moral reasoning (Kohlberg’s Level 3). These changes occur during a similar timeframe as youth begin leaving the concrete operational stage of thinking and develop cognitive skills needed to think through problems hypothetically and in abstract terms in formal operations. This is representative of the drastic developmental shift many parents notice in their children around age 12.

In viewing the stages of cognitive, language/reading, and social/moral skills together in Figure 4, it can be seen that at about the age of 12, most youth have entered the final stages of development. Because development in these domains stabilizes and prerequisite abilities are present, this age has important implications for instrument development because it represents an age at which instrument designers can begin to treat youth as adults. At the age of 12, working memory capacity is equivalent to adult levels, vocabulary is at a 5th grade reading level or higher, and youth are familiar with the social norms and perspective-taking skills expected of survey respondents.

Figure 4. Cognitive, Reading, Social, and Moral Developmental Stages

How Development Affects the Survey Response Process

Cognitive, language/reading, and social/moral development provide the necessary foundational skills for children and youth to participate in instrument-based research. Designing instruments that result in reliable and valid data requires consideration beyond calculating grade-level equivalency of the text. To more fully understand measurement errors in children’s and youths’ responses, this section examines how the stages of the survey response model can be affected when cognitive, language/reading, and social/moral skills are not fully formed.

Comprehension

The comprehension of a survey task is a function of cognitive, language/reading, and social/moral abilities. Because youth have underdeveloped cognitive skills, lower levels of language comprehension, and variability in their social and moral abilities (Bell 2007), comprehension is more difficult for youth than adults.

Cognitive skills such as working memory help respondents remember and understand the context of survey questions, such as instructions, conditional information, and additional steps. Problems in the comprehension stage tend to occur because of the language used and how information is presented (Jenkins and Dillman 1997; Wright and Barnard 1975). Levine, Huberman, and Buckner (2002) combined ten questions with the common stem, “When you do mathematics in school, how often do you do the following?” into a matrix. By the time youths reached item 10 (“Use a computer”), they had forgotten the context of “When you do mathematics in school,” and answered about their general computer use. Although increased working memory capacity should enable older youth to better remember contextual information, researchers should promote deeper processing by separating questions and incorporating contextual information into each question stem. Most children under eleven years old are in the Concrete Operations stage (Feldman 2004), and thus see the world in “black and white” terms, are less likely to understand abstract concepts, and have difficulty understanding hypothetical scenarios that are unrelated to any of their own personal experiences. This limits the content of questions, as well as the language that can be used.

Language comprehension is another essential skill for the comprehension stage. As stated earlier, general population government surveys are designed to meet a 5th grade reading level (Biemer and Lyberg 2003). Since 2007, over 60% of children assessed in 4th and 8th grade have not met reading proficiency standards (U.S. Department of Education 2013). For youth, items should be written well below the intended grade level to ensure that youth can understand them. De Leeuw (2011) recommends that the text be written at a grade level that is two years lower than that of the target population.

Defining grade-level writing is difficult. Reading statistics such as the Flesch-Kincaid Grade Level are based on the numbers of words, sentences, and syllables, and cannot account for sophisticated vocabulary or grammar. In the United States, reading proficiency standards differ across states, making it difficult to determine what on grade-level writing should look like. Although not widely adopted, the Common Core State Standards (National Governors Association Center for Best Practices, Council of Chief State School Officers 2010) define language arts and literacy skills for grades K-12, including specific rules for each grade level, to enable comparisons across states. These standards may be useful for instrument development because they define what youth should understand by the end of each grade. Elementary school teachers can also provide expert review of grade-level language and text.

A large amount of text is burdensome for children, but there are several ways to simplify language. One way is to use more basic vocabulary. Younger children have smaller vocabularies and have not mastered advanced language concepts such as metaphors or humor (Nippold 1998). Abstract terms are problematic because they are generally too complicated for children under 12

years old. Although the use of examples can promote comprehension, youth may fixate on the provided examples and not generalize to the broader meaning of the term. Older youth understand abstract terms better. Another common pitfall is the use of survey-specific phrases such as “Very unimportant,” which are common in surveys for adults. This “surveyspeak” is awkward and may not be understood by all respondents (Harkness 2012).

Other language concerns in children and youth are complex lexical and structural syntax and double negatives. Although a common approach to decrease reading difficulty is to shorten sentence length (De Leeuw 2011), this practice has the potential to instead increase the difficulty by removing important syntactical information (Davison and Kantor 1982). Language development markedly improves around age 12, enabling youth to understand more complex syntax. Children will have considerable trouble processing double negatives, which combine negatives in the question stem with negatives in the response options. Negatives can be incorporated into a question with the use of the word “not,” negative terms, negative prefixes, and negative suffixes. To reduce respondent burden, positively worded question stems, devoid of negatives, should be paired with a balanced set of response categories.

Social and moral development influence the understanding of social norms and others’ perspectives. As youth become more socially aware, they may not ask for clarification out of a desire to appear knowledgeable or avoid embarrassment. Because youth may differ in their current world views and moral perspectives, they may interpret questions differently. For instance, children ages 10 and under would likely view a question about drug use in terms of following rules, whereas youth older than 10 might be able to adopt others’ perspectives and view issues from a societal or legal perspective. If respondents interpret a question differently due to their level of perspective-taking, comparability is compromised.

Due to developing cognitive, language/reading, and social/moral structures, questions written for adults can easily confuse youth. Differences in these abilities may affect the validity of inferences. Researchers should employ a variety of measures to ensure that the target population can understand questions, including ensuring close proximity of contextual information, teacher reviews, and pretesting with targeted probes.

Retrieval

The retrieval stage can be especially difficult for younger children and youth due to their underdeveloped cognitive abilities. Measurement errors during the retrieval stage can be reduced by asking about events, attitudes, or behaviors that were encoded and are clearly represented in memory. Food consumption is notoriously difficult to report without a food diary—even for adults—because eating occurs with a high frequency and low rate of encoding. Retrieval tasks need to be simplified to match the target population’s cognitive skills and supported by encouraging appropriate retrieval strategies.

Several strategies that support retrieval come from empirical studies with adults. One way to reduce cognitive load is to encourage the use of a retrieval strategy that matches how something is represented in memory (Conrad, Brown, and Cashman 1998). For instance, if an event can be

assumed to occur frequently and regularly, the events will blur together in a respondent's memory and be difficult to count. Accordingly, researchers should encourage the use of a rate-based estimation strategy rather than an enumeration strategy. Time-related questions may be hard for young respondents due to an incomplete understanding of time. Although an 8-year-old child might be able to tell the time on a clock, he or she may have difficulty estimating the passage of time. Younger children may be more likely to use an estimation strategy during the retrieval stage. On the other hand, if an event is thought to be infrequent and irregular, researchers should promote an enumeration strategy (i.e., counting the actual number of occurrences) because they are more easily represented in memory (Menon 1993). Although short reference periods might help the recall of dates or frequency, instrument designers should test several reference periods to determine how far back respondents can recall with accuracy.

Recall prompts are another method for stimulating retrieval. In asking about the total number of times the respondent left the classroom during a given day, Dirghangi (2014) provided several recall prompts: to use the bathroom, to get a drink of water, to go to the office or nurse, and so on. Although this method has been found to prevent under-reporting with 7- to 8-year-olds, it may also result in double-counting (Belli et al. 2000) or telescoping, which is counting an event that did not occur during the reference period.

Finally, event history calendars (Belli 1998) may help support retrieval. Event history calendars help respondents remember by mapping memory cues such as seasons and salient times (e.g., "it was right before Christmas"). Because this method has been shown to improve the quality of autobiographical memory with adults (Belli 1998), it may be particularly useful for helping youth approximate time (Blair 2003).

Retrieval is one of the most difficult stages of the survey response process, especially for younger children whose cognitive skills are not fully developed. In designing an instrument for youth, researchers can reduce errors during the retrieval stage by simplifying the difficulty of these questions and using one or more strategies to encourage recall, especially when time is involved. Retrieval tasks become easier when respondents' working memory reaches full capacity at approximately twelve years of age (Cole and Loftus 1987; Kail 1990).

Judgment

During the judgment phase, respondents reflect on what is being asked and whether the information retrieved is adequate. This stage makes extensive use of working memory. Because working memory capacity is fully developed around age 12 (Cole and Loftus 1987; Kail 1990), older children will be better able than younger children to remember contextual information and complete multiple-step directions. Mathematical skills such as multiplication and division are needed to compute totals or averages. Measurement errors in younger respondents or those with weaker mathematics skills may be reduced with the use of two-part questions: first recalling information and then conducting secondary operations (e.g., averages).

The ability to use metacognitive strategies such as self-questioning for comprehension can lead to the highest levels of understanding text (Haller, Childs, and Walberg 1988) and successful

reasoning through what has been read (Franks et al. 2013). The ability to engage in these types of metacognitive processes is not developed until a child reaches the formal operations stage at approximately 12 years of age. As youth proceed through adolescence, their ability to use metacognitive and self-regulation strategies improves (Huizinga, Dolan, and van der Molen 2006). Because children and youth may not automatically evaluate their responses, it is possible to encourage these activities during the survey response process. Researchers could give respondents a metacognitive checklist for the survey response process, such as, “Do I understand what the question means?” or “How easy or hard was it for me to remember?” to indicate when they have problems with a question. Because children often use similar checklists in school for tasks such as writing stories (e.g., “Does each sentence begin with a capital letter?”), a similar checklist could be used with children to trigger these evaluative processes.

Responding

The literature linking lower cognitive ability to measurement errors in older adults suggests that similar measurement errors in young respondents is due to incomplete cognitive development. Normal aging is associated with cognitive declines such as slower processing speed, reduced working memory capacity, and lower sensory function (Park 2000). Older adults with lower working memory are more susceptible to question wording, response format, and context effects (Knäuper et al. 2007). Older adults also demonstrate more recency and primacy effects (Knäuper et al. 2004; Schwarz and Knäuper 2000). Lower cognitive skills may explain why younger children fail to recognize problematic aspects of questions, such as vague quantifiers or how to reconcile differences between the “true” answer and the offered response options (Borgers and Hox 2001). Children ages 7 to 10 may also be more susceptible to scale effects, scale numbering, and order effects than older youth (Fuchs 2005).

Some language- and reading-related problems involve the response categories. Children may have difficulties anchoring and evaluating adverbs of magnitude (Nippold 1998), which can impair the validity of response options. Previous research has found that children ages 10 and 11 prefer 5 options on a Likert scale (Rebok et al. 2001), and 6 or 4 options (Borgers, Hox, and Sikkel 2004). If younger children cannot fully differentiate between middle categories, however, it is better to use fewer response options that children can clearly understand.

Researchers disagree on whether to include a “Don’t know” category for children and youth. Scott (1997) advocates for a “Don’t Know” option to be explicitly offered when surveying children to avoid guessing, but Holaday and Turner-Henson (1989) reported that children marked “Don’t know” responses not only to indicate true “Don’t Know” responses, but also lack of comprehension and refusals. Although multiple reasons may render the interpretation of a “Don’t Know” unclear, this category provides respondents with a way to indicate problematic questions. In a similar fashion, unmarked boxes in “mark-all-that-apply” questions also had multiple meanings such as insufficient processing, uncertainty, or refusal (Holaday & Turner-Henson 1989; Levine, Huberman, and Buckner 2002). For this reason, forced-choice question formats are preferred over “check-all-that-apply” because they encourage deeper processing and prevent primacy effects (Smyth, Christian, and Dillman 2008).

Understanding where youth are in terms of social development can help researchers understand youths' responses. The perspective-taking and moral reasoning models suggest that youth under 10 years of age should respect the authority of the test-giver and their ability to determine what rules need to be followed. Younger children believe adults have greater knowledge and power (Backett and Alexander 1991) and so may be anxious to please adults. Socially-desirable responding has been observed in children, both as underreporting of discouraged behaviors and overreporting of acceptable behaviors (c.f., Ogan, Karakuş, and Kursun 2013; Schober et al. 1992; Turner, Lessler, and Devore 1992). When teachers administer the instrument, younger children may try to avoid being “wrong” because they assume that adults know the “correct” response (Bell 2007). Acquiescence bias, or the tendency to agree, may also occur more frequently in children and youth due to their desire to please the interviewer (De Leeuw 2011; Maccoby and Maccoby 1954). Hence, the use of Agree-Disagree scales is strongly discouraged.

Older youth are extremely concerned about privacy, so group administrations with respondents in close proximity may result in significantly fewer reports of sensitive behaviors (Beebe, Harrison, McRae, Anderson, and Rulkerson 1998). Older youth are also more likely to take a more nuanced approach to the morality of not following instructions or engaging in purposeful dishonesty, creating a “jokester group” of responders (Fan et al. 2006). Adolescents are less likely to perceive themselves as “bad” if they can justify their actions. Furthermore, as they develop the ability to recognize and use dual social realities, they may manipulate them to suit their purposes.

Summary

There are many ways in which measurement errors can occur throughout the response process. The integration of the survey response model with developmental theories yields a better understanding of when and how measurement errors manifest in children's and youths' responses. In particular, the findings connecting age-related abilities to measurement errors underscore the need for age-sensitive questionnaire design practices.

Recommendations for Developmentally Appropriate Instrument Design

Based on this review, a set of theoretical recommendations was developed to guide instrument design for children and youth. The recommendations build on existing guidelines for instrument design (e.g., Dillman, Smyth and Christian 2014; Fowler 1995; Schwarz 1996) with the goal of matching youths' ability to complete questions, maintaining motivation, and minimizing developmentally-related errors throughout the response process. Table 1 provides both general recommendations for surveying youth between the ages of 9 and 18 (grades 4-12), and additional recommendations for youth ages 12 and younger, because 12-year-olds may not yet have reached the highest developmental stages. An overall recommendation for data collection with children under 12 is to provide up to twice as much time because younger youth have slower processing speeds and are less efficient readers.

To minimize errors during the comprehension stage, encourage cooperation, and prevent boredom, all content should be relevant to the target population (Fan et al. 2006; Scott 1997).

Because youth may not be familiar with “survey-speak” (Harkness 2012), language and response options should reflect natural conversation. To reduce processing time, write in the form of questions rather than items. Aim for a reading level that is two grade levels below the target population’s grade, with the 5th grade reading level as a maximum. To help maintain the motivation of youth, question length should be limited, and as short and straightforward as possible for youth 12 and under. To encourage deeper processing, questions should not be combined into matrices or grids, especially when the question stem includes important contextual information. Due to the greater overlap in the social/moral stages, a given sample of 12-year-olds may include youth with widely varying perspective-taking abilities. Therefore, questions requiring respondents to consider multiple perspectives simultaneously (e.g., “Some people believe ‘X,’ while others believe ‘Y.’ What do you believe?”) should be limited to youth ages 16 and older. Hypothetical scenarios and vignettes that are unrelated to any personal experiences are also more likely to be difficult for youth under 12 (Inhelder and Piaget 1958). Because children in the concrete operational stage of cognitive development are likely to fixate on examples provided rather than generalize to the full meaning of a term, abstract terms should be avoided for youth aged 12 and under. Because electronic reading level calculations are based on syllable and word length, and not context or vocabulary knowledge, researchers are encouraged to enlist teachers to review language for a specific reading level.

To minimize errors during retrieval, it is best to ask about attitudes, events, or behaviors that are well represented in memory and are easy to recall. Youth respondents may also benefit from strategies to support autobiographical memory, such as memory cues in the question wording (e.g., “about how much” for estimation), or event history calendars (Belli 1998). Shorter reference periods may also be helpful, but should always be pretested with youth.

To minimize errors during judgment and evaluation, there are two recommendations for youth ages 9 to 12. Questions asking for totals or averages require the respondents to retrieve and then conduct mathematical operations (e.g., addition, division), which requires considerable working memory. To reduce cognitive load, these multistep questions can be simplified by breaking them up into separate questions. Because youth under 12 do not automatically use metacognitive and self-regulation strategies to evaluate their responses, a short checklist may encourage these behaviors and help them articulate problems with a question.

Finally, to minimize errors during the reporting phase, there are three recommendations to increase the validity of responses. Because youth, especially children, are likely to agree with adults, Agree/Disagree scales should be avoided to prevent acquiescence bias. Fewer response options may also be beneficial for children ages 9 to 12, who are less able to differentiate between two or more similar options, particularly in the middle of the response scale. To reduce socially-desirability, avoid using people in positions of authority (e.g., parents, teachers) as interviewers, use self-administered modes and reassure youth that parents, peers, and other adults will never see their answers. When surveying older youth simultaneously in a group setting, provide a respectful distance from others.

Researchers seeking to create instruments for youth must be prepared to consider developmental differences in the age range they are seeking to assess. These instrument design recommendations combine theory from several disciplines to inform instrument design practices

for youth ages 9 to 18. The recommendations aim to prevent and reduce measurement errors during the response process by providing guidelines for constructing instruments to match the target population's cognitive, language/reading, and social/moral abilities.

Conclusions

Very little methodological research has been conducted on children and youth. In designing instruments for children and adolescents, researchers have much to learn from educational and developmental psychologists about developmentally-appropriate adaptations. This review considers young respondents' capacities to participate in research and the measurement errors occurring throughout the response process that can be attributed to development.

Prior to this review, previous research examined how cognitive development may affect the survey response process in youth. This review builds on previous work by additionally examining the language/reading and social/moral abilities that are also needed to participate in survey research. Although it was not clear when these skills become sufficient to conduct survey research, this review suggests three major thresholds. Children aged six and younger form one group that have wide-ranging and insufficient abilities, and so research with this age group may be best served via proxies. Children between the ages of seven and 11 form a second group that is heterogeneous with respect to their cognitive, language, social, and moral skills, but are better able to answer questions than younger children. Instrument design pitfalls for this group include complicated vocabulary, syntax, and grammar; estimating the passage of time; computing averages; and advanced perspective-taking. The third group consists of adolescents aged 12 and older, who have most skills needed to complete instruments with minimal errors related to developmental concerns. This group should be able to answer nearly every type of question, although they may lack advanced social skills such as perspective-taking.

Perhaps of most interest to researchers is that age 12 seems to be a transitional threshold at which youth begin to be capable of completing instruments designed for adults. Not only have most 12-year-olds entered the final stages of development, but most can also read at a 5th grade reading level and have the working memory capacity of an adult. Yet, it is important to recognize that 12-year-olds should not be treated as adult respondents in every respect—content must be appropriate and relevant. Because not all 12-year-olds may not have reached the highest stages, the recommendations provided here group 12-year-olds with youth aged 9 to 11.

It is hoped that these theoretical recommendations will inspire additional research. The thresholds described above are theoretically-based, so research is needed to empirically test them. For instance, much remains to be learned about how different levels of these skills affect responses to certain question types. Research in these areas is necessary to improve measurement with children and youth.

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Table 1.
Instrument Design Recommendations for Children and Youth

Response Stage	General Recommendations for Youth	Recommendations for Ages 12 and Under
Overall		Provide plenty of time; do not rush respondents
Comprehension	<ul style="list-style-type: none"> - Ensure that content is relevant to youth - Use a conversational tone - Write questions (not items) - Limit question length and complexity - Reading level should be two grades below target (maximum 5th grade level) - Do not combine questions into matrices - Limit questions about multiple perspectives 	<ul style="list-style-type: none"> - Questions should be as short and simple as possible - Hypothetical scenarios must be relatable - Avoid abstract terms
Retrieval	<ul style="list-style-type: none"> - Ask about things that were encoded and are clearly represented in memory - Encourage strategies to support memory - Pretest reference periods 	
Judgement		<ul style="list-style-type: none"> - Simplify multi-step questions - Consider providing a megacognitive checklist
Reporting	<ul style="list-style-type: none"> - Avoid agreement scales - Emphasize privacy and confidentiality - Provide a respectful distance from others 	<ul style="list-style-type: none"> - Use two to four response categories

Note. General recommendations are for youth ages 9 - 18. 12-year-olds are grouped with youth ages 9 to 11 because they may not yet have progressed to higher developmental stages.