



Methods of Adult Number Matching

Austrian Data

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1. Participants

Thirty-eight adults took part in this study. Participants were mainly University of Graz students. They were recruited through printed and electronic advertisements on notice boards at the Institute of Psychology and online platforms for psychology students. Out of the 38 participants 26 were female (68.4%) and 12 (31.6%) were male. The participants' age ranged from 19 years and 7 months to 31 years and 2 months. Their mean age was 24.25 years, $SD = 3.05$. The University of Graz Ethics Committees approved the study and written informed consent was obtained from participants.

28 participants completed 120 trials plus six practice trials (ga001 to ga028, rows 2-3529 in `Number_Matching_Graz.xlsx`, see Table 1 for version A of the task). The remaining 10 participants (ga029 to ga038, rows 3530-5209) completed 168 trials with no practice (see Table 2 for version B of the task).

2. Materials and stimuli

The participants performed a number matching experiment and an arithmetic fluency task.

Number Matching

The task was presented in PsychoPy v1.85.3 (Peirce, 2007). The participants sat in front of a desktop computer (screen size was 23 inches). Auditory stimuli were conveyed through headphones. Each trial began with the auditory presentation of a number word. Immediately after stimulus offset an Arabic number appeared on the screen until the participant responded, with a maximum duration of 4s. Participants were instructed to press the “l” key on the right part of the keyboard when auditory and visual numbers matched and the “a” key on the left part of the keyboard in case of a mismatch. The inter-trial-interval was 400ms.

Numerical stimuli consisted of the digits 1 to 9, excluding 7 (as it is the only disyllabic number word in English). Visual stimuli were presented in black on a white background in Arial font with a proportional height of 0.3 compared to overall screen size. Auditory stimuli were recorded by a female native speaker. All numbers were trimmed to remove excess time before and after the spoken number. While the duration was matched by slightly adapting the speech rate to a mean level in English, we aimed to present items at a natural speech rate. The duration per number word was 1.2s in English.

Altogether, 174 auditory targets were presented (six practice trials and 168 experimental trials). Each verbal Teen number (excluding the numbers used as practice) was presented four times, while each XX and XXX number was presented six times. In the experimental phase, the participants heard 24 Teen numbers (six numbers, each presented four times), 96 XX numbers (sixteen numbers presented six times), and 48 XXX numbers (eight numbers, each presented six times). To avoid a bias toward “no” responses, on 50% of the trials verbal number words were followed by the matching Arabic number.

For the Teen numbers, non-matching trials use two visual distractor types: D_IE (inversion error, e.g. *thirteen* → 31) and D_MLE (multiple lexical error, e.g. *fifteen* → 46), each distractor type occurred six times. The 48 non-matching XX trials used six possible distractor types, each types occurring eight times: (1) D_LEU (lexical error, decade stays the same, different unit, e.g. *fifty-three* → 59), (2) D_LED (lexical error, the decade of the visual number is the same as the unit of the auditive number, e.g. *ninety-four* → 41), (3) D-U+ (the unit digit is the same for both, the decade for the visual number is different, e.g. *ninety-eight* → 68), (4) D_IE (inversion error, e.g. *fifty-two* → 25), (5) D_MLE (multiple lexical error, e.g. *forty-five* → 68) and (6) D-U- (a nonrelated distractor, e.g. *twenty-three* → 56). Functionally, D-U- and D_MLE were the same distractor type. However, we used different codes in the programme because at Time 2 of the longitudinal study only distractor items labelled D_LEU, D_LED, D_IE and D-U- were used. For Time 3 testing in the longitudinal study and the adult study we added an extra distractor type: D-U+. In order to keep the number of matching and non-matching items balanced we thus double the number of non-related distractors, but labelled the new non-related distractor items D_MLE to ensure we could run analyses comparable to Time 2 number matching. Finally, the non-matching 24 XXX items used three distractor types, each type occurred 8 times: (1) D_IE (inversion of the decade and unit with the hundred number remaining the same, e.g. *four hundred and ninety-five* → 459), (2) U-D-corr (different decade and unit, hundred number stays the same, e.g. *nine hundred and thirty-six* → 952), and (3) D_MLE (unrelated number, all digits changed, e.g. *six hundred and fifty-eight* → 391).

Arithmetic task

Adults were administered the following subtests from a diagnostic inventory of arithmetic skills for elementary school age (Grube, Weberschock, Blum, & Hasselhorn, 2010): simple additions, subtractions and multiplications. The task consisted of a list of 110 items per calculation type. Total time to complete each subtest was recorded.

3. Procedure

Participants were tested individually in a silent room at the University. Each participant sat in front a laptop or computer station. Upon arrival, the participants were given the information sheet and asked to sign a consent form, they were then asked for their date of birth.

Number Matching

Participants received oral instructions from the experimenter. Six practice trials with feedback were included at the beginning of the task. The 64 two-digit items were combined with 24 teen numbers and 32 three-digit numbers, which were not the focus of the present study as we used different distractor items (see Table 1 for a complete item list in the order they appeared in the experiment). Thus, altogether participants were exposed to 120 items (60 matching and 60 non-matching). The order of experimental trials was pseudo-randomized with the restriction that identical number words were never presented consecutively and no more than three trials with the same expected response appeared in immediate succession.

Table 1. List of items in the Number Matching task version A.

Practice (1) or not (2)	Trial Number	Auditive Number	Number Structure	Visual Number	Distractor Type	Expected Key
1	7771	93	XX	39	D_IE	a
1	7772	12	Teen	12	target	l
1	7773	43	XX	34	D_IE	a
1	7774	756	XXX	756	target	l
1	7775	137	XXX	548	D_MLE	a
1	7776	21	XX	21	target	l
2	1	14	Teen	41	D_IE	a
2	2	23	XX	25	D_LEU	a
2	3	69	XX	69	target	l
2	4	658	XXX	391	D_MLE	a
2	5	49	XX	92	D_LED	a
2	6	235	XXX	235	target	l
2	7	63	XX	63	target	l
2	8	13	Teen	28	D_MLE	a

2	9	46	XX	46	target	l
2	10	82	XX	28	D_IE	a
2	11	98	XX	35	D_MLE	a
2	12	19	Teen	19	target	l
2	13	384	XXX	348	D_IE	a
2	14	63	XX	36	D_IE	a
2	15	53	XX	53	target	l
2	16	495	XXX	632	D_MLE	a
2	17	24	XX	24	target	l
2	18	384	XXX	384	target	l
2	19	18	Teen	81	D_IE	a
2	20	65	XX	65	target	l
2	21	562	XXX	562	target	l
2	22	65	XX	61	D_LEU	a
2	23	15	Teen	46	D_MLE	a
2	24	34	XX	34	target	l
2	25	562	XXX	526	D_IE	a
2	26	13	Teen	13	target	l
2	27	94	XX	94	target	l
2	28	86	XX	68	D_IE	a
2	29	495	XXX	495	target	l
2	30	24	XX	42	D_IE	a
2	31	98	XX	98	target	l
2	32	235	XXX	648	D_MLE	a
2	33	19	Teen	91	D_IE	a
2	34	936	XXX	936	target	l
2	35	32	XX	26	D_LED	a
2	36	16	Teen	16	target	l
2	37	53	XX	39	D_LED	a
2	38	384	XXX	629	D_MLE	a
2	39	94	XX	91	D_LEU	a

2	40	14	Teen	14	target	l
2	41	23	XX	23	target	l
2	42	495	XXX	459	D_IE	a
2	43	15	Teen	51	D_IE	a
2	44	32	XX	32	target	l
2	45	45	XX	45	target	l
2	46	864	XXX	864	target	l
2	47	32	XX	36	D_LEU	a
2	48	18	Teen	18	target	l
2	49	45	XX	68	D_MLE	a
2	50	936	XXX	963	D_IE	a
2	51	52	XX	52	target	l
2	52	49	XX	49	target	l
2	53	14	Teen	35	D_MLE	a
2	54	562	XXX	562	target	l
2	55	94	XX	41	D_LED	a
2	56	82	XX	46	D_MLE	a
2	57	562	XXX	439	D_MLE	a
2	58	86	XX	86	target	l
2	59	15	Teen	15	target	l
2	60	69	XX	96	D_IE	a
2	61	82	XX	82	target	l
2	62	235	XXX	235	target	l
2	63	49	XX	42	D_LEU	a
2	64	63	XX	95	D_MLE	a
2	65	13	Teen	13	target	l
2	66	52	XX	25	D_IE	a
2	67	235	XXX	253	D_IE	a
2	68	46	XX	62	D_LED	a
2	69	18	Teen	18	target	l
2	70	24	XX	24	target	l

2	71	392	XXX	465	D_MLE	a
2	72	49	XX	49	target	l
2	73	16	Teen	58	D_MLE	a
2	74	24	XX	96	D_MLE	a
2	75	936	XXX	936	target	l
2	76	864	XXX	539	D_MLE	a
2	77	15	Teen	15	target	l
2	78	46	XX	46	target	l
2	79	98	XX	98	target	l
2	80	936	XXX	852	D_MLE	a
2	81	82	XX	82	target	l
2	82	69	XX	25	D_MLE	a
2	83	23	XX	35	D_LED	a
2	84	45	XX	45	target	l
2	85	864	XXX	864	target	l
2	86	13	Teen	31	D_IE	a
2	87	94	XX	94	target	l
2	88	52	XX	52	target	l
2	89	658	XXX	685	D_IE	a
2	90	53	XX	59	D_LEU	a
2	91	86	XX	86	target	l
2	92	495	XXX	495	target	l
2	93	16	Teen	61	D_IE	a
2	94	32	XX	32	target	l
2	95	65	XX	65	target	l
2	96	392	XXX	392	target	l
2	97	18	Teen	64	D_MLE	a
2	98	46	XX	42	D_LEU	a
2	99	658	XXX	658	target	l
2	100	69	XX	69	target	l
2	101	52	XX	84	D_MLE	a

2	102	384	XXX	384	target	l
2	103	19	Teen	83	D_MLE	a
2	104	34	XX	48	D_LED	a
2	105	63	XX	63	target	l
2	106	392	XXX	392	target	l
2	107	98	XX	89	D_IE	a
2	108	65	XX	51	D_LED	a
2	109	34	XX	38	D_LEU	a
2	110	658	XXX	658	target	l
2	111	16	Teen	16	target	l
2	112	34	XX	34	target	l
2	113	392	XXX	329	D_IE	a
2	114	86	XX	42	D_MLE	a
2	115	23	XX	23	target	l
2	116	14	Teen	14	target	l
2	117	45	XX	54	D_IE	a
2	118	864	XXX	846	D_IE	a
2	119	53	XX	53	target	l
2	120	19	Teen	19	target	l

Table 2. List of items in the Number Matching task version B.

Practice (1) or not (2)	Trial Number	Auditive Number	Number Structure	Visual Number	Distractor Type	Expected Key
2	1	14	Teen	41	D_IE	a
2	2	23	XX	25	D_LEU	a
2	3	69	XX	69	target	l
2	4	49	XX	38	D-U-	a
2	5	936	XXX	936	target	l
2	6	24	XX	34	D-U+	a
2	7	53	XX	53	target	l

2	8	384	XXX	329	U-D-corr	a
2	9	23	XX	23	target	l
2	10	658	XXX	391	D_MLE	a
2	11	34	XX	26	D-U-	a
2	12	49	XX	92	D_LED	a
2	13	235	XXX	235	target	l
2	14	86	XX	56	D-U+	a
2	15	63	XX	63	target	l
2	16	864	XXX	864	target	l
2	17	52	XX	52	target	l
2	18	13	Teen	28	D_MLE	a
2	19	392	XXX	392	target	l
2	20	46	XX	46	target	l
2	21	936	XXX	952	U-D-corr	a
2	22	82	XX	28	D_IE	a
2	23	98	XX	35	D_MLE	a
2	24	86	XX	86	target	l
2	25	235	XXX	248	U-D-corr	a
2	26	19	Teen	19	target	l
2	27	384	XXX	348	D_IE	a
2	28	63	XX	36	D_IE	a
2	29	53	XX	53	target	l
2	30	495	XXX	632	D_MLE	a
2	31	24	XX	24	target	l
2	32	384	XXX	384	target	l
2	33	46	XX	46	target	l
2	34	18	Teen	81	D_IE	a
2	35	65	XX	65	target	l
2	36	562	XXX	562	target	l
2	37	65	XX	61	D_LEU	a
2	38	32	XX	32	target	l

2	39	69	XX	39	D-U+	a
2	40	15	Teen	46	D_MLE	a
2	41	34	XX	34	target	l
2	42	562	XXX	526	D_IE	a
2	43	13	Teen	13	target	l
2	44	94	XX	94	target	l
2	45	52	XX	62	D-U+	a
2	46	86	XX	68	D_IE	a
2	47	495	XXX	495	target	l
2	48	24	XX	42	D_IE	a
2	49	98	XX	98	target	l
2	50	235	XXX	648	D_MLE	a
2	51	19	Teen	91	D_IE	a
2	52	936	XXX	936	target	l
2	53	32	XX	26	D_LED	a
2	54	16	Teen	16	target	l
2	55	53	XX	39	D_LED	a
2	56	864	XXX	839	U-D-corr	a
2	57	63	XX	63	target	l
2	58	384	XXX	629	D_MLE	a
2	59	94	XX	91	D_LEU	a
2	60	14	Teen	14	target	l
2	61	23	XX	23	target	l
2	62	495	XXX	459	D_IE	a
2	63	65	XX	94	D-U-	a
2	64	15	Teen	51	D_IE	a
2	65	32	XX	32	target	l
2	66	392	XXX	365	U-D-corr	a
2	67	45	XX	45	target	l
2	68	864	XXX	864	target	l
2	69	32	XX	36	D_LEU	a

2	70	18	Teen	18	target	l
2	71	658	XXX	658	target	l
2	72	45	XX	68	D_MLE	a
2	73	936	XXX	963	D_IE	a
2	74	52	XX	52	target	l
2	75	49	XX	49	target	l
2	76	82	XX	92	D-U+	a
2	77	14	Teen	35	D_MLE	a
2	78	562	XXX	562	target	l
2	79	94	XX	41	D_LED	a
2	80	82	XX	46	D_MLE	a
2	81	562	XXX	439	D_MLE	a
2	82	86	XX	86	target	l
2	83	45	XX	25	D-U+	a
2	84	15	Teen	15	target	l
2	85	235	XXX	235	target	l
2	86	69	XX	96	D_IE	a
2	87	82	XX	82	target	l
2	88	235	XXX	235	target	l
2	89	94	XX	94	target	l
2	90	49	XX	42	D_LEU	a
2	91	63	XX	95	D_MLE	a
2	92	13	Teen	13	target	l
2	93	52	XX	25	D_IE	a
2	94	69	XX	69	target	l
2	95	235	XXX	253	D_IE	a
2	96	46	XX	62	D_LED	a
2	97	18	Teen	18	target	l
2	98	34	XX	34	target	l
2	99	24	XX	24	target	l
2	100	392	XXX	465	D_MLE	a

2	101	49	XX	49	target	l
2	102	32	XX	85	D-U-	a
2	103	16	Teen	58	D_MLE	a
2	104	24	XX	96	D_MLE	a
2	105	936	XXX	936	target	l
2	106	864	XXX	539	D_MLE	a
2	107	15	Teen	15	target	l
2	108	46	XX	46	target	l
2	109	98	XX	98	target	l
2	110	936	XXX	852	D_MLE	a
2	111	82	XX	82	target	l
2	112	69	XX	25	D_MLE	a
2	113	384	XXX	384	target	l
2	114	23	XX	35	D_LED	a
2	115	45	XX	45	target	l
2	116	864	XXX	864	target	l
2	117	13	Teen	31	D_IE	a
2	118	94	XX	94	target	l
2	119	52	XX	52	target	l
2	120	658	XXX	685	D_IE	a
2	121	65	XX	65	target	l
2	122	53	XX	59	D_LEU	a
2	123	86	XX	86	target	l
2	124	495	XXX	495	target	l
2	125	16	Teen	61	D_IE	a
2	126	32	XX	32	target	l
2	127	65	XX	65	target	l
2	128	392	XXX	392	target	l
2	129	18	Teen	64	D_MLE	a
2	130	46	XX	42	D_LEU	a
2	131	98	XX	98	target	l

2	132	658	XXX	658	target	l
2	133	69	XX	69	target	l
2	134	52	XX	84	D_MLE	a
2	135	384	XXX	384	target	l
2	136	19	Teen	83	D_MLE	a
2	137	495	XXX	495	target	l
2	138	34	XX	48	D_LED	a
2	139	63	XX	63	target	l
2	140	392	XXX	392	target	l
2	141	98	XX	89	D_IE	a
2	142	49	XX	49	target	l
2	143	65	XX	51	D_LED	a
2	144	34	XX	38	D_LEU	a
2	145	94	XX	62	D-U-	a
2	146	658	XXX	658	target	l
2	147	16	Teen	16	target	l
2	148	34	XX	34	target	l
2	149	392	XXX	329	D_IE	a
2	150	86	XX	42	D_MLE	a
2	151	23	XX	23	target	l
2	152	562	XXX	539	U-D-corr	a
2	153	45	XX	45	target	l
2	154	14	Teen	14	target	l
2	155	45	XX	54	D_IE	a
2	156	864	XXX	846	D_IE	a
2	157	53	XX	53	target	l
2	158	19	Teen	19	target	l
2	159	658	XXX	691	U-D-corr	a
2	160	46	XX	93	D-U-	a
2	161	562	XXX	562	target	l
2	162	23	XX	56	D-U-	a

2	163	24	XX	24	target	l
2	164	63	XX	43	D-U+	a
2	165	495	XXX	432	U-D-corr	a
2	166	98	XX	68	D-U+	a
2	167	82	XX	82	target	l
2	168	53	XX	49	D-U-	a

Arithmetic task

This task was performed after the number matching computer task. The participants were presented with a booklet containing all of the arithmetic tasks. The participants were asked to wait for the experimenter after completing each subtest. The experimenters noted down the time taken to complete the first page of calculations as well as the overall time taken to complete each subtest