Pre

UNI

The Social Skills Study

ID: 101

Sex: M F

	Family Background						School Experiences		
1.	SD	D	N	A	SA	1.	D	N	A
2.	SD	D	N	A	SA	2.	D	N	A
3.	SD	D	N	A	SA	3.	D	N	A
4.	SD	D	N	A	SA	4.	D	N	A
5.	SD	D	N	A	SA	5.	D	N	A
6.	SD	D	N	A	SA	6.	D	N	A
7.	SD	D	N	A	SA	7.	D	N	A
8.	SD	D	N	A	SA	8.	D	N	A
9.	SD	D	N	A	SA	9.	D	N	A
10.	SD	D	N	A	SA	10.	D	N	A

Data moderate accuracy entry wit sheets, ar sheets th three of t son with visual ch matches

event Data I

UNIVERSITY OF NEVADA LAS VEGAS

U

Abstr

ata entry errors can have catastrophic effects on the results
rate correlation turn to zero and make a significant *t* test n
acy of three data entry methods. A total of 197 undergradua
with automatic checking for mismatches and out-of-range v
s, and single entry (a control condition). After receiving tra
s that each contained six types of data. Double entry was sig
of the six data types and resulted in 28 times fewer errors. I
vith double entry done by two people and with visual check
l checking done by a single person, given its high error rate
nes and out-of-range values will be available during the post

Entry Catas

Kimberly A. Barchard
University of Nevada, Las Vegas

stract

ults of a statistical analysis. A single data entry error can n
st non-significant. The purpose of this paper was to compa
duates were randomly assigned to one of three conditions: d
ge values, visual checking of the entries against the original
training in their assigned technique, participants entered 3
s significantly more accurate than visual checking overall a
rs. Future research should compare double entry done by on
ecking done by two people. For now, researchers should ab
rate. A free double-entry system that includes checking fo
poster session.

astrophes: U

Larry A. P
gas Anderson Uni

an make a
mpare the
ns: double
inal paper
ed 30 data
all and for
y one per-
d abandon
g for mis-

All three data entry techniques had hig
them. We therefore calculated the average
sheets. Participants in the double entry cor
participants made an average of 11.09 erro
errors. Thus, visual checking resulted in 28

Visual checking was slightly more acc
statistical significance (Tukey's HSD *p* = .9
than single entry. Therefore, we do not reco
son, given that it takes more time than singl

Catastrophic Errors

Next we examined the effect of catastr
results. The 197 participants in our study a

Use Doubl

Pace
niversity

ANDEF
U N I V E

high accuracy rates, which could obscure differences betw
ıge number of errors that participants made across the 30
condition made an average of 0.38 errors. In visual check
errors. In single entry, participants made an average of 1
28 times more errors than double entry. See Figure 2.

accurate than single entry, but this difference did not re
= .971). We conclude that visual checking is no more accu
ecommend that researchers use visual checking by a single
ingle entry and has no apparent benefit.

astrophic data entry errors and low accuracy rates on resea
dy are taking the role of research assistants, each of whor

le Entry

ERSON
R S I T Y

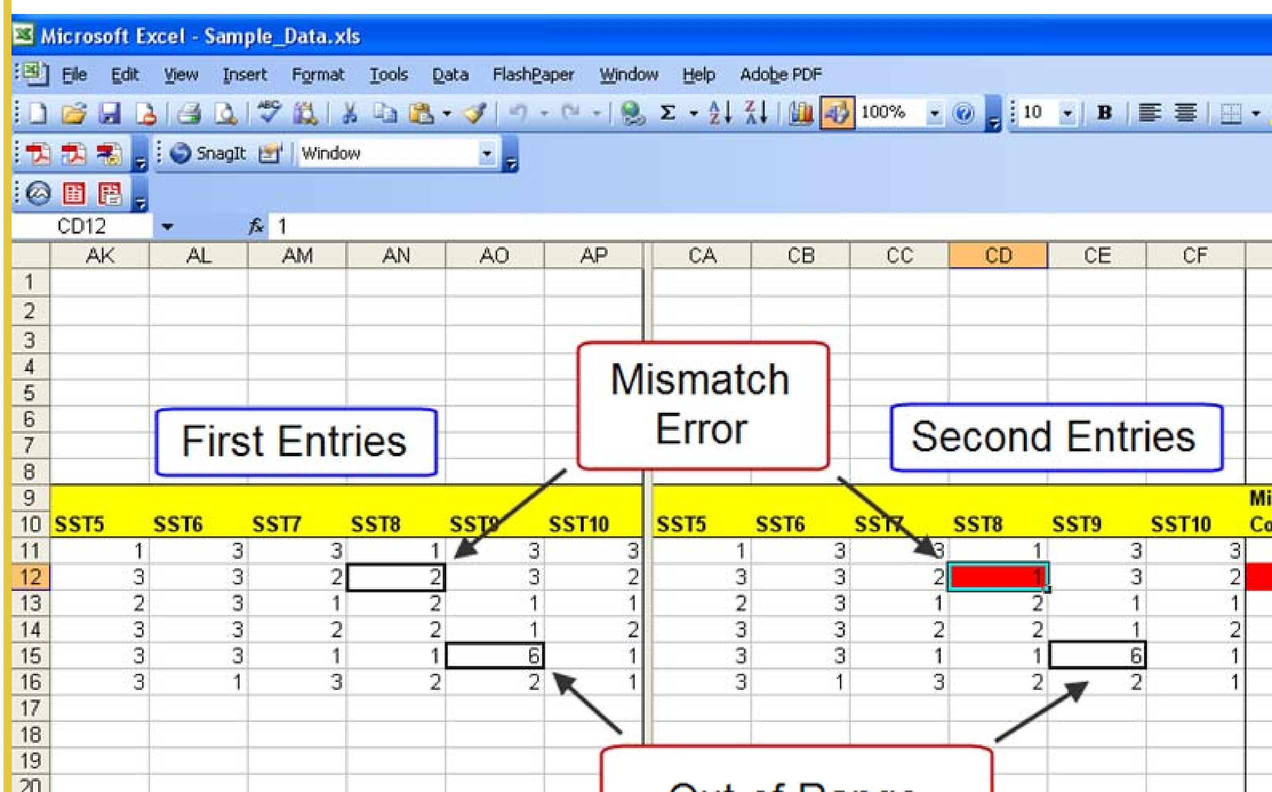
between
30 data
ecking,
of 11.97

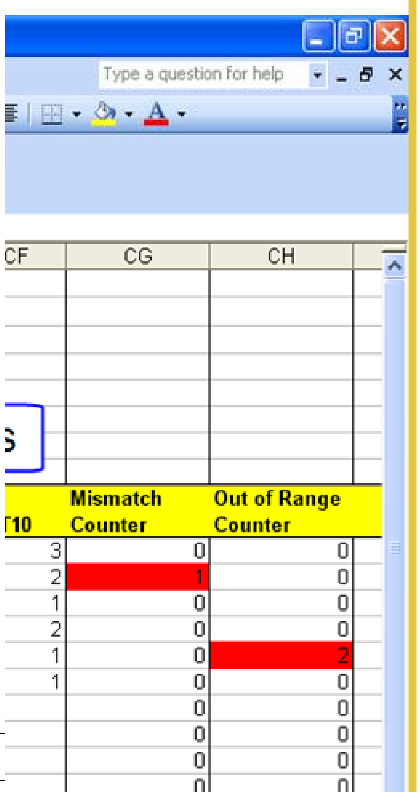
ot reach
accurate
gle per-

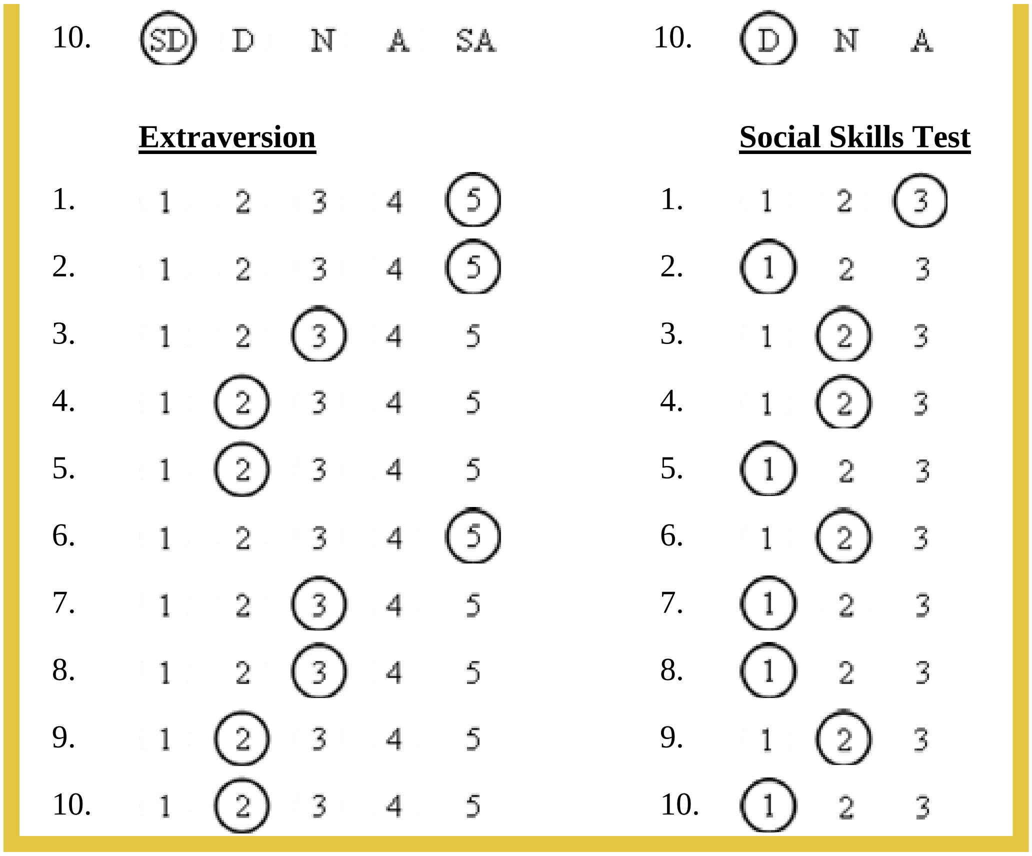
esearch
whom is

Figure 1

Double Entry Screen Layout




Type a question for help
CF
CG
CH
Mismatch Counter
Out of Range Counter


10. SD D N A SA

Extraversion

1.	1	2	3	4	5
2.	1	2	3	4	5
3.	1	2	3	4	5
4.	1	2	3	4	5
5.	1	2	3	4	5
6.	1	2	3	4	5
7.	1	2	3	4	5
8.	1	2	3	4	5
9.	1	2	3	4	5
10.	1	2	3	4	5

10. D N A

Social Skills Test

1.	1	2	3
2.	1	2	3
3.	1	2	3
4.	1	2	3
5.	1	2	3
6.	1	2	3
7.	1	2	3
8.	1	2	3
9.	1	2	3
10.	1	2	3

Data moderate complete entry err errors. Pr and chec 2004); cc outliers (' ods that a

There single entry with visual checking, the data entry p entries with the original paper measures. In doul entered twice. The computer compares these entri range. The data entry person then corrects the error

The purpose of this study is to compare these entered only once. Small-sample medical research Haertle & McBride, 1992) and visual checking (Ka sample of data entry personnel who are similar to t are commonly encountered in psychological researc

Participants

A total of 197 undergraduate students participa data entry before.

Introdu

ata entry errors can have catastrophic effects on study re rate correlation turn to zero or make a significant *t* test n letely alter (and invalidate) a statistical analysis (Kruskal, 1 errors can be so devastating, researchers sometimes spen . Preventative efforts include doing all data entry oneself, hecking entries visually (Beaty, 1999; Cummings & Mas); corrective efforts including using graphs and diagnostic rs (Tukey, 1977). The purpose of this paper is to compare t hat are intended to eliminate data entry errors at their source.

here are two common methods of preventing and catching ry person enters the data once. Afterwards, the same perso double entry with checking for mismatches and out-of-ran entries to identify mismatches, and also identifies values o rrors.

hese two techniques to each other and to a control conditio arch has shown that double entry is more accurate than sin (Kawado et al., 2003). The current study extends that resea to the volunteers used in academic research, and by using s earch.

Method

cipated in this study in return for course credit. None of the

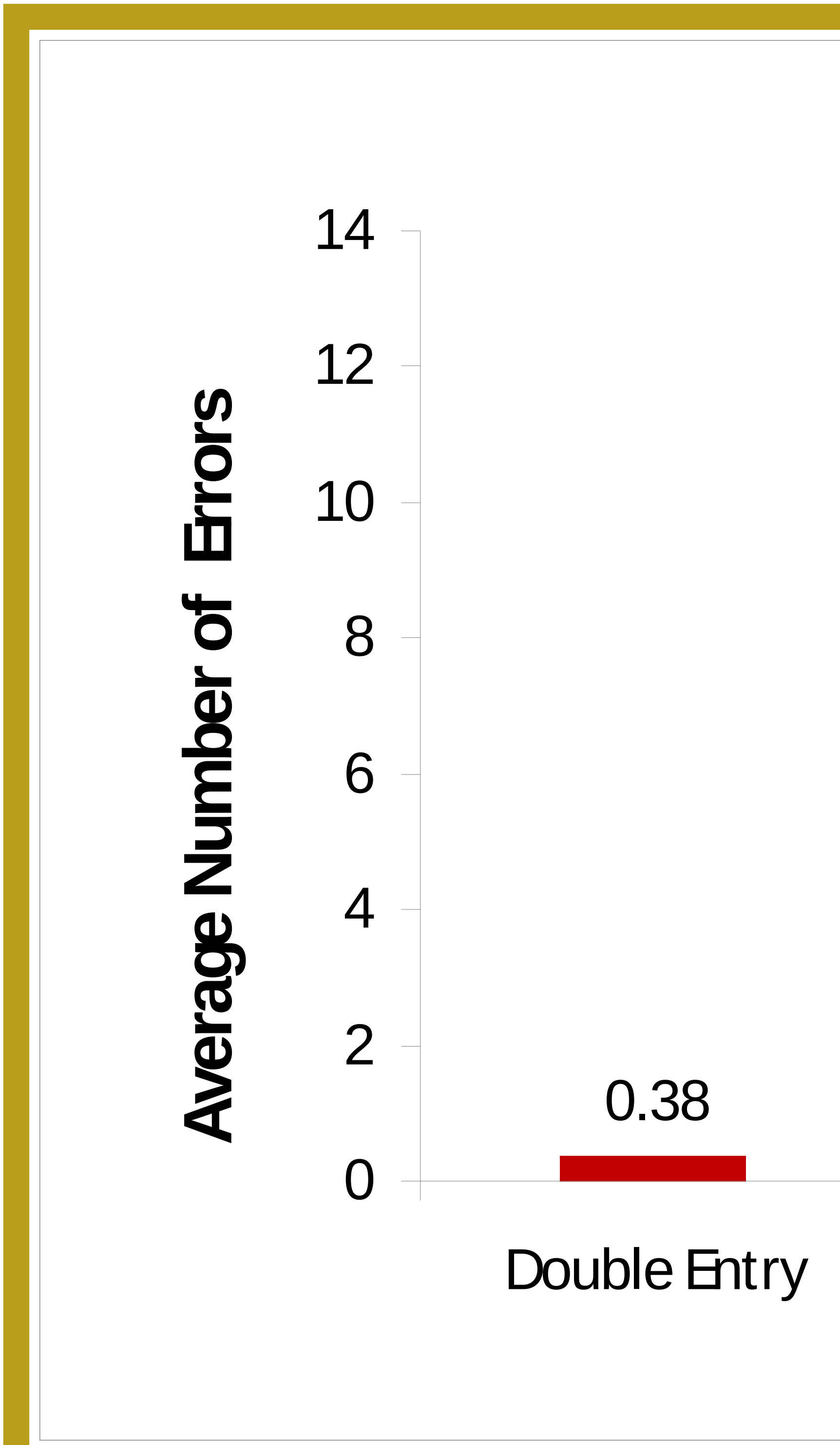
duction

y results and conclusions. A single data entry error can m
st non-significant. Just one or two serious data entry erro
al, 1960; Velleman & Hoaglin, 1995; Wilcox, 1998). Becaus
pend considerable effort to identify and correct the most
elf, entering data twice,
Masten, 1994; Winkler,
stic statistics to identify
are two data entry meth-
urce.

ing data entry errors. In
erson visually compares
f-range values, data are
es outside the allowable

dition in which data are
single entry (Reynolds-
esearch by using a large
ng six types of data that

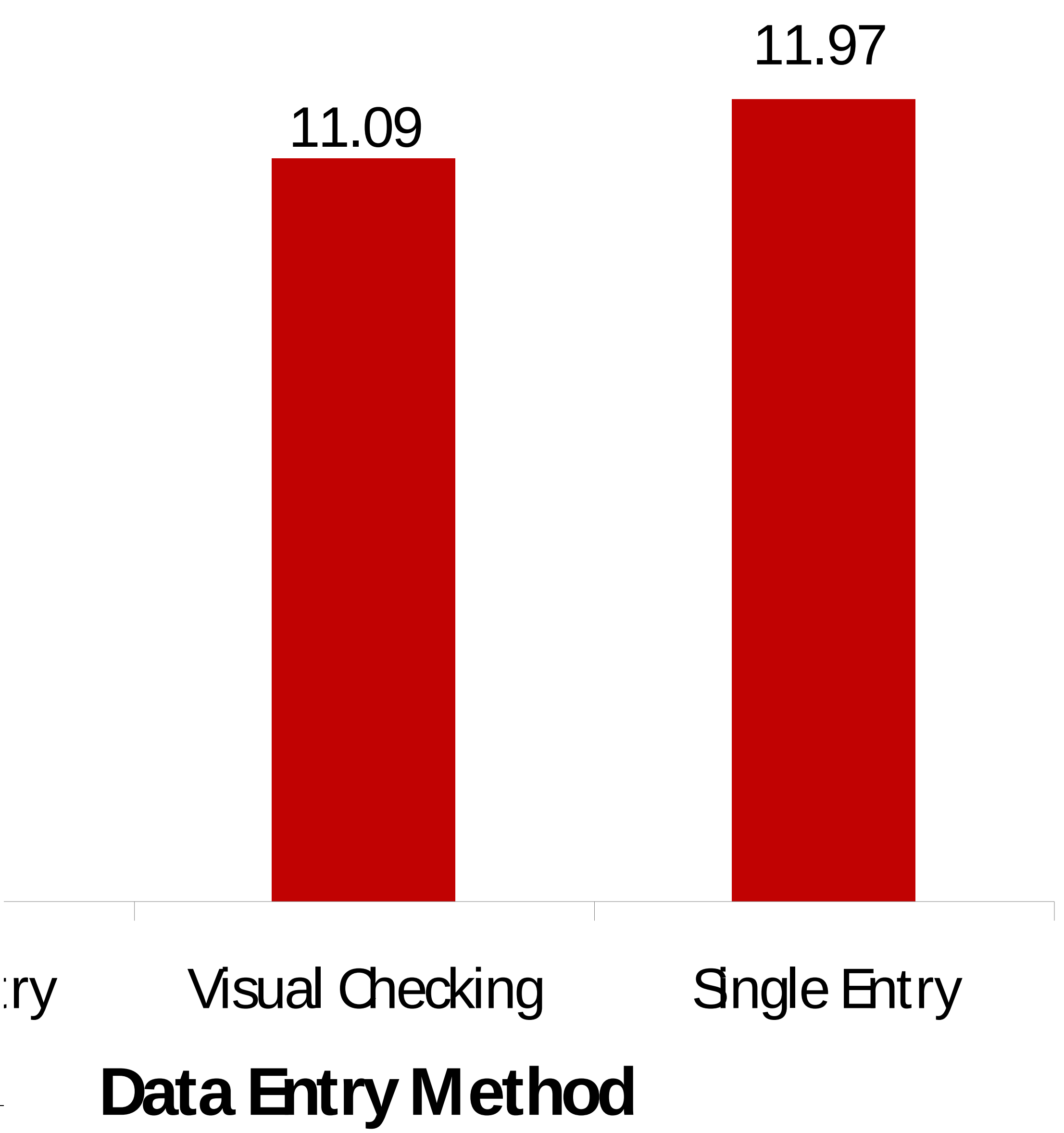
these students had done



ın make a
errors can
cause data
ost severe

Next we examined the effect of catastr
results. The 197 participants in our study a
entering the complete data set for an imagin
data entry errors, this is mimicking a situat
the published results are wrong. Of the 197
the scales in the wrong order (these part
additional participants had accuracy rates of

Figure 2



We exam
internal cons
when the cor
values of the

These er
consistencies
In two cases,
invalidate the
entry conditio

Only two
ables. The tw
entered 129 a
supervisor co

Subjective

Subjectiv
pleasant than
more frustrat
Tukey's HSD
Table 6), the
HSD p = .01

astrophic data entry errors and low accuracy rates on resea
dy are taking the role of research assistants, each of whor
aginary study with 30 participants. When our participants m
ituation where a research assistant makes data entry errors
197 participants, three made catastrophic errors such as ente
participants were excluded from the main analyses), and
s of 95% or less.

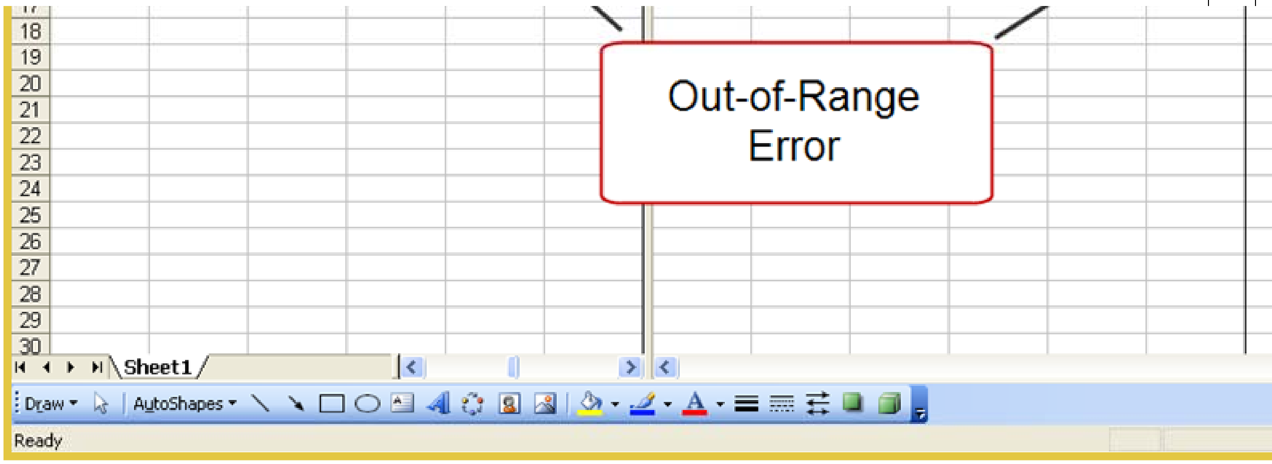
xamined the effect of catastrophic errors on three statist
onsistency, correlations, and an independent sample *t* test.
correct data were used – the data that was actually given c
the statistics that were calculated using the data entered by p
errors had strong effects on internal consistencies, corr
cies were sometimes negative (see Table 2 for selected resu
ses, a strong positive effect size was changed into a stron
the results of a study. Seven of these nine error-prone part
dition (see Table 5).

two of the nine error-prone participants entered a large num
e two participants who reversed the order of the Extraversio
29 and 132 out-of-range values, respectively. The other erro
r corrected all out-of-range values in these datasets, most of

ive Opinions

ctive opinions of the three data entry methods were signific
han double entry (single entry mean 3.46; double entry mea
strating than both single entry and double entry (single entr
HSD $p < .05$ for both comparisons). When we controlled s
the differences in pleasantness disappeared; however, visu
.011).

esearch
/hom is
ts make
'ors and
entering
and six



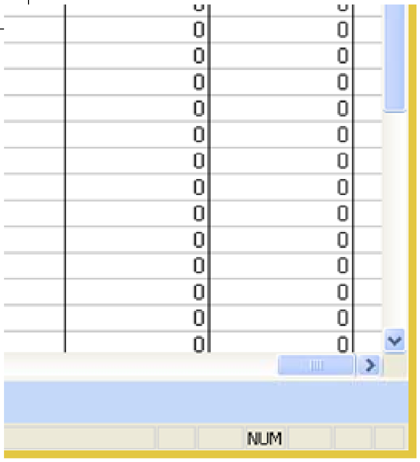
atistics:

:est. For each statistic, we calculated the "true" values of t
en on the data entry sheets. We then compared these to the
by participants.

correlations, and independent-samples *t* tests. For examp
results) and correlations were sometimes reduced to zero (s
trong negative effect size (see Table 4). Such data entry e
participants were in the visual-checking condition; none in

number of values that were outside the allowable ranges foi
rsion and School Experiences scales – participants 61321 ar
error-prone participants entered no more than 3 out-of-range
st of the data entry errors would remain.

iificantly different on two adjectives. Single entry was cons
mean 2.75; Tukey's HSD $p < .001$) and visual checking was
entry mean 2.49; double entry mean 2.54; visual checking
ed statistically for the amount of time to complete the dat
visual checking remained more frustrating than double ent



of the statistics
the "observed"

ample, internal
o (see Table 3).
ry errors would
e in the double-

s for those vari-
1 and 172439 –
inge values. If a

onsidered more
was considered
king mean 3.10;
data entry (see
entry (Tukey's

data entry before.

Procedures

Data were collected during 90-minute one-on-
video on how to use Excel. Next, the computer ra
first group (double-entry) was taught to enter the d
Figure 1. The second group (visual checking) was
sheets. The third group (single entry) was taught to
could. Next, all participants completed a practice se
pants completed the main data entry, which consist

To mimic the data entry tasks that research assis
and four 10-item measures that used different resp
some of these scales, participants were instructed to

Table 1

Average Accuracy of the Three Data Entry Meth

Data Type	Double Entry	Visual Checking
ID	1.0000	.9986
Sex	1.0000	.9915
FB 5 letters	.9997	.9885
Ex 5 numbers	1.0000	.9913
SE 3 letters	.9992	.9894
SST 3 numbers	.9999	.9950
Overall	.9997	.9912

Note. FB = Family Background. Ex = Extraversi
Social Skills Test

-on-one supervised sessions. Because data entry was compl
r randomly assigned participants to one of the data entry m
ne data twice and to locate and correct their errors using mis
was taught to enter the data once and to check the data vi
nt to enter the data once; they were told that accuracy was n
ce session where they entered five data sheets, and the study
sisted of 30 data sheets. Afterwards, participants evaluated t

assistants complete, each data sheet contained six types of in
response scales (letters or numbers, with 3 or 5 possible re
ed to type only numbers. See the example data sheet.

Methods

Single Entry	ANOVA
.9968	$F(2, 135) = 0.87, p = .423$
.9962	$F(2, 135) = 4.27, p = .016$
.9849	$F(2, 135) = 5.43, p = .005$
.9909	$F(2, 135) = 3.29, p = .040$
.9896	$F(2, 135) = 4.69, p = .011$
.9956	$F(2, 135) = 2.83, p = .062$
.9905	$F(2, 135) = 4.93, p = .009$

ersion. SE = School Experiences. SST =

Time

Doub
25% long

Accura

Doub
entry. As
and for
Backgrou
HSD sh
visual ch
Test), th
again, do

mpleted using Microsoft Excel, participants first watched a
y methods, and showed participants a video on that metho
mismatch and out-of-range counters built into the workshe
a visually by comparing the typed entries with the original
as more important than speed and to please be as accurate a
udy administrator corrected any procedural errors. Finally, p
ed the data entry technique using an 11-adjective scale.

of information: an ID number for the hypothetical participan
le responses). To increase the difficulty of the data entry ta

Results

e

ouble entry took 28% longer than visual checking, which
longer than single entry.

uracy

ouble entry was more accurate than visual checking and
. As shown in Table 1, there were significant differences o
for four of the six types of data. Furthermore, for Sex, F
ground, School Experiences, and the overall accuracy, T
showed that double entry was significantly more accurat
l checking ($p < .05$). For one additional type of data (Social
, the differences approached significance ($p = .062$) and,
n, double entry was more accurate than the other methods.

HSD $p = .01$

ed a short
ethod. The
sheet. See
inal paper
ate as they
ly, partici-

pant, Sex,
y task for

hich took

and single
es overall
x, Family
y, Tukey's
urate than
cial Skills
and, once
s.

Some methods of identifying and corre
the extra time involved. In contrast, double
differences between these techniques were
checking, we conclude that the substantial i

Future research should compare double
entered by one person but then visually ch
reads the original sheets. These techniques
different people and then compared. This
because each data entry task will be more li

Unless future research shows that some
data quality (Kawado, et al., 2003; Reynold
of researchers and data entry personnel tha
should be employed in every research lab.

Commercial double entry systems are a
2004) or as free add-ons for Access (Beaty,
during the poster session.

Table 3

Effect of Data Entry Errors on

Participant ID	
Correct Values	
172439	Scales in wrong ord
27578	87% accuracy
188413	94% accuracy

.011).

Discu

orrecting data entry errors are better than others. Visual che
ble entry resulted in significantly fewer errors than visual ch
ere large: visual checking had 28 times more errors than dou
ial increase in accuracy is easily worth the additional time.

uble entry completed by one person (which was examined
checked by someone else, or it could be visual checked by
ques might result in higher accuracy rates than visual check
his might result in similar accuracy levels compared to do
re like single entry, which was rated as the most pleasant and

ome form of visual checking performs substantially better th
nolds-Haertle & McBride, 1992) have unanimously found th
that visual checking is a highly accurate method is contrac
ıb.

ıre available from SPSS and SAS, and free double entry sy
aty, 1999) and Excel (Barchard & Pace, 2008; in press). Th

s on Correlations, Selected Participants

	Correlation	
	E and SE	SE and SST
	.67**	.41*
g order	.58**+	-.00++
	.45*++	.12++
	.49**++	.39**

Table 6

Average Unstand

Adjective	Do Er
Accurate	.0

cussion

checking was not significantly more accurate than single er
al checking for three of the six types of data examined. Furth
double entry. Thus, although double entry took 25% longer
ie.

ned here) with other data entry techniques. For example, da
ed by having one person read the entries out loud while anc
hecking by the same person. Also, data could be entered tw
double entry done by one person but have higher subject
and least frustrating.

er than it did here, it should be abandoned. Studies that hav
d that double entry is the most accurate method. The subjec
tradicted by every empirical study on this topic. Double en

y systems are available as a stand alone program (Lauritse
. The Barchard and Pace double-entry system will be availa

andardized Residuals for Subjective Opinions, Time Partia

	Double Entry	Visual Checking	Single Entry	ANOVA
	.01	.03	-.04	$F(2, 161) = 0.12$, $p =$

le entry, despite
'urthermore, the
nger than visual

e, data could be
another person
ed twice by two
ojective ratings,

have examined
ojective opinion
e entry systems

ritsen & Bruus,
vailable for free

rtialled Out

p = .883

Note. FB = Family Background. Ex = Extraversi
Social Skills Test.

Table 2

Effect of Data Entry Errors on Internal Consistency

Participant ID		Family Background 5 letters
Correct Values		.67
172439	Scales in wrong order	.62+
27578	87% accuracy	.24++
188413	94% accuracy	.60+

\+ Observed value differs from true value by at least .05.
++ Observed value differs from true value by at least .10.

ersion. SE = School Experiences. SST =

ency, Selected Participants

nd	Extraversion 5 numbers	School Experiences 3 letters	Social Skills Test 3 numbers
	.63	.54	.55
	-.24++	-.17++	-.03++
	.50++	.39++	.50+
	.63	.23++	.46+

Test), th
again, do

Table 4

Effect of I

Participan
Correct V
172439
27578
188413

* *p* < .05.

\+ Observed

++ Observe

Note. Effect

, the differences approached significance (p = .062) and,
ı, double entry was more accurate than the other methods.

le 4

t of Data Entry Errors on Independent Sample t-test, Selected Participants

	Family Background 5 letters		Extraversion 5 numbers		Schoo Experien 3 letter	
cipant ID	*t* test	Effect size	*t* test	Effect size	*t* test	I
ect Values	3.05**	3.41	3.13**	2.90	2.07*	2
39	0.22	0.10++	-1.52	-2.39++	0.04	(
'8	2.29	2.11++	1.22	0.96++	2.33*	2
13	3.66**	4.45++	3.07**	2.96	2.62*	2

: .05. ** $p < .01$.

served effect size differs from true value by at least .50.

bserved effect size differs from true value by at least 1.00.

Effect size = (mean for men – mean for women) / pooled variance.

and, once

s.

nts				
chool periences letters		Social Skills Test 3 numbers		
	Effect size	*t* test	Effect size	
	2.17	2.04	2.89	
	0.03++	1.74	1.22++	
	2.61+	2.64*	3.76+	
	2.91+	1.50	2.23+	

27578	87% accuracy
188413	94% accuracy

* $p < .05$. ** $p < .01$.

\+ Observed value differs from true v

++ Observed value differs from true

Table 5

Frequency of Catastrophic Error

Error?
None
Entered incorrect ID numbers
Entered scale in the wrong order
Accuracy rate 95% or less

	.45*++	.12++
	.49**++	.39**

rue value by at least .05.
true value by at least .10.

Errors for Each Data Entry Method

	Data Entry Method		
	Double Entry	Visual Checking	Single Entry
	61	59	68
rs	0	1	0
rder	0	2	0
	0	4	2

Accurate	.0
Reliable	-.0
Enjoyable	-.1
Fun	-.0
Pleasant	-.2
Relaxing	-.0
Satisfying	.0
Boring	-.0
Frustrating	-.2
Painful	-.0
Tedious	.0
Total Eval	-.0

.01	.03	-.04	*F*(2, 161) = 0.12, *p* =
-.03	.01	.02	F(2, 161) = 0.04, *p* =
-.15	.06	.06	F(2, 161) = 0.67, *p* =
-.09	.04	.03	F(2, 161) = 0.22, *p* =
-.23	.03	.15	F(2, 161) = 2.05, *p* =
-.05	-.02	.06	F(2, 161) = 0.16, *p* =
.02	.02	-.03	F(2, 161) = 0.04, *p* =
-.02	.04	-.02	F(2, 161) = 0.05, *p* =
-.29	.36	-.12	F(2, 161) = 4.86, *p* =
-.01	.07	-.06	F(2, 161) = 0.20, *p* =
.01	-.15	.15	F(2, 161) = 1.20, *p* =
-.01	-.02	.03	F(2, 162) = 0.10, *p* =

$p = .883$
$p = .965$
$p = .513$
$p = .802$
$p = .132$
$p = .849$
$p = .963$
$p = .952$
$p = .009$
$p = .817$
$p = .303$
$p = .903$