Effect Sizes Over Time

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### Method

We downloaded the data was that was used in {Nuijten, 2015 #550}, a study examining the number of errors in statistical tests reported in psychology articles (all data from <https://osf.io/gdr4q/>).

# importing the data  
library(readr)  
data <- read\_csv2(file = "data/150211FullFile\_AllStatcheckData\_Automatic1Tail.csv")

## Using ',' as decimal and '.' as grouping mark. Use read\_delim() for more control.

## Warning: Missing column names filled in: 'X1' [1]

## Parsed with column specification:  
## cols(  
## X1 = col\_integer(),  
## Source = col\_integer(),  
## Statistic = col\_character(),  
## df1 = col\_integer(),  
## df2 = col\_double(),  
## Test.Comparison = col\_character(),  
## Value = col\_double(),  
## Reported.Comparison = col\_character(),  
## Reported.P.Value = col\_double(),  
## Computed = col\_double(),  
## Raw = col\_character(),  
## Error = col\_logical(),  
## DecisionError = col\_logical(),  
## OneTail = col\_logical(),  
## OneTailedInTxt = col\_logical(),  
## CopyPaste = col\_logical(),  
## APAfactor = col\_double(),  
## journals.jour. = col\_character(),  
## years.y. = col\_integer()  
## )

## Warning in rbind(names(probs), probs\_f): number of columns of result is not  
## a multiple of vector length (arg 1)

## Warning: 871 parsing failures.  
## row # A tibble: 5 x 5 col row col expected actual file expected <int> <chr> <chr> <chr> <chr> actual 1 12149 df1 no trailing char~ ,59 'data/150211FullFile\_AllStatcheckD~ file 2 15695 df1 no trailing char~ ,36 'data/150211FullFile\_AllStatcheckD~ row 3 20619 df1 no trailing char~ ,27 'data/150211FullFile\_AllStatcheckD~ col 4 20623 df1 no trailing char~ ,45 'data/150211FullFile\_AllStatcheckD~ expected 5 20624 df1 no trailing char~ ,45 'data/150211FullFile\_AllStatcheckD~  
## ... ................. ... .......................................................................... ........ .......................................................................... ...... .......................................................................... .... .......................................................................... ... .......................................................................... ... .......................................................................... ........ ..........................................................................  
## See problems(...) for more details.

# exluding all articles where the articles are not appliable (i.e., samples don't go back to 1985)  
includedJournals <- c("DP", "FP", "JAP", "JCCP", "JEPG", "JPSP", "PS")  
dat <- data[data$journals.jour. %in% includedJournals,]  
  
# Renamming for clarity  
names(dat)[18] <- "journal"  
names(dat)[19] <- "year"  
names(dat)[1] <- "id"  
names(dat)[2] <- "article"

This dataset includes 258105 statistical test results which were reported in APA style from a total of 16695 articles. The current analysis only uses a subset of these studies, those for which {Nuijten, 2015 #550} extracted results going back to 1985. This analysis therfore includes data from six psychology journals chosen to be representative of the main subdisiplines of psychology reserach; Journal of Applied Psychology (JAP; Applied Psychology), Journal of Consulting and Clinical Psychology (JCCP; Clinical Psychology) , Developmental Psychology (DP; Developmental Psychology), Journal of Experimental Psychology: General (JEPG; Experimental Psychology), and Journal of Personality and Social Psychology (JPSP; Social Psychology). The excluded Journals (PLOS, Psychological Science, Frontiers in Psychology) have only began to be published in the last 15 years, which was not considered long enough to begin to look for trends in reported effect sizes over time. The included subset includes a total of 226566 statistical test results from a total of 14208 articles published from 1985 to 2013.

### Effect size extraction and conversion

All test statistics were converted to Fisher Z transformed correlation coefficents following {Open Science Collaboration, 2015 #611} for visulisation and analysis. Negative effect sizes (i.e., negative correlations) were set to be positive for ease of analysis and visulisation. Because typical APA notation for z tests does not report the included sample size in a standardised formal, Z scores were excluded from analyses (n = 8578). As it was not possible to derrive valid standard errors for F statistics with error degrees of freedom above 1 or for Chi square statistics (n = 149952), these analyses were excluded from the multilevel meta-analysis, but are included in visulisations. For other tests, standard errors were estimated as , taking the degrees of freedom for the denominator minus two as n (or just the degrees of freedom minus two in the case of correlations and t tests). Including the excluded tests in these analysis (and estimating the standard error as a above) led to *[no differences / describe difference.]*.

It is also worth noting that in ANOVA designs where there is more than one factor included (or equivalent regression analyses), this conversion leads to the exclusion of any non-focal variables’ variance from the denominator. This means that a study which includes a variable as a covariate will lead to a larger observed effect size than a study which does not include the covariate, although the amount of variance explained by the focal variable remains constant {Olejnik, 2003 #933}.

# Accounting for peripheral tests

Finally, there is no way of verifying that all of the statistical tests reported in the current study are not, for example, manipulation tests or randomisation tests, and it is likely that a large proportion of those tests reported are in fact not tests of the main hypotheses of each paper. Any observed change in effect sizes could be driven by changes in reporting practices, for example becoming more or less likely to report manipulation checks or randomisation checks over time. In order to account for this issue, a number of methods were used to attempt to identify the focal test of each article. (a) The analyses were performed looking just at the first statistical test reported in each paper. (b) The anlayses were performed looking just at the largest effect size seen in each paper. Multilevel analyses for both of these approaches dropped the random effect for article, as in each case there is only a single effect size from each article. Neither of these methods is perfect, but both are intended to look at the

… Nonetheless, the current anlayis is the first example of a study which has attempted to examine how effects change across fields of psychological reserach over time.

# Setting seed for reproducibility  
set.seed(14122018)  
  
# Extracting test subset  
dat<-dat[runif(n = nrow(dat)/1000, min = 0, max = nrow(dat)),]  
# rm("data")   
  
# Adapted from https://osf.io/z7aux/  
esComp <- function(x,df1,df2,esType) {  
 esComp <- ifelse(esType=="t",sqrt((x^2\*(1 / df2)) / (((x^2\*1) / df2) + 1)),   
 ifelse(esType=="F",sqrt((x\*(df1 / df2)) / (((x\*df1) / df2) + 1))\*sqrt(1/df1),  
 ifelse(esType=="r",x,  
 ifelse(esType=="Chi2",sqrt(x/(df2 + 2)),  
 ifelse(esType == "Z",NA,NA)))))  
 return(esComp)  
}  
  
# calculating pseudo correlation coefficent  
dat$r <- esComp(x = dat$Value, df1 = dat$df1, df2 = dat$df2, esType = dat$Statistic)

## Warning in sqrt(x/(df2 + 2)): NaNs produced

# setting to positive  
dat$r <- abs(dat$r)  
  
# transforming to fisher's z  
dat$z <- 0.5\*log((1 + dat$r) / (1 - dat$r))   
  
# Standard error for z (sample size taken as df2 - 2, se as sqrt(1/(sampleSize-3))  
dat$SEz <- sqrt(1/(dat$df2 - 5))  
  
# Binary for valid standard error  
dat$vaidSE <- !((dat$Statistic=="Chi2" | (dat$Statistic=="F" & dat$df1 > 1) | (dat$Statistic == "Z")) | dat$df2 < 6)

## Analysis

All analyses were tested and developed on a subset of 0.01% of the dataset before being pre-registered (see osf….). The main analysis

Visual trends show a clear pattern, and this forms the main basis for infererences.

library(metafor); library(tidyverse)

## Loading required package: Matrix

## Loading 'metafor' package (version 2.1-0). For an overview   
## and introduction to the package please type: help(metafor).

## -- Attaching packages ----------------------------- tidyverse 1.2.1 --

## v ggplot2 3.1.0 v purrr 0.2.5  
## v tibble 1.4.2 v dplyr 0.7.8  
## v tidyr 0.8.2 v stringr 1.3.1  
## v ggplot2 3.1.0 v forcats 0.3.0

## -- Conflicts -------------------------------- tidyverse\_conflicts() --  
## x tidyr::expand() masks Matrix::expand()  
## x dplyr::filter() masks stats::filter()  
## x dplyr::lag() masks stats::lag()

datMeta <- filter(dat, dat$vaidSE)  
  
mod <- rma.mv(z, V = SEz^2, random = ~ factor(article) | journal, mods = (year - mean(year)), data = datMeta)  
  
ranef(mod)

## $`~factor(article) | journal`  
## intrcpt se pi.lb pi.ub  
## 13 | DP -0.0109770930 0.10668043 -0.220066894 0.198112708  
## 186 | DP -0.1309745510 0.09512569 -0.317417481 0.055468379  
## 191 | DP -0.1773590041 0.10105505 -0.375423254 0.020705246  
## 249 | DP 0.0899089023 0.16050300 -0.224671200 0.404489005  
## 590 | DP -0.1315743575 0.10183344 -0.331164242 0.068015527  
## 736 | DP 0.1372240755 0.10681785 -0.072135067 0.346583218  
## 923 | DP -0.0446111268 0.07461415 -0.190852180 0.101629927  
## 1043 | DP 0.0012618597 0.12136360 -0.236606418 0.239130138  
## 1169 | DP -0.0190990818 0.11225157 -0.239108111 0.200909947  
## 1282 | DP 0.1128284871 0.14895645 -0.179120794 0.404777769  
## 1283 | DP 0.1412271804 0.18152603 -0.214557292 0.497011652  
## 1487 | DP -0.3243712639 0.04083991 -0.404416017 -0.244326511  
## 1592 | DP 0.2690976069 0.17590750 -0.075674760 0.613869974  
## 1682 | DP -0.0288958148 0.13652789 -0.296485557 0.238693928  
## 1712 | DP -0.1319358093 0.08410311 -0.296774876 0.032903257  
## 1772 | DP -0.0346576271 0.16184435 -0.351866733 0.282551479  
## 1791 | DP -0.1090637506 0.14314170 -0.389616320 0.171488819  
## 1946 | DP -0.0596293339 0.11559710 -0.286195484 0.166936816  
## 2072 | DP 0.3492032918 0.13698923 0.080709343 0.617697241  
## 2084 | DP -0.0615181494 0.15805470 -0.371299665 0.248263367  
## 2281 | DP 0.1040325912 0.14806632 -0.186172069 0.394237251  
## 2322 | DP 0.0046041706 0.15458802 -0.298382781 0.307591122  
## 2434 | DP 0.6941915464 0.11251170 0.473672672 0.914710421  
## 2632 | FP 0.1642460709 0.18160973 -0.191702467 0.520194609  
## 2704 | FP 0.2351681888 0.16631057 -0.090794543 0.561130921  
## 2752 | FP 0.4854058657 0.13711093 0.216673374 0.754138358  
## 3013 | FP -0.0214947607 0.19119792 -0.396235793 0.353246271  
## 4228 | JAP 0.0292516946 0.12107817 -0.208057167 0.266560556  
## 4297 | JAP -0.0691783554 0.10611511 -0.277160147 0.138803436  
## 5053 | JCCP 0.2135010652 0.11964900 -0.021006659 0.448008789  
## 5586 | JCCP -0.1285282233 0.10409564 -0.332551929 0.075495483  
## 5632 | JCCP 0.1395581057 0.16623885 -0.186264055 0.465380266  
## 6120 | JCCP -0.0916901957 0.15969512 -0.404686888 0.221306496  
## 6123 | JCCP 0.0338811798 0.16834934 -0.296077471 0.363839830  
## 6247 | JCCP -0.0998419866 0.04791009 -0.193744046 -0.005939927  
## 6349 | JCCP -0.1258054549 0.08722748 -0.296768182 0.045157272  
## 6354 | JCCP -0.0738980939 0.11021689 -0.289919235 0.142123047  
## 6651 | JCCP -0.1331016693 0.08565548 -0.300983325 0.034779986  
## 6677 | JCCP -0.0269533829 0.12573630 -0.273392000 0.219485235  
## 6785 | JCCP -0.1661436784 0.05442916 -0.272822868 -0.059464489  
## 7159 | JCCP -0.0763190680 0.10729775 -0.286618785 0.133980649  
## 7331 | JCCP -0.0702662840 0.09964560 -0.265568065 0.125035497  
## 7460 | JEPG 0.1715625299 0.17102193 -0.163634292 0.506759351  
## 7465 | JEPG 0.1322741043 0.17097146 -0.202823793 0.467372001  
## 7545 | JEPG 0.2108500435 0.14167940 -0.066836473 0.488536560  
## 7561 | JEPG -0.1229933521 0.09820142 -0.315464605 0.069477901  
## 7696 | JEPG 0.2910049724 0.14151204 0.013646469 0.568363476  
## 7799 | JEPG 0.3602250042 0.16839799 0.030171017 0.690278991  
## 7809 | JEPG -0.0949786373 0.07046938 -0.233096092 0.043138817  
## 7935 | JEPG -0.1055332631 0.08129404 -0.264866663 0.053800137  
## 7975 | JEPG -0.2999468496 0.06487765 -0.427104707 -0.172788992  
## 8065 | JEPG -0.1099428533 0.09293311 -0.292088406 0.072202699  
## 8136 | JEPG 0.0048358247 0.18470492 -0.357179173 0.366850823  
## 8255 | JPSP -0.0193953770 0.15726501 -0.327629123 0.288838369  
## 8378 | JPSP 0.0609594468 0.08243230 -0.100604897 0.222523790  
## 8464 | JPSP -0.0113546430 0.14093208 -0.287576444 0.264867158  
## 8520 | JPSP -0.1567033006 0.10854731 -0.369452119 0.056045518  
## 8592 | JPSP -0.0865902038 0.11259307 -0.307268573 0.134088165  
## 8619 | JPSP -0.0859683783 0.13972677 -0.359827806 0.187891049  
## 8719 | JPSP -0.0848923475 0.13288263 -0.345337511 0.175552816  
## 8737 | JPSP -0.0148954103 0.13188439 -0.273384061 0.243593241  
## 8845 | JPSP -0.1370876353 0.09991853 -0.332924363 0.058749093  
## 8896 | JPSP 0.0886972592 0.16255085 -0.229896551 0.407291069  
## 9003 | JPSP -0.0381401138 0.14700875 -0.326271960 0.249991732  
## 9111 | JPSP 0.0922102012 0.14700875 -0.195921645 0.380342047  
## 9197 | JPSP -0.1140193596 0.11985811 -0.348936931 0.120898212  
## 9206 | JPSP 0.1161224703 0.15147900 -0.180770913 0.413015854  
## 9212 | JPSP 0.3420711255 0.11437769 0.117894982 0.566247269  
## 9232 | JPSP -0.3093550729 0.07721423 -0.460692179 -0.158017967  
## 9406 | JPSP -0.0299798699 0.10930078 -0.244205464 0.184245724  
## 9410 | JPSP -0.0226421665 0.13627302 -0.289732385 0.244448052  
## 9631 | JPSP -0.1029917890 0.10920709 -0.317033761 0.111050183  
## 9669 | JPSP 0.3395179448 0.06621340 0.209742061 0.469293828  
## 9717 | JPSP -0.0566254873 0.09869709 -0.250068223 0.136817248  
## 9747 | JPSP 0.3542407363 0.15105246 0.058183353 0.650298119  
## 9783 | JPSP -0.0720949759 0.09186556 -0.252148173 0.107958221  
## 9826 | JPSP -0.1271682695 0.06842069 -0.261270350 0.006933811  
## 9831 | JPSP 0.2351115586 0.14635699 -0.051742870 0.521965987  
## 9860 | JPSP -0.0681425510 0.11452195 -0.292601449 0.156316348  
## 9964 | JPSP -0.0920312324 0.06875940 -0.226797178 0.042734713  
## 10120 | JPSP -0.0816000574 0.07475484 -0.228116847 0.064916732  
## 10158 | JPSP -0.0048105981 0.10625617 -0.213068858 0.203447662  
## 10168 | JPSP 0.0715626258 0.07629304 -0.077968976 0.221094227  
## 10182 | JPSP -0.0605184284 0.08362159 -0.224413740 0.103376884  
## 10185 | JPSP -0.0834263807 0.10016147 -0.279739264 0.112886502  
## 10191 | JPSP 0.2263682436 0.15253321 -0.072591347 0.525327834  
## 10214 | JPSP -0.0370652645 0.11263869 -0.257833042 0.183702513  
## 10229 | JPSP -0.0865709828 0.12891135 -0.339232593 0.166090627  
## 10319 | JPSP -0.1026254448 0.10201244 -0.302566160 0.097315270  
## 10321 | JPSP 0.0604500933 0.15253321 -0.238509497 0.359409684  
## 10460 | JPSP -0.0028532699 0.14176559 -0.280708726 0.275002186  
## 10462 | JPSP 0.2634949973 0.17089748 -0.071457911 0.598447906  
## 10542 | JPSP -0.2233142040 0.06364859 -0.348063158 -0.098565250  
## 10556 | JPSP -0.0336270322 0.13540005 -0.299006256 0.231752192  
## 10684 | JPSP -0.1986946541 0.05874843 -0.313839455 -0.083549854  
## 10716 | JPSP 0.3009202736 0.11732037 0.070976576 0.530863971  
## 10728 | JPSP -0.3428711484 0.03467120 -0.410825443 -0.274916854  
## 10759 | JPSP -0.0142186857 0.13530990 -0.279421217 0.250983845  
## 10802 | JPSP 0.0473701708 0.11511216 -0.178245525 0.272985867  
## 10816 | JPSP -0.2215745258 0.06843177 -0.355698338 -0.087450714  
## 10894 | JPSP -0.1054233215 0.07917817 -0.260609686 0.049763043  
## 10912 | JPSP 0.0082337269 0.13186709 -0.250221012 0.266688466  
## 10930 | JPSP 0.0125597027 0.13186709 -0.245895036 0.271014442  
## 10977 | JPSP -0.0281861138 0.09118232 -0.206900181 0.150527953  
## 11037 | JPSP 0.0969937310 0.16616827 -0.228690103 0.422677564  
## 11102 | JPSP 0.0250944680 0.10413617 -0.179008669 0.229197605  
## 11133 | JPSP -0.0075180336 0.13774993 -0.277502938 0.262466871  
## 11139 | JPSP -0.0003186821 0.15787362 -0.309745299 0.309107935  
## 11204 | JPSP -0.1543416696 0.11171783 -0.373304585 0.064621246  
## 11269 | JPSP -0.2880861455 0.03556528 -0.357792820 -0.218379471  
## 11283 | JPSP 0.2757167255 0.09991256 0.079891701 0.471541750  
## 11293 | JPSP 0.1760764512 0.08878520 0.002060663 0.350092239  
## 11305 | JPSP -0.0045281182 0.12054393 -0.240789888 0.231733652  
## 11385 | JPSP -0.0237109360 0.15986215 -0.337034984 0.289613112  
## 11409 | JPSP -0.0028310117 0.13910154 -0.275465012 0.269802988  
## 11447 | JPSP -0.1931808084 0.07839806 -0.346838186 -0.039523431  
## 11521 | JPSP -0.0617957479 0.10778316 -0.273046865 0.149455369  
## 11568 | JPSP 0.3740982345 0.14462928 0.090630059 0.657566410  
## 11684 | JPSP 0.0756435245 0.14326936 -0.205159252 0.356446301  
## 11714 | JPSP 0.0681785488 0.09299567 -0.114089610 0.250446707  
## 11761 | JPSP -0.0339753189 0.14063644 -0.309617674 0.241667036  
## 11815 | JPSP -0.0774922904 0.11643871 -0.305707972 0.150723391  
## 11843 | JPSP 0.0589185927 0.08918499 -0.115880768 0.233717954  
## 11878 | JPSP -0.1151340564 0.11790300 -0.346219688 0.115951576  
## 11906 | JPSP -0.2259043751 0.07227797 -0.367566597 -0.084242153  
## 11918 | JPSP -0.0863118429 0.11260597 -0.307015489 0.134391803  
## 11983 | JPSP 0.1235651303 0.13241268 -0.135958962 0.383089223  
## 12024 | JPSP 0.6294466094 0.13350647 0.367778744 0.891114475  
## 12171 | JPSP -0.0741155076 0.13494023 -0.338593494 0.190362479  
## 12187 | JPSP -0.2151591712 0.05655564 -0.326006186 -0.104312156  
## 12203 | JPSP -0.0233525544 0.13382694 -0.285648530 0.238943421  
## 12239 | JPSP -0.1721075398 0.05640627 -0.282661805 -0.061553275  
## 12272 | JPSP -0.1862071130 0.09805026 -0.378382093 0.005967867  
## 12279 | JPSP -0.2220409380 0.11576191 -0.448930122 0.004848246  
## 12356 | JPSP -0.0686185448 0.10939195 -0.283022835 0.145785745  
## 12386 | JPSP -0.1353586911 0.08552404 -0.302982730 0.032265348  
## 12510 | JPSP -0.1260120104 0.13210738 -0.384937716 0.132913695  
## 15026 | PS 0.0153741947 0.14583155 -0.270450399 0.301198788  
## 15147 | PS 0.1857418984 0.14897501 -0.106243751 0.477727548  
## 15324 | PS -0.2037239344 0.06656882 -0.334196425 -0.073251444  
## 15676 | PS -0.2051820479 0.11703276 -0.434562034 0.024197938  
## 15817 | PS 0.0202478619 0.10461727 -0.184798212 0.225293935  
## 15856 | PS -0.1843795096 0.06788866 -0.317438838 -0.051320181  
## 16187 | PS 0.0482756096 0.19850884 -0.340794564 0.437345783  
## 16218 | PS -0.0339946040 0.13055965 -0.289886824 0.221897616  
## 16314 | PS -0.1034554645 0.09730907 -0.294177733 0.087266804  
## 16426 | PS 0.0275551454 0.09238417 -0.153514502 0.208624793  
## 16537 | PS 0.0286053008 0.12905400 -0.224335889 0.281546491

datMetaLargest <- dat %>%   
 filter(vaidSE) %>%   
 group\_by(article) %>%  
 filter(z == max(z))  
  
modLargest <- rma.mv(z, V = SEz^2, random = ~ 1 | journal, mods = (year - mean(year)), data = datMetaLargest)  
  
ranef(modLargest)

## $journal  
## intrcpt se pi.lb pi.ub  
## DP -0.13375773 0.1031538 -0.3359355 0.06842001  
## FP 0.56975420 0.1421331 0.2911784 0.84833000  
## JAP -0.02520100 0.1255048 -0.2711859 0.22078387  
## JCCP -0.10245917 0.1034685 -0.3052536 0.10033527  
## JEPG -0.08652371 0.1049138 -0.2921509 0.11910349  
## JPSP -0.14183005 0.1018067 -0.3413674 0.05770732  
## PS -0.07998254 0.1050223 -0.2858225 0.12585745

datMetaFirst <- dat %>%   
 filter(vaidSE) %>%   
 group\_by(article) %>%  
 slice(1)  
  
modFirst <- rma.mv(z, V = SEz^2, random = ~ 1 | journal, mods = (year - mean(year)), data = datMetaFirst)  
  
  
ranef(modFirst)

## $journal  
## intrcpt se pi.lb pi.ub  
## DP -0.13343611 0.1031816 -0.3356683 0.06879611  
## FP 0.56984854 0.1421570 0.2912259 0.84847120  
## JAP -0.02497388 0.1255290 -0.2710062 0.22105846  
## JCCP -0.10219926 0.1034962 -0.3050480 0.10064950  
## JEPG -0.08641322 0.1049411 -0.2920940 0.11926759  
## JPSP -0.14293280 0.1018349 -0.3425255 0.05665984  
## PS -0.07989327 0.1050497 -0.2857868 0.12600028

## Appendix

### Conversion

All statistical tests extracted were transformed into correlation coefficents following the methods reported in {Open Science Collaboration, 2015 #611}. t statistics were converted using:

Where is the observed t statistic and is the degrees of freedom of the t test.

F statistics were converted using:

Where is the observed F statistic and is the degrees of freedom of the numerator and is degrees of freedom of the denominator.

And chi square statistics as

All values were then transformed into fisher Z transformed correlation coefficents using:

And standard errors for these statistics when derrived from F tests with denominator degrees of freedom of 1, t tests, and correlation coefficents were estimated as:

#### Diagnostics

profile(rma.mv(z, V = SEz^2, random = ~ factor(article) | journal, mods = year, data = datMeta))