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Who Theorizes Age?
The "Socio-Demographic Variables" Device and Age-Period-Cohort Analysis in the Rhetoric of Survey Research

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Abstract: In this paper we argue that quantitative survey-based social research essentializes age, through specific rhetorical tools. We outline the device of 'socio-demographic variables' and we discuss its argumentative functions, looking at scientific survey-based analyses of adult scientific literacy, in the Public Understanding of Science research field. 'Socio-demographics' are virtually omnipresent in survey literature: they are, as a rule, used and discussed as bundles of independent variables, requiring little, if any, theoretical and measurement attention. 'Socio-demographics' are rhetorically effective through their common-sense richness of meaning and inferential power. We identify their main argumentation functions as 'structure building', 'pacification', and 'purification'. Socio-demographics are used to uphold causal vocabularies, supporting the transmutation of the descriptive statistical jargon of 'effects' and 'explained variance' into 'explanatory factors'. Age can also be studied statistically as a main variable of interest, through the Age-Period-Cohort (APC) disambiguation technique. While this approach has generated interesting findings, it did not mitigate the reductionism that appears when treating age as a socio-demographic variable. By working with age as a 'socio-demographic variable', quantitative researchers convert it (inadvertently) into a quasi-biological feature, symmetrical, as regards analytical treatment, with pathogens in epidemiological research.

Key words: Age, Aging, Rhetoric of Inquiry, Socio-Demographic Variables, Survey, Public Understanding of Science

1   Introduction

We chose the title of this article in dialogue with Gubrium and Wallace's "Who theorises age?" (1990). We argue that researchers in quantitative survey-based social research are involved in an implicit theorizing work regarding age. By relying on common-reason knowledge of age, they crystallize it into a vocabulary of 'age as internal causal factor'[1], useful as a rhetorical tool in survey argumentation, largely disregarding current conceptualizations of age in social theory. *Widespread practices of working with age as a 'socio-demographic' variable* not only restrict theoretical options for asking questions and making sense of data, but also accomplish a theorizing work on their own – similar with the theorizing power of 'variables' discussed in Danziger and Dzinas (1997) and Firestone (1987).

In what follows we set out to clarify this theorizing work and to discuss its significance. Our research setting consists of the survey-based literature investigating adult scientific literacy, in the so-called "Public Understanding of Science" (PUS) field. While all our empirical evidence comes from PUS articles, we propose, based on our experience of reading, doing and discussing survey-based

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[1] We use double quotes to point to *ad litteram* citations, and single quotes to highlight relevant formulations.

research on PUS and also on ethnic identity (anonymized references), that the theorizing work of socio-demographic variables is shared across fields of quantitative research that are not directly focused on age, life course, gerontology, or other age-related topics. Thus, in our investigation, we pursue *two levels of analysis*: (1) we reconstruct the rhetoric of social survey analysis in general and, within it, (2) we outline the role of a more specific 'socio-demographic variable' device, that includes age.

We discuss *survey research as a genre of scientific literature* that relies on distinctive rhetorical devices as tools for reasoning with academic and policy-minded publics. We start from the theoretical assumption that *rhetoric is constitutive of argumentation* in daily and professional settings (Billig 1989), including scholarly inquiry (Nelson, Megill, & McCloskey 1987; Billig 1987). Still, for all theoretical and cautionary statements to the effect that rhetoric *constitutes*, rather than *invalidates* argumentation, it is easier to outline specific devices in a discourse that we observe from a critical distance. A rhetorical apparatus is often rendered visible against a background of frustrated expectations, or in comparison with other rhetorical practices. In this paper our (frustrated) expectations are grounded in an *interactional and constructionist theory of age,* as outlined in the next section.

Our research contributes to several lines of inquiry. By choice of empirical setting, our paper is part of the methodological literature in the PUS field. Our analysis also stands as a discussion concerning the use of age and other concepts as 'socio-demographic variables' in quantitative social research. Through our attempt to highlight rhetorical devices in survey research work, we engage the literature on *rhetoric of inquiry in quantitative social research*. There is an inspiring related tradition in psychology, tracing the constitution of psychological constructs through experimental work, such as Danziger (1990) or Lopes (1991). We aim to contribute to the thread of sociological reflection about the theoretical import of quantification in sociology, following the work of Blumer (1956; 1966), Cicourel (1964), Smith (1974) and Abbott (1997). Abbott (1997) argues that positivist research relies on ambiguity that "disappears into the cracks between studies" (p. 387); we continue his inquiry, as well as Jasper and Young's critical analysis of the "rhetoric of sociological facts" (2007) by pointing out *three other types of ambiguity* that are instrumental for the internal chains of argumentation in positivist articles: (1) the use of quasi-dispositions, (2) the use of constant variable names to point to meanings that change through multivariate analysis, and (3) the use of a quasi-causal vocabulary.

The paper is structured as follows: in section 2 we briefly outline an interactional and constructionist understanding of age, which informs our analysis. In section 3 we discuss PUS research that focuses on age and disambiguates it into cohort and aging, and we observe that this conceptualization remains marginal in the field. In section 4 we analyze how age is used and implicitly theorized as a socio-demographical variable. We outline survey research as a set of games of inquiry, and we examine the device of 'socio-demographic variables' and its rhetorical functions. In section 5 we discuss the systemic disattention to aging in discussions of public understanding of science, even where age is the topic of analysis. This disattention maintains a stereotypical view of 'aging as forgetting', despite evidence to the contrary. Section 5 discusses the possibility of avoiding these traps, and section 6 concludes the paper.

2   Age as social classification in use

Our starting point in an interactional and constructionist understanding of age (Holstein & Gubrium 2000; Gubrium & Holstein 1999) is that *age is a set of classifications* that people (re)define in interaction as they go ahead with their daily lives in various ordinary and institutional contexts. These classifications make reference to generational differences and family relations, to life stages, and to bodily transformations through time, among others. In any given situation, membership in an age category is an achievement (Laz 1998): people affiliate and disaffiliate with age categories, impute or deny them to others, create new categories, monitor and enforce age-related moral orders.

In modern societies, age is strongly related to a number – that is, the number of years that have passed since one's year of birth. This number becomes known to virtually all individuals, is recorded in various media, and is a resource for social organization in fields as diverse as education, health care, romance, sexual relationships, trade, sports, and many others.

The social relevance of age largely derives from its widespread use in social coordination: bringing together people through synchronization or separating them through lack thereof; regulating interaction between people of different or similar ages; affording interpretations of people's actions, and supporting attributions of personal (in)competence. As Baars (2010) notices, the widespread reliance on chronological age for social organization creates 'age effects' as self-fulfilling prophecies: if we organize an action based on the idea that age is consequential, age becomes consequential. When used to explain social events, 'age' is a *pointer* towards forms of social organization that make use of it and that have played a part in the respective events. Any understanding of the 'influence of age' over a certain outcome requires an understanding of the role of age in the social organization of that outcome. Although age is used to describe individuals, its influence does not come from within the individual; at any point in life, the import of age derives from how our life is socially organized in relation to it.

Against this theoretical understanding, we set out to examine the use of age in survey research in Public Underdstanding of Science (PUS) survey research. We notice that even when age is a central variable in analysis, there is substantial disattention to understanding the social process of aging, relying instead on the common-sense framing of aging as decay and forgetfulness. Disattention occurs even more when age is used as a socio-demographic variable. Starting from the case study of PUS survey research, we argue that survey research in general is an arena in which researchers essentialize age as a quasi-biological individual attribute, by working with it in conjunction with the rhetorical device of "socio-demographic variables".

Figure 1. Two uses of age in survey research
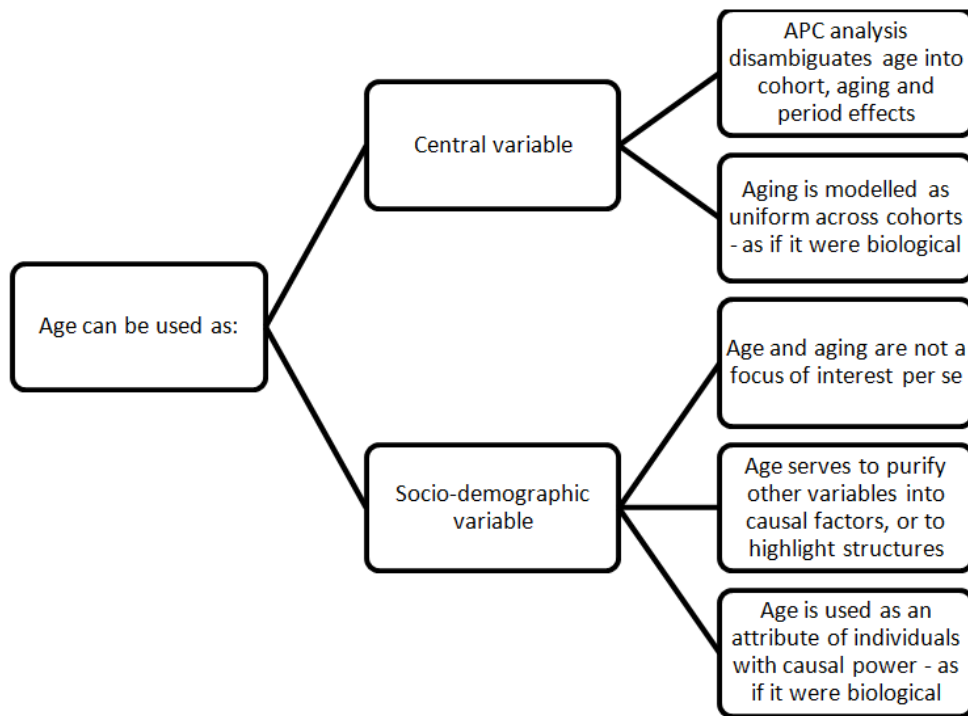
3   Aging as "memory decay": Working with age as a central variable in PUS research

In the PUS field of survey research, age is, more often than not, a socio-demographic variable, included in statistical models in order to assist the study of something else. Still, there are several articles that bring it to the fore. We examine three of them: Miller's paper on "Civic Scientific Literacy across the Life Cycle" (Miller 2007), Losh's analysis on "Generational and Educational Effects on Basic U.S. Adult Civic Science Literacy" (Losh 2006), and Shimizu's paper on "An Empirical Cohort Analysis of the Relationship between National Science Curriculum and Public Understanding of Science and Technology: A Case Study of Japan" (Shimizu 2009). The main theoretical refinement in the treatment of age as a central variable, as opposed to a socio-demographic control, consists in the *aging – cohort disambiguation*. Losh and Shimizu use Age-Period-Cohort (APC) statistical analysis, while Miller examines levels of scientific literacy by cohort at several points in time.

3.1   *The conceptual underpinning of APC analysis*

The age-period-cohort disambiguation is at the same time a conceptual distinction and a statistical operation of separating sources of variance. The assumption that supports the conceptual disambiguation is that human beings are *shaped* in three different ways: at critical formative moments that they share with their cohorts, thus bearing a cohort-specific *imprint*; in influential social events that leave unique imprints on all participants, no matter their age (the 'period' marks); and through aging, understood as *general, shared pattern of individual transformation* from childhood through adulthood and old age. Aging-related transformations are ideally observable in longitudinal datasets in which the same persons participate at different moments throughout their lives. In longitudinal research aging is studied as aggregated patterns of change in people's behavior, controlling for cohort membership, while cohort differences appear by grouping individuals in categories that share meaningful formative events, and studying the specificities of their aggregated

life trajectories. When longitudinal datasets are not available, aging and cohort related changes can be estimated through observing aggregated cross-sectional datasets, merging survey data collected at different points in time for the same variables. Respondents are grouped into cohorts according to their year of birth, and then average differences between cohorts (observed at the same age) indicate cohort "effects", while changes in cohorts' behavior while they progress through life (aggregated across cohorts) indicate aging "effects". Or, short of the causal vernacular, they indicate aging.

The statistical differentiation of the three components (aging, period and cohort-attributed differences) is rendered difficult, if not outright impossible, by redundancy: Age = Period (current year) – Cohort (birth year). This statistical problem has received considerable attention, in search of various solutions for heroically bootstrapping the numerical information out of its limitations. Still, the method is also confronted with theoretical difficulties specific to each field of inquiry: as any statistical procedure, it requires meaningful rules for deciding what to aggregate, what variability to consider as meaningful and what variability to consider as noise. The data cannot speak for itself, so to say. There is considerable risk of mechanical reification of cohorts and aging through statistical aggregation (as pointed out by Glenn as early as 1976). After all, the method works perfectly well not only with human subjects, but also with trucks: Hall (1971) estimated the *age effect* consisting in depreciation[2], the *cohort effect* consisting in "embodied technical change" (that is, the technology that is internal to the truck), and the *period effect* consisting in "disembodied technical change" (that is, repair technologies and other technological changes that are relevant for truck functioning, but which happened in the environment, thus affecting several cohorts of trucks) (apud B. H. Hall, Mairesse, & Turner, 2005, p.2). The issue is, how can one avoid methodological reductionism in interpreting findings, so that the 'age effect' is not implicitly rendered synonymous with depreciation?

It is important to notice that APC analysis on aggregated cross-sectional surveys defines aging as a uniform process across cohorts, thus encouraging a biological interpretation (since, socially speaking, cohorts have, of course, different typical trajectories). This means that APC analysis should be used with caution in discussing results about uniform aging effects, attending to the method's implicit theorizing work.

3.2   APC analysis of public knowledge of science

The aging – cohort disambiguation in the study of scientific literacy has led to interesting findings. On one hand, successive cohorts in the US improve their average scientific literacy, an increase partly attributable to improved science education in the curriculum (Losh 2006; Miller 2007). Bauer also finds improved knowledge of science in successive cohorts in Europe (Bauer 2009). Shimizu did not find expected cohort differences, considering the increase and then the decrease of science content in the national Japanese curriculum (Shimizu 2009). On the other hand, all three authors find that *cohorts maintain and even improve their scientific literacy as they age*. That is to say that aging, as observed in the aggregate, when disambiguated from cohort differences, involves *learning*, rather than *forgetting*, knowledge of science. This finding invites a reinterpretation of the relationship between age and ignorance of science in cross-sectional models, in which older age either correlates positively with lack of knowledge (Chao & Wei 2009; Miller 2007; TNS Opinion &

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[2] Which is interestingly similar with how aging effects are understood for humans.

Social 2005; Bauer 1996; Evans & Durant 1995; Einsiedel 1994) or, at best, makes no difference (Hayes & Tariq 2000; Von Roten 2004).

3.3 Disattention to age in PUS survey research

As indicated, age appears in two different roles in PUS survey research: as a 'socio-demographic variable', and as a substantive variable of interest, in analyses that disambiguate cohort from aging. In this last instance, as we can see in articles by Miller (2007), Losh (2006) and Shimizu (2009), it is *cohort* that is of main interest for researchers, and not *aging*. The three authors are interested in cohort differences because scientific literacy measures knowledge of constructs that are first and foremost discussed in the school curriculum. In this inquiry context, *aging is framed especially as forgetting*, as we have seen in Bauer's justification for his hypothesis (see Figure 2), but also in Losh:

> Age is typically used as a control or a vague background factor, and young adults often appear more interested than older ones in science (Losh, 2002; Office of Science and Technology, 2000). With several study years available, age can be disentangled from cohort and the separate impact of each can be assessed. Given changes in science education, the effects of cohort may turn out to be important indeed. For example, an "average adult" in their early 50s in 2005 completed most of their formal education 30 years ago. *Memory decay* alone could cause older adults to recall less basic science than younger ones at any point in historical time. On the other hand, birth cohort can influence *what kind* of science education a youth received (Losh, 2006, p. 837, italics in original).

Losh makes aging synonymous with forgetting – although, if knowledge of science is to have any public relevance, it may well be that adults learn about science as they participate in public life. Even *after* reporting that age does not have a negative effect as expected, Losh does not reflect back on her interpretation of *aging as forgetting*; instead, aging (again considered synonymous with memory decay) disappears completely from the interpretation, making room only for cohort change:

> In contrast, respondent age had virtually no net effect on CSL. These findings suggest that the effects of age on CSL in a single cross-sectional adult sample may reflect instead the uncontrolled and omitted effects of birth cohort, *as opposed to representing processes such as memory decay* (Losh, 2006, p. 841, italics added).

Shimizu, who cites Losh, takes over her interpretation of aging as synonymous with memory decay (the equivalence is even more poignant in his text), without taking stock either of her empirical findings, or of his similar results for Japan:

> *Considering the ageing effect (or memory decay)*, T-tests were conducted to compare the correct response rate of each cohort by using the common items between J-SCITEK2001 and J-SCITEK1991. Table 5 shows that the correct response rate in J-SCITEK2001 is significantly higher than the rate in J-SCITEK1991. So, in terms of the knowledge measured by the PUST surveys, the knowledge is retained instead of getting decayed (Shimizu 2009, p. 377, italics added).

Miller is the only PUS text in which advancing in the life-cycle and learning appear connected, and even interpreted as an "understandable finding":

> There is a clear life cycle effect, with the proportion of adults qualifying as scientifically literate increasing over time in every age cohort and at relatively similar rates. This finding documents *that most adults continue to learn a good deal of science after the*

end of their formal education. This is an understandable finding (Miller, 2007a, p.9, italics added).

Bauer (1996) starts from the hypothesis that: "The older the respondent, the more ignorant he or she will be of science (Age effect)" (p. 52 and Figure 2). He observes later in the same paper that, contrary to his hypothesis, the relationship between age and ignorance of science is actually curvilinear:

> Extension of general and science education curricula in the post-war period in EU countries leads one to expect that older people are more ignorant of science than the young. Counter to expectations it has been observed in the USA that the middle-aged score better than the younger and older people, and the same is true in Europe (Bauer, 1996, p. 56).

Still, Bauer does not interprets this finding in order to note the combined effects of cohort (older cohorts learned less science in school) and aging (people learn science during their life course). He simply concludes, in the Summary, that "In all EU countries ignorance is a matter of age. However, overall the ignorance-age relation is non-linear: the middle-aged are the least ignorant across all levels of education" (p. 59). Being "a matter of age" seems to be meaningful in and of itself, even when it runs against expectations.

What we find in Bauer's article, and also in Miller's discussion, is that, even if both authors are aware of the *disambiguation of age into cohort* and *aging*, representing two distinctive (and potentially contrary) sources of variability, they do not actually make use of this clarification and continue to refer to *age*. We do find indicators of this awareness in their texts: Bauer points to this distinction in the justification of his hypothesis (see Figure 2), while Miller observes the different patterns of cohort and aging-related variability (what he terms a "life-cycle effect") in the first part of his paper (p. 7). Still, both of them use "age" as the name of the variable and report findings about "age", without making use of the disambiguation to clarify subsequent divergent empirical findings (the curvilinear shape of the age distribution in Bauer, and the negative cross-sectional effect of age in Miller, p. 10 – which is surprising, given both positive cohort and life cycle effects at p. 7). Neither do other authors that we have read in the PUS field point to this conceptual distinction, when using age in cross-sectional analysis.

Therefore, we observe that, in the PUS field, framing *aging as forgetting* persists despite contrary empirical evidence of *aging as learning* (with the notable exception of Miller's 2007 paper). The disambiguation of aging and cohort-attributed sources of variance is an important achievement in the study of age in relation to scientific literacy; still, this conceptual clarification, otherwise widely available in the socio-statistical literature, is only used consistently in the two articles that are dedicated to an Age-Period-Cohort analysis (Losh, 2006 and Shimizu, 2009). The conceptual clarification did not spread to other analyses. Both observations point *to a pervasive disattention to age* in PUS survey research: *age and aging are tackled according to common-sense vocabularies and expectations, relying on easily available inferences about the category of "old people"* (Sacks, 1989). Scientific conceptualizations and findings about aging are not incorporated systematically, and age is dominantly treated as a condition of biological degradation ("memory decay"). The agism of vernacular representations of older people is thus inadvertently included in survey research findings, despite methodological tools that could prevent this leak; we find here that, indeed, scientific argumentation is permeated by the rhetoric of common sense age talk (Vincent 2008). As we argue below, this permeation is even more intense when age is treated as a socio-demographic variable.
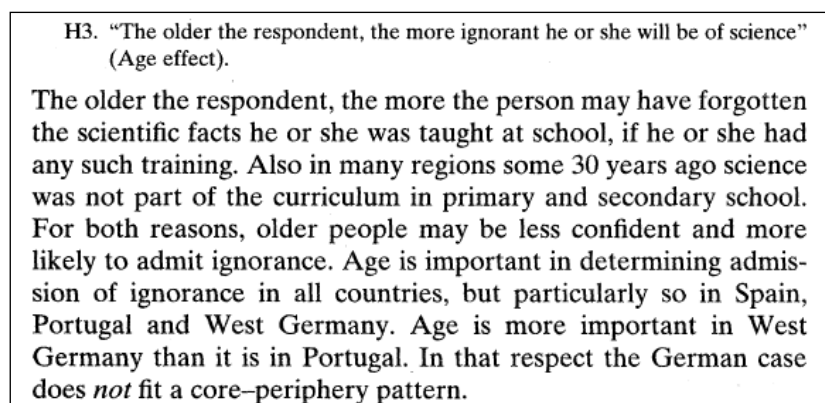
4 Old age as "ignorance": Working with age as a socio-demographic variable

After examining PUS research that focuses on age, we now look at how age is used as a socio-demographic variable, and how this methodological role leads to its implicit theorizing. We start from what we consider an exemplary article – namely Bauer's paper on "Socio-Demographic Correlates of DK-Responses in Knowledge Surveys: Self-attributed Ignorance of Science" (1996). We take it as the focus of our analysis not only because Bauer is a highly prominent scholar in the PUS field, but also because his paper includes a detailed account of the assumption and merits of survey analysis, in a polemic with critics – thus rendering explicit several rhetorical moves of interest for us. Starting from Bauer's paper and methodological justification, we go on to outline survey research as a set of games of inquiry, and then to analyze socio-demographic variables as a rhetorical device that fulfills important functions.

4.1 *Square one: a personal enigma*

If we were to present our argumentation in chronological order, there is a specific moment that we can indicate as the beginning of our reflection on age in quantitative research. It all started when we discovered the H3 sentence:

Figure 2. Hypothesis 3 in Bauer's analysis of the "Socio-Demographic Correlates of DK-Responses in Knowledge Surveys" (1996), p. 52

H3. "The older the respondent, the more ignorant he or she will be of science" (Age effect).

The older the respondent, the more the person may have forgotten the scientific facts he or she was taught at school, if he or she had any such training. Also in many regions some 30 years ago science was not part of the curriculum in primary and secondary school. For both reasons, older people may be less confident and more likely to admit ignorance. Age is important in determining admission of ignorance in all countries, but particularly so in Spain, Portugal and West Germany. Age is more important in West Germany than it is in Portugal. In that respect the German case does *not* fit a core–periphery pattern.

We present it as a figure, instead of copying it as text, because the strong impression it made on us also derived from its clearly outlined graphical presentation. The author makes it clear, in so many words, that his hypothesis is that, as regards science, *old age means ignorance*, due to both cohort disadvantages and forgetfulness through aging. Ignorance is a value-laden concept, and particularly in the PUS field it appears desirable to be knowledgeable and lack of knowledge is lamented. Thus, by attributing and imputing ignorance to older people, the author contributes to a stereotypical representation of the elderly as living in the past, out of touch with the present and losing their grasp through forgetfulness.

In what seemed to us to be a rather ironic aesthetic, the author displays his awareness of the political implications of gender classifications by making use of the "he or she" operator. Still, the derogatory implications of formulating ignorance as an effect of age go completely under the radar.

We set out to clarify the following enigma, under the guise of a research question: *how is it possible that a distinguished scholar, writing in a prestigious journal, advances such a disparaging formulation about aging and older people* – displaying a surprising unawareness of its ageism?

4.2   A comparison of age with gender

Bauer's rhetorical treatment of gender in Hypothesis 5 is equally depreciatory:

Figure 3. Hypothesis 5 in Bauer's analysis of the "Socio-Demographic Correlates of DK-Responses in Knowledge Surveys" (1996), p. 53

> H5. "Women are more ignorant of science than men" (Gender effect).

Still, there are some notable differences in the subsequent justification. First of all, it is longer – which is why we do not include it in the illustration. The age hypothesis is justified and evaluated in 10 lines, with no bibliographical references, while the gender hypothesis is treated in 25 lines, with two references. The "age effect" is explicated into two components: differential socialization (whether and how science was taught in school) and forgetting school knowledge through aging. The "gender effect" includes: differential socialization ("girls are discouraged in school from taking an interest in science"), distance in daily life ("[w]omen are traditionally more distanced from science and technology than men"), gender identity ("scientific knowledge is less part of a female than of a male gender stereotype"), and the performance of gender ("[w]omen often acquiesce in a general expectation that they are 'not supposed to know'") (p. 53). Some of the important theoretical insights on gender as social organization and interactional performance (West & Zimmerman 1987) had informed, indirectly, the author's argument, thus indicating neighborhood relationships between quantitative, survey-based social research and social theory of gender – while similar arguments concerning age had not made their way through. This asymmetry in justification is an indicator of the relative visibility of social theory of gender, respectively age in neighboring social research fields.

An increased theoretical awareness did not prevent the author from portraying women as bearers of ignorance – bringing forth an individual imputation of merit and demerit and rhetorically erasing any systemic formulation of gender as a feature of social organization.

We notice two important shared features in Bauer's treatment of age and gender: (1) they are dealt with as attributes of the individual, used as tags for grouping individuals and imputing them ignorance – rather than as aspects of social organization; (2) age and gender are not a focus of attention and theoretical interpretation; rather, they serve as rhetorical resources in pursuit of "structures" and "explanations". In the following section we will discuss both the systematic disattention to age and gender and their essentialization as individual quasi-biological attributes, resulting from their treatment as socio-demographic variables in typical games of inquiry in survey research.

4.3   Socio-demographic variables as rhetorical tools in survey research

Bauer's paper offers a fertile opportunity to reflect on the rhetoric of inquiry in survey-based social research. His article is part of the *Symposium on "self-attributed ignorance"* published in a special issue of *Social Science Information*. In his paper, Bauer replies to Turner and Michael (1996), who, in the same issue, criticize quantitative survey research. To this purpose, he succinctly makes a case[3] for the value of surveys as a research method among others.

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[3] This argumentation is presented in the section on "Limitations of survey research on ignorance" (Bauer 1996, pp. 44-47).

Bauer does not aim, in this paper, to understand age or gender as features of social organization. On the contrary, his goal is to study something different, by using age, gender and other variables (the so-called "socio-demographical correlates") in order to highlight the phenomenon of interest: the core-periphery cleavage between countries (see Bauer's main hypothesis in Figure 4). We notice here an important feature of the use of age as a socio-demographical variable, namely that it used as a resource for understanding something else. Moreover, age is taken for granted as a common-sense concept, as there is no reference to any theory of age classification or aging. Age functions as a vernacular concept, recruited in order to document another social phenomenon.

Figure 4. Hypothesis 1 in Bauer's analysis of the "Socio-Demographic Correlates of DK-Responses in Knowledge Surveys" (1996), p. 51

> H1. "Countries in the core and in the periphery have different stratifications of self-attributed scientific ignorance" (Core–periphery cleavage).

As it appears, socio-demographic variables are the key resources for constructing the so-called "objective structure (…) of subjective ignorance of science":

> Notwithstanding these limitations, the structures of self-attributed ignorance can be fruitfully explored and insights can be gained into their distribution and into what best explains it. Without making a virtue out of necessity, this study is restricted to the analysis of DK-responses abstracted from their specific context. This is a useful first step for throwing light on the *objective structure*, the socio-demographic attributes of the person, of *subjective ignorance of science*. Making this personal attribution, we are left with the truncated formula (DK)=f(disposition ignorance) without knowing anything about the polysemy of DK-responses in particular contexts. They will have to be studied by means of other techniques (p. 46, italics in original).

Bauer's argument in support of the value of quantitative survey-based research piggybacks on three concepts: "objective structures", "explanation" and the foundation that makes the other two possible: "personal disposition". What are personal dispositions, and how can they be observed?

At the core of survey research lies the possibility of individual attribution of behavior: similar to psychometrics (as pointed out by Bauer, p. 45), survey research depends on *imputing to the respondents* the recorded answers to questionnaire items. Without this axiomatic, initial move, there cannot be any survey research as we know it now.

Still, in a very empirical way, the ignorance of science of each respondent that answered "Don't know" has been brought into existence by the interviewer: without the interview situation, this particular instance of ignorance would have not happened.

To push the matter forward, in the spirit of Fayard's admonition (1992), we can see the scientific literacy survey scale as a case of *respondent entrapment*. We may wonder: is it possible to argue that such entrapment is justified for research purposes? For example, can we argue that the interview situation resembles other life situations in which the respondent would have acted alike? What aspects of respondents' real lives, outside of the interview situation, are captured through this unexpected quiz testing?

Bauer's justification for eliciting ignorance through questioning relies on the assumption that each individual's answer reveals his or her stable individual disposition towards that answer. Bauer introduces "personal dispositions" through a distinction: he asserts axiomatically that a survey

response, as a verbal utterance, is "a function of two main influences: the context (C) and the person's relatively stable response dispositions (PD) such as ignorance, fear, alienation or whatever interpretation we choose to make" (p. 45). He then argues that disregarding the context is a necessary evil in survey research, if not even a productive constraint, which *enables* inquiry rather than disables it (see the quote above).

Thus, Bauer argues that the value of survey research consists in its alleged ability to highlight "objective structures" and "explanations", at the expense of ignoring the "polysemy (…) in particular contexts". Polysemy becomes the residual business of qualitative research. As we discuss below (see section 4.4.4), "factors" are another precious currency created in survey research. "Structures", "explanations" and "factors" create the conceptual infrastructure for several games of inquiry in quantitative survey research, in which the 'socio-demographic variable' device plays its rhetorical roles.

4.3.1 Personal dispositions and quasi-dispositions

By distinguishing between *personal disposition* and *context*, and asserting the influence of each on survey response, Bauer postulates the existence of personal dispositions in general and of *ignorance of science* as a personal disposition in particular. This is where the first theoretical conflict appears with an interactional theory of social order: in this alternative perspective, 'ignorance' is not a stable, trans-situational personal disposition, but, whenever it becomes observable, it is the result of a situated, here-and-now interaction.

The *personal attribution* of survey response is achieved in two analytical steps, which are usually conflated in argumentation. First, there is attribution of the recorded response to a stable response tendency; second, there is the internalization of the (alleged) response tendency as a causal force for behavior.

a) Firstly, documenting a *stable response tendency* is covered by addressing "reliability concerns": would the answer be the same under different interview situations? For example, would the answer be the same for a different question wording? For a different position of the question within the questionnaire? For a different interviewer? For a different time of the day, weather, or other incidental circumstances of the interview? This is what Bauer points at when mentioning that "DK-responses to knowledge items like those used here are not sensitive to being asked before or after the interest questions" (p. 45).

b) The second issue is whether a stable survey answer can be understood as indicative of a *mental entity with causal force* for respondents' behavior in other life situations besides survey interviews. Such alleged causal entities include, among others, intentions, values, attitudes, opinions, beliefs, knowledge, and subjective norms. The Theory of Planned Behavior and its extended form, the Theory of Reasoned Action (Ajzen 1991; Madden et al. 1992), offer an actionable model that systematizes these entities and has become, in recent years, an increasingly used conceptual scaffold for survey analysis and meta-analysis. The list of mental entities is not closed: Bauer's article works under the explicit assumption that self-attributed ignorance (irrespective of its "subjective", contextual meaning) is a type of ignorance (the author uses "ignorance" and "self-attributed ignorance" interchangeably) which is, in turn, a stable personal disposition and, last but not least, a causal factor for social behavior.

It is possible to work with survey variables assuming that they represent stable response dispositions, but without interpreting them as mental entities. Such variables can be indicative of group membership, relationships, resources, or public statuses that shape interactions. Marital status, class, and income are such examples that invite an interactional, relational interpretation. Gender, age, ethnicity, religiosity may also be interpreted as such – but they often afford interpretation in a cognitive key, as embodied dispositions to think and act in specific styles.

It may well be that researchers working in quantitative survey research could decide, upon careful consideration, that variables of interest in their analyses are not personal dispositions, but individual attributes (grasped through stable responses) that point to other types of social processes (material and symbolic resources available in a social context, patterns of interaction). Survey research is not, in principle, incompatible with a distributed view of thinking and an interactional view of behavior. Still, its rhetoric in typical *games of inquiry* frustrates such orientations. Variables are, as a rule, dealt with *as if* they pointed to causal, mental, interior personal dispositions; we can say that they are dealt with as *quasi-dispositions*. There is a minute rhetorical leap from detecting a 'stable individual attribute' to analyzing and writing about an 'internal personal disposition' – and it may not even be completed explicitly.

4.3.2 Games of inquiry in survey research

Building on the postulated *existence of personal dispositions as causal forces internal to individuals*, some of the main types of inquiries in quantitative survey research are:

1) Methodological refinements in *grasping personal dispositions* through observable survey indicators. Recent statistical developments in measurement include latent variable models and other techniques; see for example, in PUS field, estimates using the Item Response Theory (IRT) models (Miller 1998), multiple correspondence analysis (Rughiniş & Toader 2010), or, more recently, Cultural Consensus Theory (CCT) models (Oravecz, Faust, & Batchelder 2012), and the discussion of reflective and formative latent variable models for scientific literacy in Rughiniş (2011). An alternative approach is to propose new scales, which are argued to be more relevant for the underlying construct (Bauer et al. 2000; C.-J. Rundgren et al. 2010);

2) The study of *objective structures* of personal dispositions: they are rendered visible through distributions of personal dispositions against various social categories, including the "socio-demographic variables" and potentially other categories as well. These distributions / structures are also referred to as: gaps, cleavages, stratification, and even, metaphorically, as the "epidemiology" of a certain personal disposition (M. Bauer & Joffe, 1996, p. 10);

3) *Typologies of persons* based on configurations of personal dispositions; types can be subsequently counted and studied in relation with other variables, especially the so-called socio-demographic variables;

4) *Explanation of variability:* accounting for the variability in the dependent variable through variability in other variables, arranged in a model that is associated, implicitly or explicitly, with a narrative explanation (Abbott 1997). The sign of success in this game is the overall proportion of "explained" variability and, if the model employs latent variables, success is also indicated by "goodness-of-fit" indicators;

5) Studies of *key causal relationships between two dispositions* (or quasi-dispositions) - for example, the influence of gender on scientific literacy, the influence of age on scientific literacy, or, as a core concern in the PUS field, the influence of scientific literacy on attitudes towards science. The independent variable is dealt with as a quasi-causal *predictor*, a.k.a. *factor*. This bivariate relationship is, as a rule, studied through a multivariate model, which is used to "control for" potential confounding influences; the main result of the study consists in coefficients that describe as accurately and conceptually neatly as possible the bivariate relationships of interest; these coefficients become the measure of the strength of the causal relationship. Such coefficients are reported as *precise numbers*. Their existence is established, as a rule, by *statistical significance*; the argument from statistical significance to sociological significance is still common, despite an already consistent thread of criticism originating in economics (Ziliak & McCloskey 2008) and psychology (Lambdin 2012). *Accuracy* is a key rhetorical property of coefficients, because it makes them comparable across studies.

6) 'Statistically significant' and 'accurate' coefficients can be subsequently used as inputs in other studies, for example:

   a. To *compare* new found estimates with previous estimates, creating accumulation of evidence;

   b. To include in *meta-analyses* that search for a *truer value* of that relationship by looking beyond the variability of individual coefficients, and possibly controlling for different signs of research quality (such as sample size and type);

   c. To find *underlying structures of structures*, by searching for interpretable order in sets of coefficients, for example: correlating the relationship between scientific literacy and attitudes towards science with country levels of development, as measured by GDP per capita and proportion of 18–24 year olds in tertiary education (Allum et al. 2008). Bauer also investigates a structure of structures, by looking into national configurations of distributions of DK responses across "social categories" and seeking for a "core-periphery" cleavage, as indicated in his first research hypothesis (see Figure 4**Eroare! Fără sursă de referinţă.**).

Survey researchers use "socio-demographic" (SD) variables as a rhetorical device in argumentation. As we discuss next, the SD device allows specific forms of inference and construct building, of central importance in these games of inquiry.

4.4 The socio-demographic (SD) device

What are, then, 'socio-demographic variables'? Or, what makes a variable a 'socio-demographic'? The main criterion for deciding whether a variable is treated as a focus of interest or as a socio-demographic consist in whether it appears on its own in argumentation, or as part of a *list*. The list is an important element in the SD device.

In his article on survey research, Abbott (1997) clusters 97 variables commonly used in articles relying on the GSS datasets, according to patterns of simultaneous use in any single article. The first "clump" that he identifies is "[d]emographic variables – age, education, race, sex, income, region of

residence, marital status, size of community, and prestige of occupation" (p. 367). Members of this cluster seem familiar – and *familiarity* is also an important feature of the SD device.

This category has permeable and fuzzy borders: in any given study, each of the variables on the list may or may not appear as a socio-demographic; that is, each and every one may not appear at all, or it may appear as a substantial independent variable, or even as a dependent variable. Also, in any given study, some eccentric variables may be allocated to this status; for example, Bauer (1996) includes as "socio-demographic variables" the following (p. 65): education, age, consumer social category, gender, community size, opinion leadership, media use, dominant religion, and Catholicism. To give some other examples from PUS studies: Evans and Durant (1995) use as "demographic variables" educational qualifications, class (working versus middle class), sex (female versus male) and age (younger versus older) (p. 59). Pardo and Calvo (2004) list the following "canonical sociodemographic variables": "social class, income, place of residence, age, gender, education, and other sociopsychological variables" (p. 204). In her analysis, Losh (2006) uses age as a substantial independent variable, being a focus of her inquiry; she specifies additional "demographic and educational variables" that include gender and degree level, the sum of high school science courses and the number of college science courses. Hayes and Tariq (2000) focus on gender as a substantive predictor, and thus gender is no longer a socio-demographic variable; their list includes religious affiliation (Catholic vs. other), religious beliefs, marital status, age, education, occupation (non-manual vs. manual) and employment status (labor active vs. other) (p. 440 and 442).

We thus observe that there are some typical occupants of the "socio-demographic" category in each study, but there is also variability. Socio-demographic variables are best defined not as a closed inventory, but *as a status-role (with diverse occupancy) in the organization of argumentation of a study*. Our favorite analogy is between socio-demographic variables and maintenance workers of various qualifications: electricians, plumbers, painters, furniture movers, cleaning personnel. Socio-demographics do massive work for the argumentative infrastructure, with little visibility and recognition; *disattention is a condition for their proper rhetorical functioning*.

Socio-demographics are always *independent* variables, and they contribute towards "explaining" the dependent variable, both in statistical and common-reason parlance. As a rule, besides their independent position, we find several other rhetorical features of SDs:

1. They can be referred to as *a collective*, without indicating specific membership: "Using a twelve-item scientific knowledge scale and a range of demographic variables, they then go on to fit a series of OLS regression models …" (Sturgis & Allum, 2001, p. 427);

2. When specified, they hang together in *lists* with indifferent ordering, for example: "How is scientific orientation distributed by age, education, religion, social category or gender?" (Bauer, 1996, p. 40); "the additional effects of a range of socio-demographic factors such as religion, age, marital status, and socio-economic background" (Hayes & Tariq, 2000, p. 440); "Do educational level, age, gender, income, and size of community play a role in developing perceived knowledge of and attitudes towards science?" (Roberts, Reid, Schroeder, & Norris, 2011, p.5);

3. They come with *little, if any, theoretical justification* for being included in the model; gender is a notable exception in this regard: its use in analytical models is more often justified with bibliographical references (see Bauer, 1996; Losh, 2006);

4. Their *measurement is dealt with as unproblematic,* without requiring methodological accounts;

5. They work in the *background* of the report, requiring relatively little attention from the analyst and readers;

6. They point to *considerable and intuitively meaningful variability* in all ways of life: we expect as a matter of common reason that the elderly are (*worlds apart*) different from the young, women are (*so very*) different from men, and the schooled are (*probably*) different from the unschooled.

4.4.1 Socio-demographics as structure builders

This last, sixth feature mentioned above is worth additional consideration. Socio-demographic variables can do their rhetorical work because *they carry along their significance in common-sense reasoning and conversation.* Sacks (1989) analyzed the use of the common classification categories in daily conversation in his paper on the M.I.R. device, pointing out that they constitute "some very central machinery of social organization" (p. 89). M stands for "Membership", I stands for "Inference rich", and R stands for "Representative", indicating what Sacks takes to be the three main functioning features of these basic social categories: 1) all persons may be described as a member of one division or another in each of these categories (occupational, age- or gender-related, ethnic etc.), as it is virtually impossible not to be 'something' in each of them; 2) when people are so described, a whole range of inferences about them becomes available, and 3) whatever new information is learnt about a person in particular can be fed back into the category profile by taking the person to be a "representative" of it. Because of their inference-rich character, they are often used as conversation starters and as descriptors of people of whom we know little: "When you get some category as an answer to a 'which'-type question, you can feel that you know a great deal about the person, and can readily formulate topics of conversation based on the knowledge stored in terms of that category" (ibid., p. 90).

This is precisely how SD variables get to be widely used in surveys, too: to handle talk about persons about whom we know preciously little. They bring their inference richness as a *counterweight of heavy meaning* for the uncertainty, precariousness, vulnerability of the main variables in the study. By virtue of their common-reason functioning, they allow, in daily conversations and in institutional talk, surveys included, an easy formulation of interesting and meaningful sentences about people. The most cursory piece of information about a person becomes consequential and story-tellable if connected with her gender, age, occupation, class or religious membership. This is how researchers claim to create "objective structures" out of any personal trait which correlates with socio-demographics. Also, by virtue of the clear expectations that these categories create, socio-demographics also enable researchers to find surprising findings: in some setting, it could be that, unexpectedly, the middle-aged are actually more knowledgeable of science than the young (Bauer 1996, p. 56). They also enable researchers to formulate quizzical results: "the results suggest that if a person had a religious life changing experience, they are more willing to guess. When it comes to guessing, educated people's guesses tend to be more 'False', while religious people have a stronger acquiescence bias to guess 'True'" (Oravecz et al. 2012). These surprises are precious currency in academic writing.

4.4.2 Socio-demographics as pacifiers

We have already witnessed the capacity of socio-demographic variables to generate 'objective structures', either to be reported as such, or to be further explored for new patterns interpreted as structure-generating structures (see section 4.3). Still, one of the most important tasks of socio-demographics is of less impressive stature: they work as *pacifiers*, for researchers involved in analysis and for their audience.

There is a lot of uncertainty in survey based research. In the early phases of data exploration, researchers try to figure out whether the dataset as a whole is reliable, and whether particular items function well or are problematic. Any item may display erratic behavior, indicating that something has gone astray during data 'collection', either in the field or while assembling the dataset. One of the first steps in exploring the reasonableness of data consists in inspecting expected correlations. Patterns of association with the meaningful, inference-rich socio-demographics should make sense at a glance; otherwise, explanations are required: either the data is of poor quality, inviting corrections, or some interesting empirical findings are there to be found, provided that researchers can account for these surprises.

Socio-demographics fulfill the same role of pacifiers in research reports: they assure readers that the data is sound, analytic procedures have reached their objectives, and results are meaningful. We can see this reassurance especially in methodological sections or papers that need to establish that measurements are meaningful. For example, Evans and Durant write:

> The associations between demographic variables and our understanding and interest measures are generally rather high. Respondents who score lower on the scientific understanding scale tend to express less interest in science, to possess fewer educational qualifications, to be working class rather than middle class, to be female rather than male, and to be older rather than younger. *The intuitive plausibility of these associations gives further support to the thesis that the scales have a degree of construct validity* (Evans & Durant, 1995, p. 59, italics added).

Along the same lines, Oravecz et al. observe the following in relation to their novel estimate for the scientific literacy measurement model:

> While in case of the scientific items respondents did not seem to exhibit any particular tendency on average in guessing, when it comes to the science and environment items they would rather guess 'True'. However, inter-individual variation was rather substantial for both sets of questions, and with respect to all person-specific parameters. *Additionally, these inter-individual differences can be related in a meaningful way to socio-demographic characteristics*, such as gender, religiousness and education (Oravecz et al., 2012, italics added).

4.4.3 Socio-demographics as "beetle larvae"

The third critical task of socio-demographics is *'control',* in statistical parlance. Their co-variations with the dependent variable are 'netted out', allowing other substantive independent variables (such as gender or scientific knowledge, in the two quotes below) to stand out and gain (or lose) significant coefficients of their own, indicating their force as factors (or, respectively, lack thereof):

> Finally, using multivariate regression techniques, the extent to which gender differences in attitudes toward science exist net of a range of important sociodemographic variables, including knowledge of scientific matters, is empirically evaluated (Hayes & Tariq, 2000, p. 435).

We took advantage of some standard sociodemographic measures, present in all of the surveys, to use as control variables in our analysis. Gender, education and age were controlled in each of the OLS regressions that were carried out across all of the datasets (Allum et al., 2008b, p. 43).

The work of control displays some interesting properties. In order to highlight them, we start from the observation that the purpose of controlling other variables through multivariate analysis is to eliminate potentially *confounding* factors, and to *isolate the real association* between a hypothetically causal variable and its dependent variable.

In order to understand conceptual assumptions of statistical control in surveys, we find clarifying examples in medical research: when investigators want to examine a risk factor, but experimental research is not possible, the second best solution consists in cross-sectional, correlational studies in which potential confounders are 'controlled for'. Control is always imperfect in so many ways, and there are countless studies that caution against unwarranted causal inferences, inflated or obscured by residual confounding; Christenfeld, Sloan, Carroll, & Greenland (2004) offer a clear and recent illustration in the field of statistical advice for medical research. A core analytical presupposition underlying the practice of statistical control is that the risk factor is clearly distinct from its suspected confounders; they may be distinctive pathological agents, separate substances, or different entities that are certainly not mutually constitutive. We illustrate this paradigmatic situation with the quote below, summarizing research on the effect of *Helicobacter pylori* infection, usually acquired in early childhood, on adult coronary heart disease (CHD):

In this study *H pylori* infection was related to adult CHD independently of smoking history, age at starting smoking, lifetime cigarette consumption, history of diabetes, and high blood pressure. Adult social class and other factors associated with childhood poverty caused only minor confounding of the effect of *H pylori*. In addition there was no strong relation between *H pylori* infection and conventional risk factors in the control population. Even if *H pylori* is only acting as a marker of childhood poverty, this is evidence supporting a link between early living conditions and adult risk of CHD (Mendall et al., 1994, italics in original).

It is clear, in this example, that H pylori is clearly distinctive from smoking, diabetes, blood pressure, and childhood poverty; after all, H pylori is a living organism, and the others are not. It is possible that childhood poverty favors infection with H pylori, and the authors deal with this possibility in their analysis and interpretation, as illustrated in the quote above. Still, it makes sense to say that, by controlling for so many factors, the final regression coefficient between H pylori infections and CHD is more precisely and more tightly related to their relationship. Through statistical control, we can interpret that coefficient better; we are surer of what it means.

Of course, *human affairs are very often unlike infections*; the very fact that the procedure of statistical control works so well for medical research is, actually, a reason to worry about its applicability in studies of social life, and especially about its consequences - given that it is widely applied. Starting from the observation that quantification of social situations and experiences is a difficult matter, we can be even warier of the potential of residual confounding through incomplete control; this point is eloquently discussed by Smith (2000), in his analysis concerning the use of race, controlling for several variables indicating social features, to predict health outcomes. He argues that there is no set of few variables that can capture the pattern of inequalities and racism in the lives of Whites and Blacks in the US, for example. The risk of residual confounding becomes a risk of

interconnected meaning: as Smith (ibid., p. 1696) concludes, "[s]ocioeconomic disadvantages and exclusionary social practices are, in this view, mutually constitutive".

Therefore, when we control for education and socio-economic status to estimate more precisely the 'effect' of ethnicity on health, *we change the meaning of ethnicity*, depleting it of some of its core features. 'Ethnicity' and 'ethnicity controlling for education' are written about as if they mean the same, but they do not.

Socio-demographic variables are used in multivariate analyses of survey data to rhetorically sponge up unwanted variability, to clean the focal relationship of everything that does not belong. Through this 'cleaning' they also void those substantive independent variables of much of their social meaning. Their inference-rich power helps with their absorption capacity: by controlling for "socio-demographic variables", the resulting coefficient claims to measure a clean relationship. To illustrate, Sturgis and Allum (2004, p. 61) formulate the following hypothesis: "H1 The main effect of scientific knowledge on general attitude toward science—controlling for a range of important demographic characteristics—will be significant and positive". The "range of important demographic characteristics" acts as a swarm of beetle larvae in a natural history museum, cleaning the skeleton of flesh and making it ready for inspection and exposition. The question remains, though, whether "scientific knowledge controlling for education" is the same concept as "scientific knowledge" – since, presumably, the type of understanding of science depends crucially on the process in which one has encountered it.

4.4.4 Rhetorical polysemy: "factors" and "explanation"

We have witnessed by now two ways in which the operation of quantitative survey research depends on *internal ambiguity*:

a) Survey variables that point to individual attributes are, as a rule, dealt with as if they indicated personal dispositions of a mental type, causally conducive to specific behavior; this *quasi-dispositional status* is achieved through an identical treatment, in analysis and reporting, of variables that are deemed to be mental dispositions ("attitudes", "beliefs", "opinions" etc.) and other variables whose locus (Abbott 1997) is not discussed explicitly;

b) When dealing with variable individual attributes whose relevance and meaning depend on other experiences and events[4] – as it is likely to be the case with gender, age, ethnicity, and other inference-rich and non-specific 'socio-demographic' variables – the introduction of *controls in multivariate analysis* does not lead to a better specification and increased accuracy of measurement (as in the bacteria-and-other risk factors prototype); instead, it leads to changes in the meaning of the respective variables. Still, by using the same simple variable name ('gender', 'education', 'age') across multiple multivariate models as if they pointed to the same variations in the social situation of the respondent, such changes in meaning are rendered invisible.

These two types of ambiguity function to facilitate a causal vocabulary, and to allow comparisons leading to conclusive findings, respectively. They participate in *rhetorical practices of ambiguity* that,

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[4]Such as: social classifications whose social relevance is established, interactionally, depending on other marks of membership that the individual presents: womanhood may not be the same as an aged woman, a young woman, a Gypsy woman; experiences whose quality depends on their context: aging as a single person or as a child caretaker in the context of learning about science or about antibiotics.

all in all, is useful for talking about *causes* of human events. In this respect, they are assisted by a third type of ambiguity:

> c) *Polysemy of causal terms* such as 'factors', 'explanation', and 'prediction': on each occasion they may be used in accordance with the rules of statistical jargon, or as common-reason terms pointing to increased understanding, or in a mixed-code in which statistical correlations (statistical 'effects') between plausibly related events (narrative 'effects') transubstantiate into scientific explanations.

For all the critiques of causal formulations of social action, they are thriving in survey based social research. How can we understand this persistence? There is the century-long aspiration towards 'talking science', of sharing the same vocabulary and style of inquiry with the natural sciences. As a related aspect, there is also the aspiration towards gaining scientific legitimacy in the communication with state authorities. Policy-makers require evidence-based recommendations concerning populations, with high financial and political stakes; the positivist language is suitable for formulating authoritative, actionable scientific advice. In this context, to put the finger on the aspect that is most relevant for the purposes of this article, causal-like formulations in survey research are useful for the manufacture of '*factors*'. 'Factors' are a shared currency of common-reason, scientific and policy-making discourses; they function as boundary objects (Star & Griesemer 1989; Akkerman & Bakker 2011) that enable the transdisciplinary circulation of ideas. If surprising correlations, complex models, 'objective structures' and 'structures of structures' are precious findings for academic research, it is 'factors' that are particularly valuable for public communication of social research. Factors, especially as instantiated in multivariate analysis, also accomplish the commensuration of heterogeneous social processes (Espeland & Stevens 1998; Espeland & Stevens 2009) and facilitate decision making through comparisons of size.

What are 'factors' in survey research? It is instructive to follow the usage of the term in actual papers in order to observe their argumentative work. We have chosen Miller's paper (2007) as a case in point, since it includes several types of factor-occurrences. We first have to distinguish between two homonymous, unrelated uses: first, there is factor as in 'factor analysis', meaning an analytically identifiable numerical dimension of data patterns, presumably corresponding to a distinctive facet of the concept under study. For example, the concept of scientific literacy was initially conceptualized and investigated as consisting of two 'factors', that is, two *dimensions*: knowledge of a scientific vocabulary, and an understanding of the scientific method. Miller then notices that:

> National surveys of adults in the United States show that the distinction originally found between the *two factors* in studies in the mid-1980's narrowed over the remaining years of the 20th century (Miller, 2007a, p. 2, italics added).

These factors are latent phenomena that produce observed data; their causal power is of interest only for scholars interested in measurement.

The second meaning of factors refers to a *distinctive, substantive cause of human affairs*. This is a meaning that is shared in common-reason talk, in policy-talk, and in survey research. For example, in a common-reason usage, Miller writes:

> Stem cell research became a frequently discussed issue in the 2004 presidential election campaign and was an important *factor* in several Senate elections in 2006 (Miller, 2007a, p. 7, italics added).

In daily talk, factors need not be precisely measured or clearly delineated; there is considerable ambiguity in use. For example, the factor that presumably influenced outputs of Senate elections in 2006 can be further understood as variability concerning: politicians' strategies in discursively framing stem cell research, public understanding of stem cell research, public evaluations of stem cell research, scientists' public communication of results, media framing of the debate, and so on. It is not required to detail them to be able to say that, all in all, stem cell research was a "factor" for success in elections. Common-reason factors are pinpointable, consequential, interesting, story-tellable.

Policy-oriented talk requires more precision and causal directionality: policy makers are interested in 'factors' that contribute to or prevent a specific outcome, especially in those 'factors' that can be a subject of intervention. The main policy-relevant 'factor' that Miller pursues and discusses in his recent work is *college science education* as a stimulant of public scientific literacy.

In survey research parlance there is an inflation of 'factors', since all independent variables are reported as such:

> To clarify the intersection of formal education and informal adult learning about science, it is useful to turn to a relatively simple structural equation model of civic scientific literacy in 2005. To estimate *the relative influence of several factors* on the development of civic scientific literacy, the analytic model included *each individual's age, gender, highest level of education, number of college science courses completed, presence or absence of minor children in the household, level of use of informal science education resources, employment in a science-related job, and personal religious beliefs* (see Figure 3) (Miller, 2007a, p. 9, italics added).

Factors in survey research fulfill two essential argumentative tasks: they predict (as 'predictors'), and explain (as 'explaining variables'). Still, both 'prediction' and 'explanation' are very much polysemous – if not outright homonymous – terms. Their semantic ambiguity is openly acknowledged and used as rhetorical resource in survey research, allowing authors to claim common-reason "explanation" (to be read as 'having offered explanation'), and to defend precarious arguments by pointing that "explanation" means something else in statistical analytical terms than in lay or epistemological discussions.

This bifurcation of meaning is most obvious for predictors: at best, survey models can claim to 'predict' the present with past events, with the force of hindsight, if data cover multiple moments in time. In the case of cross-sectional data (such as PUS surveys discussed in this article), 'prediction' is synonymous with 'educated guess': a variable is said to predict another if knowledge of the first enables an observer to better estimate (that is, to guess) the values of the second.

From a statistical point of view, any variable that correlates with a second is a 'predictor' for it, and it may also be said that it 'explains' its variability. In statistical parlance, variability of an outcome is 'explained' by sets of 'predictors' that co-vary with that outcome. There need not be any meaningful work of explanation: statistically speaking, any covariate can be called a 'predictor' or an 'explaining' variable, and its coefficient (bivariate or multivariate) can be called an 'effect' (distinguishing, then, between 'direct', 'indirect' and 'total' effects, depending on the causal paths specified in the model). Provided that independent variables are discerningly chosen so that there are plausible narratives connecting them with the putative 'effect', any correlational analysis can claim explanatory power:

> The model also provides *useful and plausible explanations of the impact* of children in the home, religious fundamentalism, and employment in a science-related occupation

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on adult scientific literacy. A full discussion of the role of family, religion, and employment is beyond the scope of this analysis, but it is useful to be able *to fit these factors into a more general sense* of the development of civic scientific literacy (Miller, 2007a, p. 14, italics added).

For example, in the quote above, Millers claims that the model "provides useful and plausible explanations of the impact"; a more adequate formulation would have been that, if we *assume* on the basis of prior knowledge that these variables do have an "impact" on scientific literacy, then these models offer some plausible and potentially useful *quantifications of impact*. It is common knowledge among survey researchers and their audience that any causal relevance of a given model derives entirely from researchers' theoretical knowledge prior to model specification. Still, this open consensus does not prevent liberal talk of explanatory successes; on the contrary, it facilitates it, granting it *plausible deniability* if confronted with skeptical demands. Strong claims of 'explanation' are rhetorically paired with weak claims of 'exploration'. For example, Bauer introduces his model as follows: "To *explore* what *determines* ignorance of science in late 20-th century Europe I define a multiple regression model (SPSS_X, OLS stepwise method) for each country and compare the *importance of different variables for the explanation of the distribution of ignorance* (…). The model comprises nine socio-demographic variables, each in linear relationships to ignorance, for *predicting the distribution of ignorance*" (Bauer, 1996, p. 47, italics added). The generous, relaxed, yet cautionary use of explanatory vocabulary is observable throughout the article. While the title claims the minimalist finding of "socio-demographic correlates of DK-responses" and the analysis is assumed as "exploratory", the author discusses "what determines ignorance"; *determination* can be simultaneously read here as a powerful causal influence, or, for the more cautious readers, as a simple correlational pattern in the data. The balancing couple exploration – explanation is also used in the abstract ("We (…) explore how different variables explain self-attributed ignorance in different countries", p. 39), and in the "Limitations" section ("the structures of self-attributed ignorance can be fruitfully explored and insights can be gained into their distribution and into what best explains it", p. 46).

4.4.5   *Socio-demographic variables and the 'factor factory'*

To summarize the discursive work of socio-demographic variables, they carve *structures*, they chisel *factors*, and they serve as factors themselves. By virtue of their rich inferential potential, which they carry over from common reason and from volumes of scholarly research reaffirming their correlation with virtually anything, socio-demographics can give comfort in the quality of data and the plausibility of results (thus serving as 'pacifiers'). When they are 'controlled for', they aid in sharpening the meaning of coefficients and thus in highlighting the substantive independent variables in their role as factors (thus acting as 'beetle-larvae'). Last but not least, due to their inferential power, they are easily cast as 'factors' in themselves: socio-demographics can be plausibly integrated into a narrative that accounts for variation in any event – and plausibility plus correlation is what it takes to be a good factor.

5   Discussion: The rhetorical production of disattention to age in survey research

In this article we argue that common argumentative strategies in working with and reporting survey data rely on systematic and productive *disattention* to a social theoretical understanding of age. On

the one hand, age is treated as a numerical attribute of the person, that is, as clock-time age[5], completely independent from theoretical considerations concerning the social construction and utilization of age as a categorization and identification device. On the other hand, sometimes researchers do not even use or build upon those insights on age and aging that are generated through statistical analysis of survey-data, such as the conceptual disambiguation of aging and cohort, or the interpretation of surprising empirical findings. Since this is, in our judgment, a general practice, we consider it *standard use* rather than *misuse* of the survey method.

From a broader perspective, there are several reasons why this inquiry practice should change:

a) Survey researchers participate in a rhetoric of age as an ingredient of persons, an internal causal factor. The survey rhetoric for working with age and reporting age-related findings is similar with the rhetoric for working with Helicobacter pylori and reporting it as a risk factor. This discursive introjection de-socializes age and has affinities with a biological understanding of age.

b) The practice of estimating aging effects in the aggregate, as largely shared across cohorts and various populations, also facilitates an understanding of aging that is dismissive of people's agency in shaping their lives, and of social variation and change in institutional age arrangements.

c) Through internalization and uniformization, and through the statistical parlance about "age effects", age is matter-of-factly anticipated and reported as a *cause* of deficient behavior (in the case at hand, a 'factor' in the "epidemiology of ignorance responses", M. Bauer & Joffe, 1996, p. 10) - which amounts to a form of epistemological violence (Teo 2011).

d) We take it that an understanding of age as resource and outcome of structuring processes, and of aging as diverse human experiences, is important for a self-determined life; we also take it that social researchers are privileged to have time in their working hours to reflect upon these matters. Still, survey research is, to a large extent[6], a distraction in this humanistic pursuit, encouraging systematic disattention to age and disconnection from theorizing age.

A change in survey rhetoric concerning age would be largely dependent on three types of actions. First, it would involve a shift in theoretical commitments, with *attention to social theories of age and aging*. For example, statistical findings from an APC analysis of the relation between attitude change and aging can be interpreted in light of social theories of aging, rather than by appealing to common-sense understandings of aging as memory decay or disengagement from social life (Danigelis et al. 2007):

> More generally, our results also question life course theories and theories of aging that at least implicitly set older people apart and emphasize persistence and adherence to earlier attitudes, values, and world views. Impressionable years' hypotheses and

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[5] 'Clock-time age' is widely referred as 'chronological age' (Settersten & Mayer 1997) (Baars 2010). Still, we think that clock-time age makes for a better label: the problems of chronological age do not derive from its being linked to time, since age is conceptually related to the temporal unfolding of life. That is, age is chrono-logical by definition. It is clock-time that requires homogeneity and imposes a standard of synchronization that disregards the social organization and the subjective experiences of age.

[6] We refer here only to survey research on topics that are not strongly linked to aging, life course, and other age-related concepts, and which consequently makes use of age mostly as a socio-demographic variable.

gerontological theories that focus on disengagement and persistence imply that aging is accompanied by a growing resistance to change. We do not claim to have falsified these theories, although the present findings lend little support to the more determinate predictions associated with these arguments. Rather, our data suggest that an emphasis on social structure that differentiates the old from the young fails to capture a social structure in which period effects can influence people across the lifespan (p. 823).

Second, it would be favored by a change in typical research agendas of specialists working in survey research. For all arguments concerning the primacy of the topic and the secondary, instrumental nature of methodology, we can observe a strong methodological specialization in either 'quantitative' or other types of methods. *It is a rare exception to find authors who work, at least in the PUS field, within diverse methodological approaches.* This specialization is also observable in survey articles' sections on 'further research', which typically recommend further survey research with improved techniques, extended datasets or, at best, a 'complementary' qualitative approach that would fill in the nuances and qualitatively illustrate the structural quantitative findings. There is no opening, in survey research, for other types of inquiries into social structure and social order than quantitative.

Third, last but not least, such a change would require *a rhetorical transformation* – that is, a change in argumentation focus and style. If patterns in quantitative data are studied and interpreted as blurry, aggregate images rather than 'objective structures'; if the search for even more refined measurement techniques and models to compensate for 'weak' or 'error-laden' data is replaced with a search for indicators that are reasonably interpretable as conversational events, without needing further statistical processing; if more trust is placed on scholars' observation and engagement, throughout many methods and contacts, with characters and events of interest, rather than on statistical technique; if the quasi-causal jargon is replaced with a descriptive vocabulary that does not seek persuasion by ambiguity and plausible deniability; then, survey research can become more compatible with research on age and aging informed by social theory. A succinct example: when reporting 'aging effects', as the standard statistical parlance and software outputs have it, aging becomes a process distinct from whatever change it supposedly 'causes'. A first-step rhetorical solution is to replace 'aging effects' with simply 'aging', or 'age-related changes', pointing to the mutual constitution of aging and organized change in life situations.

We can observe a more attentive treatment of aging in PUS research that avoids the "deficit model" of scientific literacy (Gross 1994), focusing instead on how the public interacts with science in situations which are relevant for people themselves, rather than for researchers. As an illustration, Shaw (2002) interviews a diversity of people, including elderly respondents, on their attitudes towards GM foods. She takes into account age in interpreting results, framing it as a correlate of individual experiences and structures of relevance, rather than as memory decay, ignorance, or deficient education. We can find a similar approach in Kerr et al. (1998), where authors understand lay people's knowledge of scientific constructs, including a group of elderly respondents, in relation with their experiences and concerns shaped through specific biographies. Jette & Vertinsky (2011) highlight the pragmatism of elderly women in combining Western medicine with traditional Chinese medicine, and they investigate the life worlds from which such combinations appear. As a closing example, Arber et al. (2008) discuss elderly women and men's knowledge of health issues and medical technologies in two overlapping contexts: present-day considerations of decisions about prolonging life, and life-course experiences of caring for others. Age does not feature as an

individual, biological attribute, but as an index towards ways of perceiving selves and others, shaped through years of work and recurrent patterns of interaction.

6   Conclusions

To reiterate Gubrium and Wallace's (1990) response to the question 'Who theorises age?', it is not only gerontologists, neuropsychologists, sociologiss or anthropologists who propose various models of age and aging, but also, most frequently, ordinary individuals in and as part of their daily activities. The social constructionist approach to age and aging (Gubrium & Holstein 1999; Holstein & Gubrium 2000) sets out to observe, document, understand and systematize the plethora of metaphors, discourses, categories, repertoires, narratives, characters and images that make up the sets of interpretative practices and resources people use for making sense of their life course, their age-related experiences and events. As such, chronological age, life stages, or age-associated norms are not treated as structuring principles, but as products of the organization of lived aging (Bytheway 2011; Holstein & Gubrium 2000; Marschall 1979). In this context, the response to Marshall's (1999) question whether it is both possible and desirable to embark on a research endeavor without a theory of age becomes self-evident. As we have shown, this is precisely what quantitative social research has tried, unsuccessfully, to get away with.

A meaningful inquiry about age in survey research does not require detailed measurements of various types of age, such as those discussed by Settersten & Mayer (1997) in their review: biological age, social age, psychological age, functional age, identity age, feel age, look age, interest age, cognitive age, or relative age (but, of course, it does not preclude them). Neither does it require that age become a focus of analysis. The point is that clock-time, numerical age can be used as a scaffold to understand the social organization of aging, or *age structuring* (*ibid*.), since it is actually widely used as an ordering benchmark in contemporary societies. The required change in inquiry would be that chronological age *ceases to be a 'predictor' and becomes a correlate*, in which typical ages are described by typical situations and configurations. Age would thus lose its explanatory status based on certainty about what age is and how it impacts events, and becomes an open topic of investigation into the social process of age classification and age-based organization.

Therefore, we argue that surveys allow interpretive openness, in agreement with Bauer (1996, p. 45) – provided that there occurs a substantial transformation in inquiry practices. It would require turning surveys' power inside out: instead of transmuting 'weak numbers' into 'strong structures' or 'accurate factors', one could proceed to use 'reasonable data' for exploring 'fuzzy patterns' and contributing to theoretically informed and methodologically diverse discussions of social organization and social life.

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