Appendix C. Index of Jewish Engagement and Latent Class Analysis

One of the purposes of the Jewish Engagement Index is to serve as a single metric representing the full range of participation in Jewish life. For example, some subgroups have high levels of participation in ritual behavior but lower participation in communal behavior, and other subgroups may have the opposite pattern. How can these subgroups be compared to one another? The Index consolidates many of the individual measures so that the pattern of relationships among the behaviors can be identified. Each group can be considered separately for identifying interests and unmet needs that will guide the development of targeted programs and initiatives.

To develop the Index, we selected a range of Jewish behaviors that were included in the survey instrument. The set of Jewish behaviors used to develop the typology are inclusive of the different ways—public and private—that contemporary Jews engage with Jewish life. Some of the activities are located primarily within institutions (e.g., synagogue membership), while others are home-based (e.g., Passover seders).

We employed a statistical tool, latent class analysis (LCA), to cluster similar patterns of behavior based on respondents' answers to survey questions. LCA identifies groups of behaviors that "cluster" together by analyzing patterns of responses. The result of the LCA analysis was the identification of five unique patterns of Jewish engagement.

Using LCA, each Jewish adult in the community was classified into one of the five engagement groups according to the pattern that most closely matches the individual's participation in different types of Jewish behaviors. For purposes of this report, the names of the engagement groups will be used to refer to the groups of Jewish adults who most closely adhere to each pattern. The names of the groups are intended to highlight the behaviors that distinguish each group from the others.

Latent Class Analysis (LCA) is a method (Henry & Lazarsfeld, 1968) for uncovering the latent dimensions that explain the associations between categorical variables. It is a statistical method that is designed to identify latent variables. Latent variables are hypothesized variables of interest that cannot be measured directly in a dataset but are measured indirectly through variables that can be included (observed or manifest variables). As an illustration, "Jewish engagement" cannot be measured directly on a survey, but it is the latent variable of interest for the present study (Aronson et al., 2018).

Unlike factor analysis, a more frequently utilized method of cluster analysis, the goal of LCA is to identify classifications of people rather than groups of variables or characteristics. The latent variable for LCA is a categorical variable representing multiple classes or types of people. Each individual is assumed to be a member of only one class. The LCA method assigns, for each case in the dataset, a probability that the case is a member of each class. This assignment is based on the pattern of responses to the observed variables used in the analysis. An excellent explanation of these techniques can be found at http://nap.edu/18623 (Institute of Medicine 2014). The present study uses a modern version of LCA, a Stata plugin, to estimate the latent classes (Lanza et al., 2015).

Latent class analysis works with the patterns and attempts to group them in such a way that within each group, called a class, there is no association between the items. The latent class is called latent because, although it is actually not in the variable set, it accounts for the associations between the manifest variables in the same way that a third variable can account for the observed association between two variables. In the classic example of a nonsensical statement, "The more firemen at a fire, the greater the damage," the association is accounted for by a third variable—the size of the fire. The greater the fire, the more firemen; the greater the fire, the more damage. In technical terms, this is called "local independence," which is also an assumption of factor analysis. The goal of completely accounting for the associations is rarely met, in part because there are so many empty cells, as well as the messiness of real data. Rather, the method tries to find through iterative fitting the right number of classes and relationship between them that minimizes the discrepancy between a perfect fit and the actual data.

To develop an index of Jewish engagement for the present report, 14 items were used to represent the range of Jewish behaviors (Table C.1.) These items were selected to include ritual, communal, and cultural behaviors, as well as public and private behaviors. In all cases when items had more than two possible response levels, responses were dichotomized with the cutoff based on the distribution of responses in the original variable. After conducting the latent class analysis, a five-class solution was identified.

Latent Class Analysis was conducted in Stata version 15 using a user-developed LCA Stata Plugin developed by the Methodology Center at Penn State (Lanza et al., 2015). Solutions were examined for up to nine classes, as shown in Figure C.1. The five class solution was selected as the point where the goodness-of-fit measures "level off", that is, improvement by adding more classes begin to decline. In addition, the five-class solution made intuitive sense. As in factor analysis, the number of classes, like the number of factors, is partly a matter of theory and intuition and the labels for the classes and factors are given by the analyst and are not in the data themselves. In addition to various indexes of fit, the output of the Stata program among other matters shows the size of the classes, the probability that a particular indicator would be endorsed by a member of a particular class, and the limits of confidence for the various parameters. The output is voluminous and not presented in this report. As is the case with factor analysis, the names of the classes were developed by researchers to characterize the distinguishing behaviors of each class.

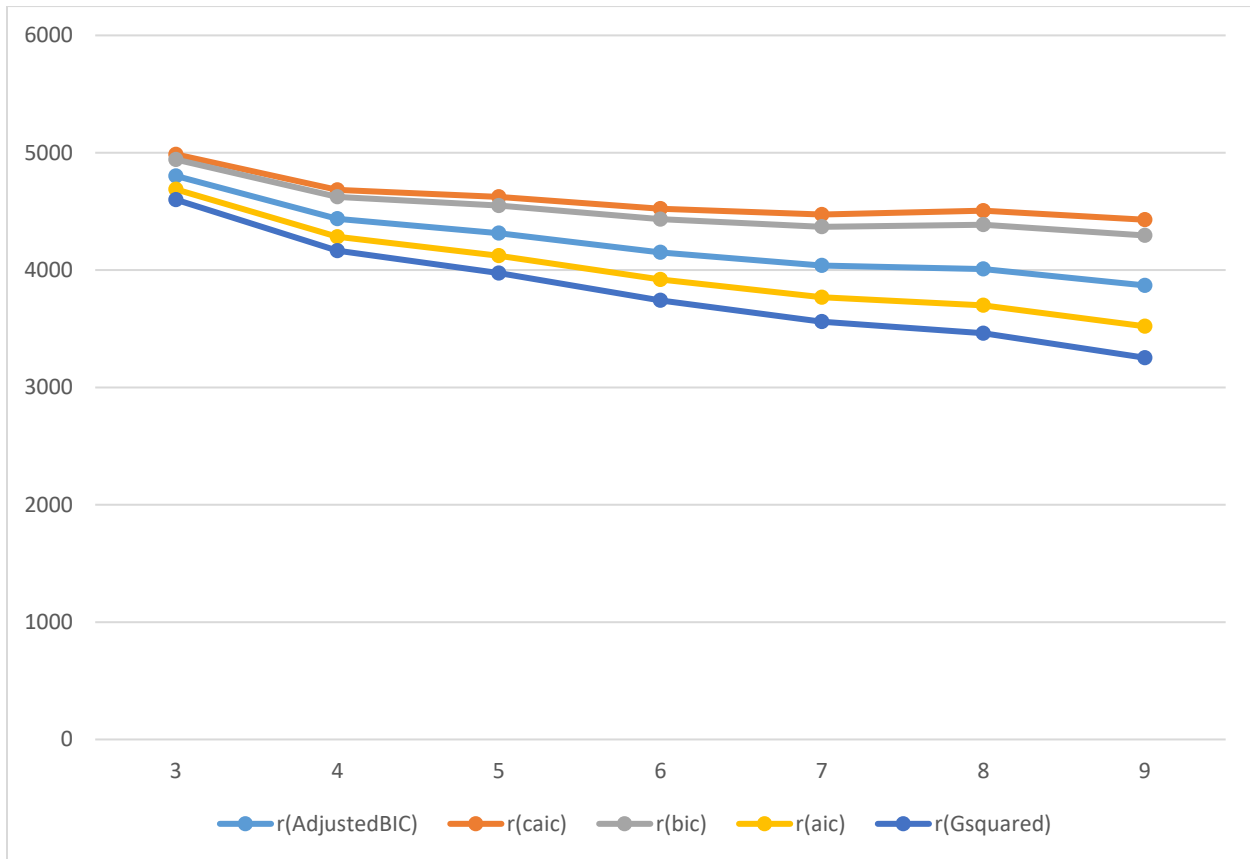FIGURE C.1. GOODNESS-OF-FIT MEASURES FOR 3 THROUGH 9 LCA CLASSES

Table C.1 shows the conditional response probabilities for each behavior in the LCA analysis with the five-class solution. The first row of the table shows the probability of a random respondent being categorized in each of the five classes. The remaining rows show the conditional response probability of each behavior: the probability that a randomly selected member of a class will exhibit the given behavior. For example, for those in the class we called "Minimally Involved," the estimated probability of attending a seder was 12% as compared with 98% for those labelled "Immersed."

NOTE: This table should not be confused with Table 3.1 in the main report, which shows weighted proportions of class membership and of each behavior within the dataset, rather than conditional probabilities as estimated by the LCA algorithm.

TABLE C.1. CONDITIONAL PROBABILITY PREDICTED BY LATENT CLASS MODEL

	Minimally Involved (%)	Personal (%)	Holiday (%)	Communal (%)	Immersed (%)
	13	14	25	28	20
Family holidays					
Attended seder	12	25	74	96	98
Celebrate Shabbat or holidays	5	33	99	93	99
Light Shabbat candles	0	5	33	55	91
Organizations and programs (past year)					
Attend program at JCC	32	9	20	58	70
Attend program/service at Chabad	0	3	10	21	30
Attend program/service at a synagogue	2	26	52	87	100
Donated to Jewish organization	3	39	26	71	98
Volunteered for Jewish organization	0	10	3	40	86
Participate with Jewish social action group	0	9	8	33	61
Attend Jewish educational program	0	13	11	31	93
Jewish congregations					
Pay dues to congregation	0	1	2	24	71
Attend services at least monthly	5	1	0	4	51
Personal activities (past year)					
Visited Jewish websites	33	85	81	86	99
Read Jewish publications	0	85	49	71	96

Legend	0-19	20-39	40-59	60-79	80-100

Tables C.2a and C.3a show the distribution of *demographic or Jewish characteristic within each engagement group*. For example, the first row of Table C.2b, labelled 18-34, shows what proportion of the Minimally Involved group are 18-34 years old. Values in the "Jewish adults" column may be different from those in the main report because they are based on respondents who provided enough information to be classified into an engagement group.

Tables C.2b and C.3b show the distribution of engagement groups *within each demographic or Jewish characteristic*. For example, the first row of Table C.2b, labelled 18-34, shows what proportion of 18-34 year olds fall within each engagement category.

TABLE C.2A. JEWISH ENGAGEMENT BY DEMOGRAPHICS

	Minimally Involved (%)	Personal (%)	Holiday (%)	Communal (%)	Immersed (%)	Jewish adults (%)
Overall	13	12	27	29	18	n/a
Age						
18-34	11	39	36	26	17	27
35-49	25	13	24	26	23	23
50-64	47	24	18	24	37	28
65-79	10	21	15	16	15	15
75 +	8	3	8	7	8	7
Total	100	100	100	100	100	100
Gender						
Male	43	50	54	47	48	49
Female	57	50	46	53	51	51
Total	100	100	100	100	100	100
Region						
Denver	30	15	23	27	43	27
South Metro	13	20	20	17	15	17
Boulder	25	33	27	28	20	26
N&W Metro	18	20	23	13	6	18
Aurora	12	8	5	8	8	6
N&E Metro	2	4	1	7	7	5
Total	100	100	100	100	100	100
Marriage status						
Unmarried	17	19	23	20	16	20
Married	83	81	77	80	84	80
Total	100	100	100	100	100	100
Financial status						
Well off	16	14	18	17	21	21
Not well off	84	86	82	83	79	79
Total	100	100	100	100	100	100

TABLE C.2B. DEMOGRAPHICS BY JEWISH ENGAGEMENT

	Minimally Involved (%)	Personal (%)	Holiday (%)	Communal (%)	Immersed (%)	Total (%)
Overall	13	12	27	29	18	100
Age						
18-34	5	20	35	27	13	100
35-49	14	8	27	31	20	100
50-64	22	11	17	24	26	100
65-79	9	18	25	29	20	100
75 +	14	7	30	26	23	100
Gender						
Male	12	14	29	26	20	100
Female	15	13	24	28	20	100
Region						
Denver	14	7	21	26	31	100
South Metro	10	15	30	27	18	100
Boulder	12	17	27	29	15	100
N&W Metro	15	17	38	23	8	100
Aurora	19	13	18	29	21	100
N&E Metro	7	10	7	45	31	100
Marriage status						
Unmarried	12	13	31	28	16	100
Married	13	13	25	28	21	100
Financial status						
Well off	12	11	27	27	23	100
Not well off	13	14	27	28	19	100

TABLE C.3A. JEWISH ENGAGEMENT BY JEWISH BACKGROUND

	Minimally Involved (%)	Personal (%)	Holiday (%)	Communal (%)	Immersed (%)	Jewish adults (%)
Overall	13	12	27	29		18
Marital status						
Inmarried	12	7	33	55	74	41
Intermarried	88	93	67	45	26	59
Total	100	100	100	100	100	100
Denomination						
Orthodox	< 1	< 1	< 1	2	14	3
Conservative	7	4	10	12	22	12
Reform	12	25	20	39	38	28
Other	12	9	12	10	8	10
None	69	62	58	37	18	46
Total	100	100	100	100	100	100
Type of Jew						
JBR	25	48	60	83	95	66
JNR	58	38	29	11	2	24
JMR	17	14	11	7	3	10
Total	100	100	100	100	100	100
Jewish background						
Parents inmarried	69	73	66	79	80	73
Parents intermarried or converted	31	27	34	21	20	27
Total	100	100	100	100	100	100
Childhood Jewish education						
Jewish education	68	78	67	81	84	75
No Jewish education	32	22	33	19	16	25
Total	100	100	100	100	100	100

TABLE C.3B. JEWISH BACKGROUND BY JEWISH ENGAGEMENT

	Minimally Involved (%)	Personal (%)	Holiday (%)	Communal (%)	Immersed (%)	Total (%)
Overall	13	12	27	29	18	100
Marital status						
Inmarried	4	2	20	37	38	100
Intermarried	20	21	28	21	9	100
Denomination						
Orthodox	< 1	< 1	1	16	83	100
Conservative	8	5	21	29	38	100
Reform	5	12	19	38	27	100
Other	15	11	31	28	16	100
None	20	18	33	22	8	100
Type of Jew						
JBR	5	9	23	34	28	100
JNR	32	22	32	12	2	100
JMR	24	19	31	20	6	100
Jewish background						
Parents Inmarried	12	13	23	29	22	100
Parents intermarried or converted	18	15	38	18	11	100
Childhood Jewish education						
Jewish education	12	13	23	30	22	100
No Jewish education	17	12	36	22	14	100

References

Aronson, J.K., L. Saxe, C. Kadushin, M. Boxer, & M.A. Brookner. (2018). A new approach to understanding contemporary Jewish engagement. *Contemporary Jewry*. https://doi.org/10.1007/s12397-018-9271-8

Henry, N.W., & Lazarsfeld, P. F. (1968). *Latent structure analysis*. Boston: Houghton Mifflin.

Institute of Medicine. (2014). *Chronic Multisympton Illness in Gulf War Veterans: Case Definitions Reexamined*. Washington, DC: The National Academies Press. https://doi.org/10.17226/18623. http://nap.edu/18623

LCA Stata Plugin (Version 1.2) [Software]. (2015). University Park: The Methodology Center, Penn State. Retrieved from methodology.psu.edu

Lanza, S. T., J. J. Dziak, L. Huang, A. T. Wagner, & L. M. Collins. (2015). LCA Stata plugin users' guide (Version 1.2). University Park, Penn State, PA: The Methodology Center, Penn State. https://methodology.psu.edu/downloads/lcastata.