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Exploring the Effects of Interviewer- and Self-Administered Survey Modes on Record Linkage Consent Rates and Bias

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In an effort to reduce data collection costs survey organizations are considering more cost-effective means of data collection. Such means include greater use of self-administered interview modes and acquiring substantive information from external administrative records conditional on respondent consent. Yet, little is known regarding the implications of requesting record linkage consent under self-administered survey modes with respect to consent rates and consent bias. To address this knowledge gap, we report results from a linkage consent study in which employees in an employment survey were randomly assigned to an interviewer-administered (face-to-face) or self-administered (mail/web) interview, which included a consent question to link to federal employment records. We observed a strikingly lower linkage consent rate in the self-administered (53.9 percent) versus the interviewer-administered (93.9 percent) survey mode. However, the impact of survey mode on linkage consent bias was much less severe: survey-measured correlates of linkage consent did not interact with mode and relative consent biases in the linked-administrative variables tended to be small (less than 6 percentage points) under both mode groups; though, linkage consent biases in the administrative variables were larger in the self-administered mode group compared to the interviewer-administered mode group, on average. We discuss the implications of these findings for survey practice and speculate on their possible causes.

Keywords: administrative records; informed consent; mode effects; employment survey; record linkage

1 Introduction

Collecting high quality sample survey data is a challenging exercise. Survey organizations are continually grappling with declining response rates, non-coverage of the target population, and pinched budgets that threaten the quality of the collected data (Curtin, Presser, & Singer, 2005; Pew Research Center, 2015). Overcoming such challenges while simultaneously cutting costs – a seemingly counterproductive operation – has forced survey organizations to consider more cost-effective means of data collection, including greater use of self-administered modes of data collection (e.g., mail, web), or a combination of self- and interviewer-administered (e.g., face-to-face) modes deployed in sequence (De Leeuw, 2005). Another cost-effective strategy is to supplement, or link, the collected survey data with external administrative records. Supplementing surveys with administrative records (e.g., social insurance records, employment records, or welfare records) greatly expands the amount of substantive and longitudinal information on a given unit, enabling more detailed analyses than would otherwise be possible using survey data alone. For these reasons, numerous large-scale surveys perform administrative data linkages, including the US Health and Retirement Study (HRS), the US Panel Study of Income Dynamics (PSID), Understanding Society – The UK Household Longitudinal Study, the English Longitudinal Study of Ageing (ELSA), and the German panel study "Labour Market and Social Security (PASS)."

While linking administrative records to surveys has clear advantages, one significant challenge is obtaining respondent

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permission to access and link these highly confidential data. In multiple countries, such as the United States and Germany, legal regulations require that consent be obtained from survey respondents prior to linkage[1] (German Code of Social Law X, 2013; German Federal Data Protection Act, 2013). As such, surveys typically request linkage consent from respondents at some point during the interview. The proportion of respondents who agree to this request varies widely from study to study. Literature reviews suggest that linkage consent rates (in percentages) vary from the low-20s to the high-90s (da Silva et al., 2012; Sakshaug & Kreuter, 2012). There is also evidence that linkage consent rates are declining over time. For example, the National Health Interview Survey saw their linkage consent rate decline from 85 to 50 percent between years 1993 and 2005 (Dahlhamer & Cox, 2007). The Survey of Income and Program Participation observed a similar drop from 88 to 65 percent between years 1996 and 2004 (Fulton, 2012).

In addition to falling consent rates which diminish the number of linked cases available for analysis, the lack of full consent also has potential bias implications. Studies have shown that non-consent is a non-random process and that consenters systematically differ from non-consenters with respect to commonly-measured survey variables, including demographics, financial characteristics, health measures, and attitudes regarding trust and data confidentiality (e.g. Al Baghal, Knies, & Burton, 2014; Sakshaug, Couper, Ofstedal, & Weir, 2012; Sala, Burton, & Knies, 2012). However, the magnitude and direction of consent biases are inconsistent across studies. For example, some studies show that respondent age is positive correlated with consent (Beebe, J.Y., Jenkins, Haas, & Davern, 2011; Jenkins, Cappellari, Lynn, Jäckle, & Sala, 2006; Young, Dobson, & Byles, 2001), while others report a negative correlation (Al Baghal et al., 2014; Banks, Lessof, Taylor, Cox, & Philo, 2005; Dahlhamer & Cox, 2007; Sala et al., 2012). Health measures have also been shown to be inconsistently related to consent (Dahlhamer & Cox, 2007; Haider & Solon, 2000; Young et al., 2001). Notwithstanding these inconsistencies, it is evident that many important survey variables are susceptible to linkage consent bias.

The dual threat of low linkage consent rates and increased risk of linkage consent bias is concerning for researchers seeking to obtain valid and robust inferences from linked survey and administrative data. These concerns are even more salient at a time when surveys are shifting away from expensive interviewer-administered modes of data collection towards cheaper self-administered modes, because the lack of an interviewer could adversely affect linkage consent rates. Interviewers play a critical role in the linkage consent process as the concept of linkage is likely to raise questions (and possible concerns) among respondents. Interviewers can address these issues directly and ensure the necessary information is collected to certify the consent (e.g., signature, unique ID key). These positive aspects of interviewers are naturally lost if the consent request is delivered via self-administration.

Not only does the survey mode affect the administration of the linkage consent procedure, it can also affect the composition of the respondent pool. Because linkage consent is conditional on survey participation, the composition of respondents can influence the linkage consent rate. Hence, if different modes bring in different types of respondents then this could contribute to differences in linkage consent rates between modes. For instance, self-administered surveys tend to elicit respondents who are better educated than their interviewer-administered counterparts (Roberts, 2007) – an attribute shown to be positively correlated with linkage consent (Knies, Burton, & Sala, 2012; Sakshaug et al., 2012; Young et al., 2001). Moreover, leverage-saliency theory asserts that members of the population who have higher levels of interest in the survey topic are more likely to participate in surveys than those with lower levels of interest (Groves, Presser, & Dipko, 2004, 2000). To the extent that topic interest is positively related to linkage consent, modes which lack interviewers to motivate population members that have low interest in the survey topic could yield higher linkage consent rates than interviewer-administered modes. On the other hand, trust in the survey organization and perceived legitimacy of the survey – both factors which likely influence the linkage consent decision – have been attributed to interviewer presence (Roberts, 2007).

The net effect of both factors – differential nonresponse and level of interviewer involvement – on linkage consent rates in self- and interviewer-administered surveys remains an open topic of investigation. The empirical literature suggests that self-administered surveys yield lower linkage consent rates than interviewer-administered ones. In a review of 22 surveys, Fulton (2012) found that mean linkage consent rates were highest in face-to-face surveys (75 percent) followed by telephone (63 percent) and mail (49 percent) surveys. Only three surveys were conducted by mail and none by web – a result which reflects the sparseness of self-administered surveys that request linkage consent. Only few web surveys have reported linkage consent rates. For example, Sakshaug and Kreuter (2014) observed a linkage consent rate of 60 percent in a survey of social security contributors and benefit recipients in Germany. Sakshaug and Vicari (in press) reported a linkage consent rate of about 53 percent in a survey of German establishments. It is worth noting that all of the reviewed linkage consent studies varied in their target populations, sponsorship, and questionnaire content, which confounds the comparison of linkage consent rates between modes. To our knowledge, no study has compared linkage consent rates achieved under self- and interviewer-administered survey modes which were randomly assigned

[1] US Privacy Act of 1974, 5 U.S.C. § 552a.

to sampled units recruited as part of the same study, holding the above survey design features constant.

Beyond linkage consent rates, another important consideration is the influence of mode on linkage consent bias. As previously noted, there are many published results of systematic differences between consenters and non-consenters with respect to commonly-measured survey variables, but whether these correlates of consent are differentially affected by mode is unknown. The impact of mode on linkage consent bias in the linked administrative variables is also an important, yet understudied, topic of interest to linked-data analysts. Evaluating the extent of consent bias in linked-administrative variables can be a challenging task given that administrative records belonging to the non-consenting units are usually not made available for research purposes. Some studies have overcame this issue and were able to examine administrative records for all survey respondents regardless of linkage consent (e.g. Sakshaug & Huber, 2016; Sakshaug & Kreuter, 2012). These studies revealed statistically significant, but generally small, consent biases for the linked administrative variables. However, these evaluations were based on interviewer-administered surveys that achieved relatively high linkage consent rates (about 80 percent or higher). An open question is whether these bias results translate to self-administered surveys, which are likely to yield lower linkage consent rates than their interviewer-administered counterparts.

In this article, we address these research gaps using an employment survey in Germany. The survey implemented a unique study design in which a sample of employees was randomly assigned to be interviewed via an interviewer-administered (face-to-face) or self-administered (mail/web) mode. All respondents were asked for consent to link their responses to federal employment records. Employment records were made available for both consenting and non-consenting respondents to facilitate the evaluation of linkage consent bias on the linked administrative variables. Altogether, the study design allows us to address the following research questions:

1. Do self- and interviewer-administered modes of data collection yield different linkage consent rates in the same survey? Specifically, do self-administered interviews yield lower linkage consent rates than interviewer-administered interviews as suggested by the literature?

2. Are survey-measured respondent correlates of linkage consent differentially impacted by self- and interviewer-administered modes of data collection?

3. Does the magnitude of linkage consent bias in estimates of linked administrative variables vary by self- and interviewer-administered interview modes?

In answering these questions we aim to provide useful insight to survey organizations that are considering shifting more of their data collection operations from interviewer- to self-administered survey modes and want to know about the potential implications that such a decision will have on the quality of their administrative data linkages.

2 Data and Methods

The present study makes use of two data sets. The analysis of linkage consent rates and survey-measured respondent correlates of linkage consent is based on the first wave of the "Legitimation of Inequality over the Life Span (LINOS)" panel survey. The analysis of linkage consent bias for estimates of linked-administrative variables is based on federal employment records from the "Integrated Employment Biographies (IEB)" database, which are made available for all survey respondents regardless of consent. Relevant details of each data source are provided below.

2.1 Survey data collection

LINOS is a long-term panel survey in Germany. The first wave (LINOS-1) was conducted in Winter 2012/13 as part of subproject A6 of the Research Center 882 "From Heterogeneities to Inequalities" based at the University of Bielefeld (Sauer & Valet, 2014; Sauer, Valet, & Meyer, 2014; Valet, May, Sauer, & Liebig, 2014). The survey was carried out in cooperation with the German Institute for Employment Research (IAB) of the Federal Employment Agency (BA) and federally funded by the German Research Foundation (DFG). The target population consists of individuals aged 18 to 57 years who on December 31st, 2011 were employed and liable to social security contributions. The LINOS panel investigates the conditions under which inequalities are perceived as problems of justice and how social contexts influence the formation of justice attitudes over the life span. The LINOS-1 dataset (Liebig, May, Sauer, Schneider, & Valet, 2014) provides detailed employee information, including socio-demographic characteristics, attitudes toward justice and inequality, and information about their employment situation and social network.[2]

LINOS-1 was implemented using multiple modes of data collection, including two self-administered modes: paper-and-pencil interviewing (PAPI) and computer-assisted web interviewing (CAWI), and one interviewer-administered mode: computer-assisted personal interviewing (CAPI). Separate random samples were allocated to each of the two mode groups. The samples for the self-administered (PAPI/CAWI) group and the interviewer-administered (CAPI) group consisted of 28,001 and 9,986

[2] A scientific use file for the LINOS-1 survey data is currently under preparation. The data will be made available at the Research Data Center of the IAB in the future.

named individuals, respectively. Both samples were drawn from social security records housed at the IAB. The CAPI sample was drawn in two stages. First, a random sample of 60 (out of 178) geographical districts (defined by the BA) was drawn from IAB records. Then a random sample of employees within each sampled district was drawn proportionate to the total number of employees in each district. The PAPI/CAWI sample was drawn in a single stage across all 178 districts (Valet et al., 2014). Younger persons (< 30 years) and persons with shorter job tenures (≤24 months) were oversampled in both mode groups to meet analytic objectives.

Advance letters introducing the study and the multiple actors involved, i.e. the University of Bielefeld, IAB, DFG, and the third-party survey contractor, were mailed to all sampled individuals. Subsequent screening calls were made when a telephone number was available. For the self-administered mode group, a choice was offered between completing the questionnaire via PAPI or CAWI. If a telephone number wasn't available then the PAPI questionnaire was mailed along with a personalized CAWI code and an invitation link. For the CAPI mode sample, individuals were informed that their contact details would be transferred to an interviewer who would contact the respondent in order to arrange an appointment. For the non-telephone cases, the interviewer just showed up at the household. Additional recruitment details can be found elsewhere (Sauer & Valet, 2014; Sauer et al., 2014; Valet et al., 2014).

A total of 4,731 (out of 37,987) individuals completed the survey for an overall response rate of 12.5 percent (Response Rate 1 AAPOR, 2016), which is comparable to other surveys in Germany (e.g. Berg et al., 2012; Schaurer, Struminskaya, & Enderle, 2014). The CAPI mode yielded 1,010 interviews for a response rate of 10.1 percent, whereas 3,721 completed the PAPI ($n = 2,459$) or CAWI ($n = 1,262$) interviews for a combined self-administered response rate of 13.3 percent. Some ($n = 153$) of the PAPI/CAWI interviews were completed by individuals who were initially assigned to the CAPI mode. This was done for logistical reasons in cases where a CAPI interview was not practically feasible. We remove these cases from all subsequent analyses, although a sensitivity check revealed that their removal did not alter the study's conclusions. Hence, the full respondent pool used in this analysis consists of 4,578 cases.

2.2 Record Linkage Consent procedure

All survey respondents were asked for consent to link their survey data to IEB administrative records. Respondents were presented with the following statement and question:

> "In order to analyze this survey we would like to use data from the Federal Employment Agency in Nuremberg. This includes, for example, additional information about your past employment status. In order to link the data we will issue a random identification number which cannot be traced back to your name and will assure your anonymity at all times. We guarantee that all data protection regulations are strictly followed. Your consent is, of course, voluntary and can be withdrawn at any time. Do you agree to the linking of your data?" (Sauer et al., 2014, p. 23)[3]

The consent procedure was administered early in the questionnaire (page 6 of the 32 page PAPI questionnaire). Respondents answered the consent question verbally in the CAPI interview and ticked a box in the PAPI/CAWI interview. There was no additional consent form or signature requirement.

2.3 Respondent Correlates of Linkage Consent

In examining the impact of mode on respondent correlates of linkage consent we focus on five sets of survey variables: respondent background, perceived injustice, trust, survey attitudes, and financial item nonresponse. We elaborate on and motivate each set of variables below.

Respondent Background. Respondent background variables include sex, age, education (measured via the CASMIN classification; König, Lüttinger, & Müller, 1988), region (East vs. West Germany), and whether the respondent was born in Germany. Employment/occupation-related variables include occupational prestige captured by the International Socio-Economic Index of Occupational Status (ISEI; Ganzeboom, De Graaf, & Treiman, 1992), employment status (part-time vs. full-time), and employment branch (public/non-profit vs. private/self-employed). Similar background variables have been used in studies evaluating correlates of linkage consent (e.g. Knies et al., 2012; Sakshaug et al., 2012).

Perceived Injustice. Research shows that perceived (in)justice has various consequences for individuals' attitudes, behaviors, and health (e.g. Greenberg & Colquitt, 2005; Jones, 2009; Sabbagh & Schmitt, 2016; Sauer & Valet, 2013; Schunck, Sauer, & Valet, 2015; Tyler & Blader, 2000). Justice is multifunctional (Liebig & Sauer, 2016; Liebig, Sauer, & Hülle, 2015) and, among other aspects, it represents a mechanism that facilitates effective cooperation by providing the rules of how to cooperate and resolve conflicts (e.g., by applying distributive justice principles that guide the distribution of goods and burdens), or by enabling people to determine (un)acceptable outcomes in interactions with another party (Hülle, Liebig, & May, 2017; Tyler, 2012). According to social exchange theory (Blau, 1964; Homans, 1961),

[3]The original German item wording can be found in Sauer and Valet (2014, p. 191).

individuals are self-interested and maximize their own utility by engaging in beneficial exchange relationships. Hence, "cooperation is driven by the desire to maintain the reciprocal exchange of valued benefits between the parties (Blader & Tyler, 2005, p. 336)." According to Homans (1961), exchange relationships are perceived just when the profits (rewards minus (investment) costs) of two actors are equal or proportional (Cook, Cheshire, Rice, & Nakagawa, 2013, p. 68). On the contrary, perceived injustice exists in the exchange relationship when the costs are higher than the rewards, i.e. the outcome is negative and unfavorable. Moreover, perceived injustice also signals that one's own interests are being disregarded by the other party. The result is a lower willingness to engage in cooperative activities with the interaction partner (May, 2016, p. 101).

Following this perspective in the survey context with respect to linkage consent, we expect that the likelihood of a respondent's cooperation with the linkage request increases the more s/he considers her/his own exchange relationship with the government survey partners (DFG, IAB, University of Bielefeld) to be just. Conversely, the more a respondent evaluates her/his own relationship with the government to be unjust, the less likely s/he will cooperate with the linkage request. To our knowledge, (in)justice,[4] and therewith, this expected relationship has not been assessed in the linkage consent literature.

We assess perceived injustice with the federal government on the basis of two items. The first item relates to the (in)justice of social security contributions ("When you think about your monthly contributions to the social security system (contributions to healthcare, nursing care, pension, and unemployment insurance), would you say these contributions are just, unjustly too low, or unjustly too high?"). The second item reads the same but refers instead to "the amount of income tax you currently have to pay." The 11-point scale of both items ranges from "unjustly too low" (−5) to "unjustly too high" (5), while the middle category constitutes a "just" burden (0). The computed injustice measure is an additive index that assesses the number of evaluations in which the burden is considered as "unjustly too high" (values from 1 to 5) ranging from 0 to 2, i.e. the higher the value the more frequently the burdens are evaluated as "unjustly too high."[5]

Trust. There is clear empirical evidence that trust fosters cooperation during individual interactions (e.g. Balliet & Van Lange, 2013). When there is trust, persons are more open towards others, have a higher readiness to initiate interactions, and to join into lasting relationships (Sztompka, 1999, p. 103), but in situations of distrust, people are hesitant to initiate interactions and engage in cooperative behaviors. Though, when considering the relationship between trust and the specific cooperative behavior of linkage consent, the empirical evidence is rather mixed. According to qualitative results of an open-ended question for the reason(s) of (non)consent, "trust" was mentioned only by 3 percent of non-consenters, while "trust" (or a belief that "no harm" would result from granting record access) was mentioned by only 5.6 percent of consenters (Fulton, 2012, pp. 162–166). Similarly, Sala, Knies, and Burton (2014) observed that less than 10 percent of linkage consenters and non-consenters mentioned "trust in survey/field agency" among a list of reasons for their linkage consent decision. Other studies have considered trust as a predictor of linkage consent. Al Baghal (2016) found a positive effect for the single item of "trust in strangers" and Sala et al. (2012) reported a positive effect of the dummy variable "generally trust others." In contrast, Fulton (2012) found no effect of a trust index.

In our own context, we expect that respondents with higher levels of trust in interactions with different potential actors will have a higher likelihood of consent compared to respondents with lower levels of trust. We measure trust on two explanatory levels: the micro- and macro-level. We consider micro-level trust toward actors in the narrow surrounding such as family and neighbors, and macro-level trust toward actors on a broader societal level such as government and political parties. We expect that both levels of trust are relevant for the record linkage decision. Both levels of trust are measured on the basis of an item battery that asks "How much do you personally trust the following persons, public institutions and organizations?" and lists different actors. The 7-point scale ranges from "trust not at all" (1) to "trust completely" (7). Trust on the micro-level is assessed for three actors: "your neighbors," "your colleagues," and "the head of the organization you work for." Trust on the macro-level is assessed for the following three actors: "big corporations," "political parties," and "the federal government." We computed two mean indices based on these groupings of actors; thus, larger values of the computed indices denote greater levels of trust.

Survey Attitudes. People's attitudes towards surveys have been shown to affect their response behavior and data quality in particular. Specifically, respondents with more positive attitudes towards the usefulness of survey data and the perceived value of survey efforts contribute fewer missing values and are more willing to take part in additional surveys compared to those with less positive attitudes and perceptions (Rogelberg, Fisher, Maynard, Hakel, & Horvath, 2001).

[4]Fulton (2012) uses a "fairness" dummy variable that is part of a trust index as a predictor for linkage consent, which turns out to be insignificant. However, the issue of justice or fairness as such is not discussed.

[5]Our computed measure of perceived injustice combines "just" and "unjustly too low" responses into a single reference category. While we acknowledge that these responses are substantively different, we expect both responses to be positively related to consent because in each case the burdens are not considered "unjustly too high," i.e. as rather fair, which constitutes the rationale for combining them.

It is conceivable that survey attitudes are also positively related to linkage consent as studies have demonstrated relationships between attitudes, intentions, and behaviors (e.g. Ajzen & Fishbein, 1977; Fishbein & Ajzen, 1975). In this context, we hypothesize that people with positive survey attitudes should be more likely to develop intentions to comply with survey requests, including linkage consent. Based on our review of the linkage consent literature, we are not aware of studies that have explicitly tested this hypothesis. We construct a survey attitudes index measure which is based on an item battery with the introductory text: "People can have very different views about the meaningfulness of social surveys. Please indicate how much you agree with the following statements." The four statements were: "Surveys are very important for science, politics and the economy," "Surveys bring variety and are interesting," "In most cases survey results are correct," and "Survey participants usually give their true opinion." The 7-point scale for each item ranges from "disagree completely" (1) to "agree completely" (7). The four items are operationalized with a mean index, where higher values denote more positive attitudes towards surveys.

Financial Item Nonresponse. One of the most common consent correlates found in the linkage consent literature is that respondents who deliberately avoid answering financial and other sensitive items are less likely to consent to linkage (Jenkins et al., 2006; Sakshaug et al., 2012; Sala et al., 2012). The result likely underlies a reluctance to share any sensitive information, regardless of its form, due to concerns about a potential breach of data confidentiality or misuse of the data, or a general feeling that the information is simply too personal to share. In line with previous studies, we construct a measure of financial item nonresponse by assessing the amount of missing values to financial items in the LINOS-1 questionnaire. Specifically, we construct an additive index counting the number of missing values for the following four income-related questions: net income ("How high is your monthly net income from employment?"), gross income ("How high is your monthly gross income from employment?"), household net income ("How high is the total net monthly income in your household?"), and tax class ("Please indicate your tax class.").

2.4 IEB Administrative Data

Linkage consent biases for administrative variables are analyzed using the IEB administrative data (Antoni, Ganzer, & vom Berge, 2016; Bender & Haas, 2002; Jacobebbinghaus & Seth, 2007) – the same data source for which linkage consent was sought in the survey.[6] These administrative data are made available for all respondents – independently of whether or not linkage consent was obtained. This unique situation enables us to compare consenting and nonconsenting respondents and, in turn, estimate linkage consent bias for administrative estimates. The estimation of linkage consent bias is made possible by linking the consent indicator to the IEB data, as has been done in some prior linkage consent studies (Sakshaug & Huber, 2016; Sakshaug & Kreuter, 2012). This procedure avoids any linkage of substantive survey variables to the administrative data. Approval for this procedure was sought through (and granted by) the IAB legal department.

We make use of several IEB variables allocated to four variable groups: demographics, employment, wages, and benefits. The demographics group consists of four variables: sex, age (in years; less than 25, 25–32, 33–44, and 45 or older), foreign nationality, and highest level of education (intermediate/upper secondary, applied science degree, college/university degree, and a missing data category).[7] The employment group has six variables: currently employed, marginally employed, number of days on current job (1–152, 153–364, 365–1825, 1826 or more), number of days at current establishment (1–157, 158–502, 503–2224, 2225 or more), percentage of days employed since 2007 (0, 1–54, 55–99, 100), and number of employment changes since 2007 (0, 1, 2, 3 or more). The wages group consists of a single variable measuring average daily wage (in Euros; 28.69 or less, 28.69–63.95, 63.96–102.91, 102.92 or more). Lastly, the benefits group consists of two variables: number of benefit spells since 2007 (0, 1, 2, 3, 4 or more) and the number of days on benefits since 2007 (0, 1–365, 366 or more). The numerical variables were recoded into somewhat arbitrary categories after inspecting their distributions. Attempts were made to create equal sized categories when possible. All of these variables were measured on the date of December 31st, 2012, which approximately overlaps with the beginning of the survey field period.

These administrative variables were selected based on their common utilization in labor market research studies. Several surveys in Germany link to these data, including the PASS study, the National Educational Panel Study (NEPS), and the "Working and Learning in a Changing World (ALWA)" study. The high level of interest in these variables has also been exhibited in other survey methodological research (Kirchner, 2015; Kreuter, Müller, & Trappmann, 2010; West, Kreuter, & Jaenichen, 2013).

[6] The Integrated Employment Biographies (IEB) data are sensitive administrative data which are available for the researchers at the Institute for Employment Research (IAB; http://www.iab.de) in Nuremberg, Germany. The Research Data Center of the IAB (http://fdz.iab.de) supplies a 2% sample of the IEB as a Scientific Use File or weakly anonymous version via on-site use and remote execution for external researchers (Ganzer, Schmucker, vom Berge, & Wurdack, 2017).

[7] Missing data in the IEB education variable is a well-known issue in studies analyzing this variable. The missing data rate is about 15 percent in the present study. Imputation techniques have been proposed specifically for this variable (Fitzenberger, Osikominu, & Völter, 2005), but we do not make use of them here.

2.5 Statistical Analysis

In addressing the first research question we utilize the full set of survey respondents who complied with the randomized mode assignment ($n = 4,578$) as the linkage consent question was posed to all of them. Because the PAPI and CAWI modes were self-selected by respondents and not randomly assigned, we combine them into a single self-administered mode group. We use chi-squared tests to test the overall effect of self- and interviewer-administration on linkage consent. In testing the effect of mode on linkage consent we also control for respondent compositional differences using the aforementioned respondent background variables (e.g. age, sex, education, etc.).

To assess the impact of mode on correlates of linkage consent (the second research question), we first restrict the survey data to the 3,451 respondents (PAPI/CAWI: $N = 2,698$; CAPI: $N = 753$) who reported being currently employed at the time of the interview. The reason for excluding the unemployed cases is that they were not asked all questionnaire items in the survey, including some of the items hypothesized to be related to linkage consent (perceived injustice and financial items). To examine respondent correlates of linkage consent we fit two logistic regression models where linkage consent (1 = consent; 0 = no consent) is the dependent variable and the independent variables comprise the five sets of survey variables: respondent background, perceived injustice, trust, survey attitudes, and financial item nonresponse. The first model (Model 1) consists of main effects to assess whether these independent variables are significantly related to the linkage consent outcome across both mode types. To evaluate the impact of mode on these correlates of linkage consent we interact each independent variable with an indicator variable of mode (1 = CAPI; 0 = PAPI/CAWI). We then test these interaction terms to determine whether mode influences the relationship between the independent variables and the linkage consent outcome. Two indicators of model fit are used: McFadden's Pseudo R^2 and Area under the ROC curve (AUC).

Fitting the logistic regression models resulted in a non-trivial loss of cases due to item missing data in the independent variables. The missing data pattern was not random as missingness was found to be related to demographic and other background variables. Hence, the decision was made to multiply impute the missing values for all independent variables used in this analysis. A total of 10 imputations were generated using the `mi impute chained` command in Stata 14.2 (StataCorp., 2015);[8] smaller numbers of imputations did not change the conclusions of the regression analysis. The regression models were fit using the *mi estimate* command, which accounts for the between-imputation variance in the estimated standard errors.

The third and final research question is addressed by computing estimates of linkage consent bias for estimated proportions of the categorical IEB administrative variables. For this analysis we utilize the entire respondent pool ($n = 4,578$) and present linkage consent bias estimates separately for the PAPI/CAWI and CAPI mode groups. Estimates of linkage consent bias are calculated by computing the difference between the i^{th} proportion of interest ($P_{i,c}$) derived from the c consenting respondents with the corresponding proportion derived from all r respondents ($P_{i,r}$):

$$\text{Linkage consent bias for the } i^{\text{th}} \text{ proportion} = P_{i,c} - P_{i,r} \quad (1)$$

We also report an absolute relative consent bias (ARCB) measure to assess the relative size of the linkage consent bias in relation to the size of the respondent-based proportion. The ARCB measure is calculated by dividing the above linkage consent bias expression by the respondent-based proportion ($P_{i,r}$) and computing the absolute value of this ratio:

$$\text{ARCB for the } i^{\text{th}} \text{ proportion} = \left| \frac{P_{i,c} - P_{i,r}}{P_{i,r}} \right| \quad (2)$$

Lastly, we summarize the impact of linkage consent bias for each of the four IEB variable groups by reporting the average ARCB value across all $i\,(= 1, \ldots, K)$ estimates associated with a given variable group:

$$\text{Average ARCB value for a given variable group} = \frac{\sum_{i=1}^{K} \left| \frac{P_{i,c} - P_{i,r}}{P_{i,r}} \right|}{K} \quad (3)$$

All analyses account for survey weights, stratification, and clustering by using the Stata survey commands. The LINOS-1 survey weights account for unequal probabilities of selection and nonresponse. Nonresponse was adjusted separately for each mode group using a sample-based weighting class adjustment using variables from the sampling frame (sex, age, and job tenure). While the nonresponse-adjusted weights account for some factors of the selection process, they do not account for all-possible selection factors that are likely related to the linkage consent mechanism. Thus, we do not claim that the weights are ideal for disentangling the

[8] The `mi impute chained` command imputes missing values iteratively by using chained equations. More specifically, the procedure is implemented by fitting a series of univariate imputation models, one for each variable to be imputed. The variables are then imputed iteratively, with previously imputed variables used as predictors in subsequent imputations, until a specified convergence threshold is reached. In our application of the procedure, we included the following variables as predictors in the imputation models: sex, age, education, born in Germany, occupational prestige, full-time and part-time employment status, employment branch, perceived injustice index, trust indices, survey attitudes, financial item nonresponse index, linkage consent, mode of interview, and mode assignment.

effects of differential nonresponse and measurement on linkage consent. The inability to completely separate these two effects is a limitation of the study design.

3 Results

3.1 Respondent composition by survey mode

Before the linkage consent results are presented it is appropriate to report on compositional differences between respondents in each mode group as such differences could influence differences in the linkage consent rates. Table 1 provides univariate estimates of survey variables for all respondents separated by self- and interviewer-administered data collection modes. To give an example, the percentage of PAPI/CAWI respondents who were not born in Germany is 8.44, whereas the corresponding percentage among CAPI respondents is 12.15 – a statistically significant difference. CAPI respondents also have a higher mean education (CASMIN) score and a higher percentage of part-time workers compared to PAPI/CAWI respondents. No statistically significant differences are found with respect to other respondent background variables (e.g. sex, age, occupational prestige). Survey variables related to perceived injustice, trust, survey attitudes, and financial item nonresponse exhibit strong compositional effects. CAPI survey respondents report lower levels of perceived injustice and higher levels of trust (both micro- and macro-level), on average, compared to PAPI/CAWI respondents. CAPI respondents also express more positive survey attitudes, though they are less likely to answer financial items than PAPI/CAWI respondents.

3.2 Linkage consent rates by survey mode

Next we turn to the impact of survey mode on the linkage consent rate (Research Question 1). Linkage consent rates (overall and by mode group) are presented in Table 2. A total of 2,862 (out of 4,578) respondents consented to linkage for an overall (weighted) consent rate of 62.46 percent. As suggested by the linkage consent literature, the interviewer-administered mode group (CAPI) produces a higher linkage consent rate than the self-administered mode group (PAPI/CAWI): 93.88 percent (or 934 out of 1,010) of CAPI respondents consented to linkage, whereas only 53.87 percent (or 1,928 out of 3,568) of PAPI/CAWI respondents consented.[9] The difference between the two consent rates is statistically significant at the 0.001 level. The same conclusion is drawn after controlling for respondent demographic characteristics, including sex, age, education, region, Germany born, occupational prestige, and employment status (result not shown). To sum up, the results indicate a clear (and striking) effect of self-administered survey data collection on the linkage consent rate.

3.3 Respondent correlates of linkage consent and the influence of survey mode

The next analysis examines the association between survey-measured respondent attributes and linkage consent, and the impact of mode on these associations (Research Question 2). As a reminder, this analysis is performed on respondents who reported being employed at the time of interview ($N = 3,451$) as these respondents were presented with the full questionnaire. Table 3 presents odds ratios from two logistic regression models of linkage consent conditional on the five aforementioned sets of survey variables hypothesized to be related to consent: respondent background, perceived injustice, trust, survey attitudes, and financial item nonresponse. An indicator variable denoting mode of interview (1 = CAPI; 0 = PAPI/CAWI) is also included in the models. Model 1 shows odds ratios for the main effects of each covariate. This model is used to test the overall effect of each covariate on linkage consent. Model 2 provides main effects and interactions with the mode indicator variable for each covariate. This model is used to test whether mode influences the relationship of each covariate on linkage consent.

It is worth noting that the main effect of interview mode in Model 1 is highly significantly related to linkage consent (OR = 14.71; p–value = 0.000). That is, employed respondents interviewed by CAPI were more likely to consent to linkage than those who were interviewed by PAPI/CAWI, which is consistent with the previous analysis which found the same relationship regardless of employment status. The remaining model results are interpreted separately for each set of covariates.

Respondent background. The respondent background variables consist of sex, age, education, region, Germany born, occupational prestige, employment status, and employment sector. Model 1 shows that only one of these variables is associated with linkage consent; namely, respondents employed in the public sector are more likely to consent to linkage compared to private sector employees. A few marginally significant ($p < 0.10$) results are also observed: respondents who were born in Germany are more likely to consent than foreign-born respondents, and respondents residing in East Germany are more likely to consent than those living in West Germany. Model 2 does not reveal any significant mode interaction effects; that is, interview mode does not influence the relationship between respondent background variables and linkage consent.

[9] The two self-administered modes (PAPI and CAWI) yielded very similar linkage consent rates. The PAPI mode yielded a linkage consent rate of 53.37 percent (or 1,255 out of 2,323 respondents) and the CAWI mode yielded a linkage consent rate of 54.91 percent (or 673 out of 1,245 respondents). The difference between the two linkage consent rates is not statistically significant (chi-squared test statistic = 0.751; p–value = 0.449).

Table 1
Means (or Percentages) and Standard Errors (Std. Err.) of Respondent Characteristics, by Survey Mode (PAWI/CAWI vs. CAPI).

	Survey Mode				χ^2-test for Survey Mode
	PAPI/CAWI[a]		CAPI[b]		
Respondent characteristics	Mean/%	Std. Err.	Mean/%	Std. Err.	p-value
Sex (%)					
Female	49.03	0.96	48.53	1.84	
Male	50.97	0.96	51.47	1.84	0.809
Age	40.50	0.08	40.55	0.53	0.955
Education[c]	5.89	0.04	6.15	0.10	0.019
Region (%)					
East	21.09	0.79	18.67	3.04	
West	78.91	0.79	81.33	3.04	0.457
Born in Germany (%)					
Yes	91.56	0.53	87.85	1.33	
No	8.44	0.53	12.15	1.33	0.006
Occupational prestige[d]	46.31	0.32	47.77	0.78	0.082
Employment status (%)					
Full-time employed	69.21	0.86	63.53	1.80	
Part-time employed	15.84	0.71	20.25	1.58	
Not employed	14.95	0.60	16.22	1.48	0.009
Employment branch					
Public sector/non-profit	26.63	0.93	23.55	1.98	
Private/self-employed	73.37	0.93	76.45	1.98	0.171
Perceived injustice index[e]	1.38	0.02	1.20	0.04	0.000
Trust indices (larger values denote greater trust)[f]					
Micro-level	4.50	0.02	4.80	0.05	0.000
Macro-level	2.58	0.02	2.74	0.05	0.002
Survey attitudes index[g]	4.51	0.02	5.19	0.04	0.000
Financial item nonresponse index	0.67	0.02	0.92	0.06	0.000

All estimates are weighted and account for complex sample design features.
[a] $N = 3,568$ [b] $N = 1,010$ [c] CASMIN; larger values denote higher levels of education
[d] ISEI; larger values denote more prestige [e] larger values denote greater levels of perceived injustice
[f] larger values denote greater trust [g] larger values denote more positive attitudes

Table 2
Contingency Table of Linkage Consent, by Survey Mode.

	Consent		No consent		
Survey Mode	Percent	N	Percent	N	N (Total)
PAPI/CAWI	53.87	1,928	46.13	1,640	3,568
CAPI	93.88	934	6.12	76	1,010
Overall	62.46	2,862	37.54	1,716	4,578

All estimates are weighted and account for complex sample design features.
Chi-squared test statistic (PAPI/CAWI vs. CAPI) = 527.149; $p - value = 0.000$.

Table 3
Logistic Regression Coefficients (Odds Ratios) and Standard Errors (Std. Err.) of Linkage Consent on Respondent Survey Characteristics, and Interaction with Survey Mode (CAPI vs. PAPI/CAWI).

	Model 1: Main Effects Only			Model 2: Main Effects and Interactions		
Respondent characteristics	Odds Ratio	Std. Err.	p-value	Odds Ratio	Std. Err.	p-value
CAPI mode (ref: PAPI/CAWI)	14.71	3.50	0.000	3.81	6.04	0.397
Female (ref: Male)	0.86	0.08	0.110	0.86	0.09	0.120
× CAPI mode	-	-	-	1.06	0.36	0.868
Age	1.01	0.00	0.268	1.01	0.00	0.242
× CAPI mode	-	-	-	0.99	0.02	0.527
Education (CASMIN)	1.05	0.03	0.121	1.04	0.03	0.243
× CAPI mode	-	-	-	1.18	0.15	0.184
East Germany (ref: West Germany)	1.21	0.13	0.077	1.24	0.14	0.048
× CAPI mode	-	-	-	0.60	0.33	0.352
Born in Germany (ref: No)	1.33	0.21	0.069	1.36	0.23	0.062
× CAPI mode	-	-	-	0.83	0.57	0.785
Occupational prestige (ISEI)	1.00	0.00	0.806	1.00	0.00	0.677
× CAPI mode	-	-	-	0.99	0.02	0.554
Employed part-time (ref: Full-time)	0.92	0.11	0.481	0.96	0.12	0.734
× CAPI mode	-	-	-	0.64	0.23	0.205
Public sector (ref: Private sector)	1.24	0.13	0.037	1.24	0.13	0.039
× CAPI mode	-	-	-	0.98	0.58	0.976
Perceived injustice index	0.89	0.05	0.031	0.89	0.05	0.042
× CAPI mode	-	-	-	1.03	0.26	0.892
Micro-level trust index	1.09	0.05	0.030	1.09	0.05	0.036
× CAPI mode	-	-	-	0.97	0.16	0.828
Macro-level trust index	1.01	0.04	0.798	1.01	0.04	0.816
× CAPI mode	-	-	-	1.04	0.21	0.830
Survey attitudes index	1.24	0.05	0.000	1.22	0.05	0.000
× CAPI mode	-	-	-	1.39	0.34	0.183
Financial item nonresponse index	0.65	0.03	0.000	0.64	0.03	0.000
× CAPI mode	-	-	-	1.17	0.18	0.287
Intercept	0.20	0.08	0.000	0.21	0.08	0.000
McFadden's Pseudo R-Square		0.153			0.155	
Area under the curve (AUC)		0.741			0.738	
Sample size		3,451			3,451	

All estimates are weighted and account for complex sample design features.

Perceived injustice. The next respondent attribute we examine is perceived injustice. We hypothesized that respondents who feel that their federal tax and social security contributions – topics which might be salient to respondents given the many government partners involved in the survey – are "unjustly too high," will be less likely to consent to linkage of federal employment records. Model 1 supports this hypothesis as the perceived injustice index is negatively associated with linkage consent. The interaction of the perceived injustice index and interview mode is not statistically significant, suggesting that mode of interview does not affect the relationship between perceived injustice and linkage consent.

Trust. The next factor that we consider is trust. Based on our earlier hypothesis we expect that respondents who possess higher levels of trust with respect to micro-level (e.g., family and neighbors) and macro-level actors (e.g., government and political parties) will be more likely to give linkage consent. We find partial support for this hypothesis in Model 1. Micro-level trust is positively related to consent, whereas macro-level trust shows no significant relationship with linkage consent. The Model 2 interaction term shows no evidence that mode of interview affects the relationship between trust (micro- or macro-level) and linkage consent.

Survey attitudes. The next factor we consider is respondents' survey attitudes. We hypothesized respondents

who view surveys more positively across multiple dimensions (e.g., importance to science, accuracy of results) will consent to linkage at a higher rate compared to those who hold less positive views towards surveys. This hypothesis is supported by Model 1, which shows a significant positive relationship between the survey attitudes index and linkage consent. This relationship is unaffected by mode of interview as evidenced by the non-significant interaction term in Model 2.

Financial item nonresponse. Lastly, we test the association between financial item nonresponse and linkage consent. We hypothesized that – based on findings from prior linkage consent studies – respondents who answer fewer financial items will be less likely to consent to linkage compared to those who answer more of these items. Model 1 reveals support for this hypothesis as the additive index of financial item nonresponse is negatively, and highly significantly, related to linkage consent. Furthermore, a closer inspection of each of the five variable groups shows that item nonresponse makes the largest contribution to the model fit statistics (Pseudo R^2 and AUC) when it is removed from the model (results not shown), which highlights the importance of this covariate as a predictor of linkage consent.

To summarize the analysis of survey-measured correlates of linkage consent, we find that several respondent attributes are associated with the consent outcome, including some new correlates (survey attitudes and perceived injustice) not previously studied in the linkage consent literature. As with all correlates of linkage consent, the implication of including such variables in linked-data analyses is the potential for biased estimates. However, despite being a significant correlate of linkage consent, we find that survey mode does not differentially impact the relationship between these survey variables and linkage consent.

3.4 Linkage consent bias in administrtative variables by survey mode

The final analysis examines the magnitude of linkage consent bias in IEB administrative variables for each survey mode (Research Question 3). Estimated percentages derived from the administrative variables are shown for all respondents and those who consented to linkage under each survey mode in Appendix Table 1. Estimates of linkage consent bias and absolute relative linkage consent bias (ARCB) are presented for each variable in Table 4. Estimates of linkage consent bias can be interpreted as the difference between the estimated percentage based on consenting cases and the corresponding percentage based on all respondents. For example, the linkage consent bias for the percentage of responding males in the self-administered mode group is 2.46 percent, which means that males are slightly overrepresented among consenting cases. The ARCB value for males in the self-administered mode group is 4.81 percent; this means that the magnitude of linkage consent bias for this variable constitutes slightly less than five percent of the respondent-based (bias-free) estimate – a relatively small amount of bias.

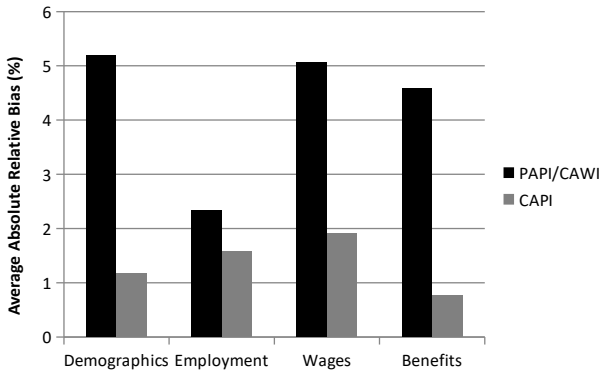

Figure 1. Average Absolute Relative Linkage Consent Bias Estimates for Each of Four IEB Variable Groups, by Survey Mode.

In general, the magnitude of linkage consent bias is relatively small across most IEB variables regardless of survey mode. Only three estimates have ARCB values exceeding 10 percentage points with each one belonging to the PAPI/CAWI survey mode group: education (missing category; ARCB: 12.02 percent), percentage of days employed since 2007 (0; ARCB: 13.36 percent), and average daily wage (< 28.68 Euros; ARCB: 10.84 percent). The highest ARCB values for the CAPI mode are less than half the size of the highest PAPI/CAWI values: percentage of days employed since 2007 (0; ARCB: 5.22 percent), followed by education (intermediate/upper secondary; ARCB 4.40 percent), and number of days at current establishment (158–502; ARCB: 3.58 percent).

The disparity in estimates of ARCB between survey modes is further exemplified in Figure 1, which shows the average ARCB values for each of the four IEB variable groups: demographics, employment, wages, and benefits. For each variable group, the PAPI/CAWI mode group yields a higher average ARCB value than the CAPI group. The range of average ARCB values in the PAPI/CAWI mode group is between 2.33 (Employment) and 5.18 (Demographics) percent, which is larger than the corresponding range of average ARCB values under the CAPI mode: 0.76 (Benefits) and 1.90 (Wages) percent. In summary, the results of this analysis show that the lower linkage consent rate achieved under the PAPI/CAWI mode corresponds to larger relative linkage consent biases in the administrative variables, on average, compared to the CAPI mode.

4 Discussion

The results of this randomized mode study can be condensed into three main findings. First, the self-administered

Table 4
Estimates of Linkage Consent Bias and Absolute Relative Consent Bias (ARCB) for Percentage Estimates of IEB Administrative Variables, by Survey Mode.

	Survey Mode			
	PAPI/CAWI		CAPI	
IEB administrative variables	Consent bias %	Abs. Relative Consent bias %	Consent bias %	Abs. Relative Consent Bias %
Demographics				
Male	2.46	4.81	0.27	0.53
Age (in years)				
< 25	−0.73	7.26	−0.04	0.39
25-32	0.48	2.58	0.55	3.08
33-44	0.10	0.35	−0.30	1.04
45 or more	0.16	0.37	−0.21	0.49
Foreign nationality	−0.23	6.75	0.02	0.38
Highest level of education				
Intermediate/upper secondary	−0.25	8.14	−0.11	4.40
Completed applied science degree	−2.65	4.45	−0.07	0.11
College/university degree	1.17	5.11	0.07	0.32
Missing	1.74	12.02	0.11	0.92
Employment				
Currently employed	1.07	1.17	0.61	0.67
Marginally employed	−0.45	3.02	−0.11	0.64
No. days on current job				
1–152	0.03	0.31	−0.27	2.48
153–364	0.54	5.01	−0.35	2.82
365–1,825	−0.45	1.24	0.00	0.00
1,826 or more	−0.12	0.28	0.62	1.79
No. days at current establishment				
1–157	0.10	0.99	−0.26	2.31
158–502	−0.05	0.34	−0.60	3.58
503–2,224	0.04	0.12	0.08	0.21
2,225 or more	−0.08	0.19	0.77	2.31
Percent days employed since 2007				
0	−0.31	13.36	0.12	5.22
1–54	−0.32	1.91	−0.36	1.72
55–99	0.23	0.80	0.08	0.26
100	0.40	0.77	0.17	0.37
No. employment changes since 2007				
0	−1.77	4.01	0.30	0.85
1	1.34	5.73	0.09	0.39
2	0.19	1.33	−0.40	2.80
3+	0.25	1.37	0.01	0.04
Wages				
Average daily wage (in Euros)				
< 28.69	−1.75	10.84	−0.55	3.04
28.69–63.95	−0.45	2.00	0.48	2.02
63.96–102.91	1.30	4.82	−0.34	1.30
102.92 or more	0.89	2.59	0.40	1.25
Benefits				
No. benefit spells since 2007				
0	1.40	2.90	−0.13	0.34
1	0.77	4.04	0.15	0.62
2	−1.02	8.25	0.15	1.18
3	−0.74	9.17	0.05	0.54
4+	−0.42	3.45	−0.22	1.36
No. days on benefits since 2007				
0	1.40	2.90	−0.13	0.34
1–365	−0.03	0.11	0.33	1.09
366+	−1.37	5.83	−0.20	0.63

All estimates are weighted and account for complex sample design features.

(PAPI/CAWI) survey mode yielded a strikingly lower linkage consent rate (about 40 percentage points lower) compared to the interviewer-administered (CAPI) survey mode. Second, while the likelihood of linkage consent was related to some survey-measured variables concerning respondents' background characteristics, financial item nonresponse, trust, and the newly considered concepts of perceived (in)justice and survey attitudes, there was no evidence that survey mode impacted these relationships. Lastly, the PAPI/CAWI modes yielded larger relative consent biases in the linked administrative variables compared to the CAPI mode. This result – one that is perhaps not surprising given the higher linkage consent rate among CAPI respondents – held for all variable groups comprising demographic and employment characteristics, wages, and benefit receipt. However, relative linkage consent biases were generally small for these variable groups, on average, regardless of which mode was used – a reassuring finding for users of linked employment data.

The finding that self-administered survey modes yield lower linkage consent rates than an interviewer-administered mode is consistent with literature reviews of linkage consent rates achieved in different surveys utilizing different design features (e.g., target population, sponsorship, questionnaire content). The fact that the present study was able to employ a random mode assignment while simultaneously holding relevant design features constant provides some support to the notion that survey mode itself likely plays an important role in the share of respondents who provide linkage consent.

The lower linkage consent rate achieved under the self-administered mode group is a concerning finding for surveys striving to achieve greater cost savings by shifting away from interviewer-led data collection activities. These efforts are likely to coincide with a drastic reduction in the number of linkable records, which could diminish any cost-savings that might result from replacing survey items with corresponding items obtainable from administrative records. From an analytic perspective, the reduced number of linked records may have a greater impact on meeting statistical power objectives than on the validity of the linked-data estimates, as estimates of linkage consent biases in the administrative estimates studied here were relatively small, a finding which is consistent with other linkage consent bias studies (Sakshaug & Huber, 2016; Sakshaug & Kreuter, 2012).

The extent to which differential nonresponse and measurement mode separately contributed to the linkage consent rate differences reported here remains unknown. Because the purpose of the study was not to disentangle the effects of selection and measurement we can only speculate on their individual contributions. Regarding differential nonresponse, it is plausible that the PAPI/CAWI modes yielded respondents who were less trusting and more skeptical regarding the study's authenticity than the CAPI mode. Without an interviewer present it is more difficult to address people's concerns regarding trust and legitimacy of the study in a persuasive manner. PAPI/CAWI respondents indeed reported lower levels of trust and expressed more negative attitudes towards surveys in general than CAPI respondents (see Table 1) – and both were strong correlates of linkage consent (see Table 3). Though, it is also possible that (despite efforts to maintain measurement equivalency between modes) these attitudinal differences are themselves driven by measurement mode effects rather than recruitment/selection effects.

On the measurement side, we speculate that the lack of an interviewer may have had negative consequences in terms of being able to effectively answer respondent questions about linkage and address potential concerns regarding the confidentiality of the linked data. Das and Couper (2014) found in a web survey that respondents had a generally poor understanding about various aspects of linkage (e.g. data access, personally identifiable information) despite having received written informational materials. To the extent that interviewers can assist respondents in overcoming these knowledge deficiencies, interviewer-administered survey modes are more likely to equip respondents with necessary information needed to make an informed decision, which may translate to higher linkage consent rates relative to self-administered modes. Alternatively, it is conceivable that the linkage consent question is susceptible to some form of acquiescence where the respondent may grant consent in order to appear more compliant and favorable to the interviewer. In this context, an ethical question can be raised as to whether it is more appropriate to ask for linkage consent using a self-administered mode, as this mode may reflect respondents' true consent wishes more accurately than interviewer-administered modes.

Several limitations of the present study should be acknowledged. First, as noted above, the study design does not allow us to completely disentangle the effects of differential nonresponse and measurement mode effects on linkage consent without making some strong assumptions. While nonresponse-adjusted weights were utilized in the analysis, we do not purport that they account for all selection factors relevant to the linkage consent outcome. Disentangling nonresponse and measurement effects on linkage consent under different survey modes is an important topic for future work. Second, the study is based on a target population of persons who were employed and contributing to the social security system in Germany at the time the sample was drawn. While this population is highly relevant to the study of linking federal employment records, their linkage consent behaviors may not translate to more general populations. Lastly, the survey partners: DFG, IAB, and the University of Bielefeld are well-known government entities in Germany. The saliency of these actors likely played a (positive or negative) role on respondents' willingness to participate in the study and consent to linkage. It is unclear what the net ef-

fect (if any) on the linkage consent rate would have been had less salient actors (e.g. private foundations) been used. The ideal data source needed to overcome these limitations would therefore have to control for selection effects, different target populations, and different survey sponsors.

These limitations notwithstanding, the present study identifies a conflict between two cost-effective data collection strategies: self-administered data collection and administrative data linkage. Employing self-administered survey modes comes with clear cost savings compared to interviewer-administered alternatives; however, these cost savings must be weighed against the likely reduction in the share of respondents who consent to administrative record linkage and any linkage consent bias that may result. While this tradeoff may not be viewed as a critical one by survey organizations and survey sponsors whose primary objective is to carry out high quality primary data collections, it is more likely to be felt by researchers who are increasingly using administrative data in scientific research (Chetty, 2012) and who are calling for greater access to these data (Card, Chetty, Feldstein, & Saez, 2010). Researchers and survey organizations alike may want to consider adopting statistical adjustment procedures (e.g., imputation, statistical matching) to compensate for the loss of linked administrative information for the non-consenting cases (e.g. Gessendorfer, Beste, Drechsler, & Sakshaug, 2017).

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Appendix

(Appendix table follows on next page)

Table A1
Estimated Percentages Derived from IEB Administrative Variables for All Respondents and Consenting Respondents, by Survey Mode.

	Survey Mode											
	PAPI/CAWI						CAPI					
	All respondents			Consenters			All respondents			Consenters		
IEB administrative variables	*N*	%	Std. Err.	*N*	%	Std. Err.	*N*	%	Std. Err.	*N*	%	Std. Err.
Demographics												
Male	1,660	51.15	0.96	942	53.61	1.31	548	51.43	1.83	506	51.70	1.89
Age (in years)												
< 25	748	10.06	0.36	382	9.33	0.48	218	10.18	1.03	201	10.14	1.04
25–32	953	18.58	0.58	526	19.06	0.79	303	17.86	1.46	284	18.41	1.50
33–44	866	28.43	0.46	480	28.53	0.63	264	28.73	2.15	241	28.43	2.15
45 or older	1,001	42.93	0.69	540	43.09	0.09	225	43.23	2.61	208	43.02	2.57
Foreign nationality	127	3.41	0.35	66	3.18	0.45	69	5.30	0.93	60	5.32	0.99
Highest level of education												
Intermediate/upper secondary	200	3.07	0.27	98	2.82	0.36	51	2.50	0.48	45	2.39	0.49
Completed applied science degree	1,992	59.56	0.94	1039	56.91	1.30	598	63.83	2.00	554	63.76	2.04
College/university degree	753	22.88	0.82	429	24.05	1.13	201	21.76	1.80	185	21.83	1.77
Missing	623	14.48	0.65	362	16.22	0.93	160	11.91	1.32	150	12.02	1.37
Employment												
Currently employed	3,067	91.13	0.48	1,671	92.20	0.60	875	90.85	1.13	812	91.46	1.05
Marginally employed	699	14.92	0.65	363	14.47	0.88	205	17.09	1.55	191	16.98	1.56
No. days on current job												
1–152	761	9.55	0.32	407	9.58	0.44	279	10.89	0.91	254	10.62	0.90
153–364	799	10.78	0.35	449	11.32	0.49	300	12.43	0.99	273	12.08	0.98
365–1825	1,013	36.21	0.87	538	35.76	1.17	264	41.01	2.17	247	42.01	2.30
1826 or more	993	43.46	0.83	534	43.34	1.13	164	34.67	2.29	157	35.29	2.37
No. days at current establishment												
1-157	845	10.07	0.31	456	10.17	0.43	299	11.25	0.93	274	10.99	0.94
158–502	843	14.52	0.51	458	14.47	0.67	311	16.75	1.23	281	16.15	1.29
503–2224	905	33.70	0.88	494	33.74	1.19	232	38.66	2.11	217	38.74	2.18
2225 or more	973	41.71	0.87	520	41.63	1.17	165	33.35	2.23	159	34.12	2.34

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	Survey Mode											
	PAPI/CAWI						CAPI					
	All respondents			Consenters			All respondents			Consenters		
IEB administrative variables	*N*	%	Std. Err.	*N*	%	Std. Err.	*N*	%	Std. Err.	*N*	%	Std. Err.
Percent days employed since 2007												
0	122	2.32	0.25	57	2.01	0.31	33	2.30	0.57	32	2.42	0.61
1-54	1,114	16.74	0.53	590	16.42	0.71	372	20.99	1.50	340	20.63	1.55
55-99	1,059	28.83	0.85	583	29.06	1.15	349	31.01	1.84	324	31.09	1.91
100	1,271	52.11	0.83	698	52.51	1.14	255	45.70	2.25	237	45.87	2.23
No. employment changes since 2007												
0	1,196	44.11	0.92	618	42.34	1.25	219	35.16	2.36	207	35.46	2.46
1	806	23.39	0.82	452	24.73	1.14	191	23.29	1.88	175	23.38	1.96
2	593	14.27	0.64	324	14.46	0.87	175	14.30	1.41	155	13.90	1.38
3 or more	957	18.23	0.64	528	18.48	0.87	417	27.25	1.78	389	27.26	1.81
Wages												
Average daily wage (in Euros)												
< 28.69	889	16.14	0.62	449	14.39	0.79	252	18.08	1.37	230	17.53	1.39
28.69–63.95	856	22.47	0.79	458	22.02	1.06	288	23.73	1.96	268	24.21	2.03
63.96–102.91	891	26.98	0.86	497	28.28	1.20	256	26.24	1.76	237	25.90	1.77
102.92 or more	930	34.42	0.92	524	35.31	1.25	211	31.96	2.31	196	32.36	2.34
Benefits												
No. benefit spells since 2007												
0	1,844	48.35	0.94	1,015	49.75	1.28	406	37.82	1.95	377	37.69	1.97
1	665	19.07	0.76	366	19.84	1.05	229	24.13	1.62	213	24.28	1.67
2	416	12.36	0.64	218	11.34	0.83	122	12.71	1.33	115	12.86	1.44
3	246	8.07	0.54	120	7.33	0.70	90	9.19	1.12	80	9.24	1.14
4 or more	395	12.17	0.62	209	11.75	0.84	162	16.16	1.60	148	15.94	1.64
No. days on benefits since 2007												
0	1,844	48.35	0.94	1,015	49.75	1.28	406	37.82	1.95	377	37.69	1.97
1–365	955	28.14	0.87	514	28.11	1.18	297	30.37	1.95	276	30.70	2.04
366 or more	767	23.51	0.81	399	22.14	1.07	306	31.81	1.95	280	31.61	2.00

All estimates are weighted and account for complex sample design features.