SimSST: An R Statistical Software Package to Simulate Stop Signal Task Data

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Outline

Background

- **Response Inhibition:** Situations in which the current ongoing course of actions or thoughts must be:
  - changed, or
  - controlled, or
  - stopped.
- **Types:**
  - Reactive,
  - Proactive
- **Paradigms of Study:**
  - GO-No Go Task(GNGT),
  - Stop Signal Task(SST)

Background

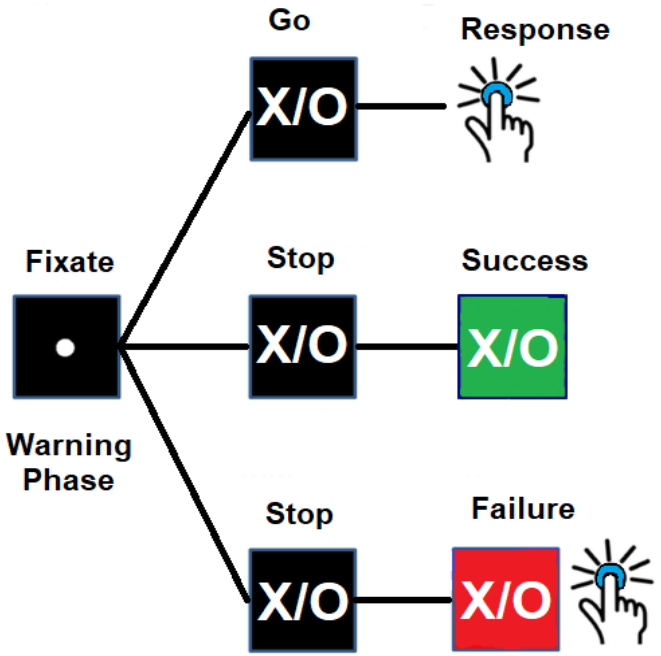

Figure 1: The standard stop signal task.

Background

- **Methods of Stop Signal Task(SST):**
  - the deadline model;
  - the independent horse race model;
  - the interactive horse race model;
  - the Hanes–Carpenter model.
- **The Horse Race Model:** A race between two go process (GORT) and the stop process (SSRT) with two conditions:
  - Stochastic Independence,
  - Contextual Independence
- **Modelling Distributions for GORT/SSRT:**
  - Exponentially Modified Gaussian (ExG),
  - Shifted Wald (SW)

Background

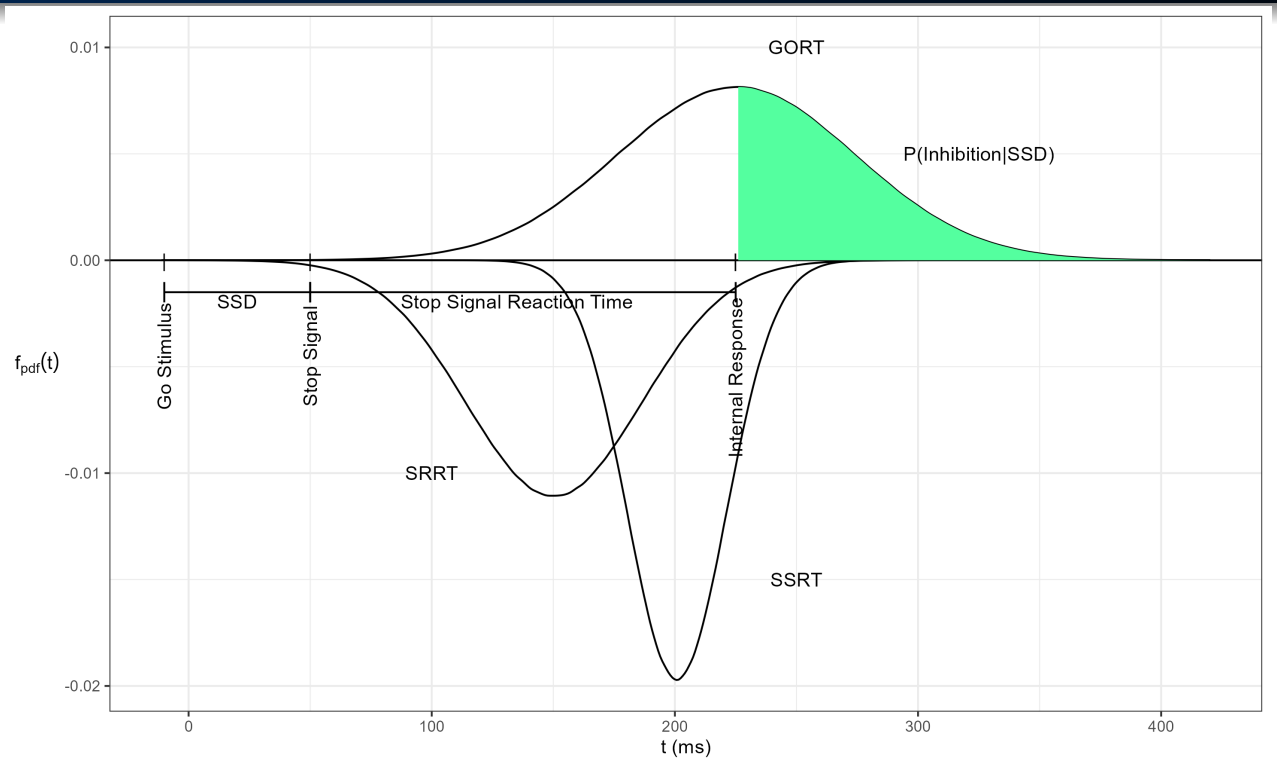

Figure 2: Graphical representation of the complete horse race model: GORT: go reaction times, SRRT: signal respond reaction times, SSRT: stop signal reaction times, *SSD*: stop signal delay.

Motivation

- Simulation Script Codes to test various SST hypothesis:
  - C
  - Matlab
  - Python
  - R
- Limitations:
  - No standalone Simulation Statistical Software Package yet !
  - Mostly focused on ExG model for GORT/SSRT
  - Mostly focused on independent Horse Race model
  - Covering either fixed SSD or Tracking SSD !

Introduction

- Simulates based on both fixed SSD/Tracking SSD
- Covers both idenpendent and dependent GORT/SSRT
- Covers two parametric distributions ExG/SW for each GORT/SSRT
- Covers 16 scenarios
- Depends on only three packages:
  - gamlss.dist
  - MASS
  - dplyr

Description

- Installation & Loading:

```
line #1: > install.packages("SimSST", dependencies=TRUE)
line #2: > library(SimSST)
```

- Functions:
  - First(9 parameters): simssfixed(pid,block,n,m,SSD.b,dist.go,theta.go,dist.stop,theta.stop)
  - Second(9 parameters): simsstrack(pid,block,n,m,SSD.b,dist.go,theta.go,dist.stop,theta.stop)
  - Third(11 parameters): simssgen(pid,block,n,m,SSD.b,dist.go,theta.go,dist.stop,theta.stop,rho,d)

Fixed SSD

```
line #1:> mySSTdata1<- simssgen(
                pid = c("John.Smith", "John.Smith"),
                block = c(1,2),
                n = c(10,10),
                m = c(4,4),
                SSD.b = c(220,240),
                dist.go = c("ExG", "ExG"),
                theta.go = as.matrix(rbind(c(440,90,90),
                c(440,90,90))),
                dist.stop = c("ExG", "ExG"),
                theta.stop = as.matrix(rbind(c(120,80,70),
                c(120,80,70))),
                rho=c(0,0),
                d=c(0,0))
line #2:> mySSTdata1
```

Fixed SSD

Filter

	Participant.id	Block	Trial	Inhibition	GORT	SSRT	SRRT	SSD
1	John.Smith	1	Stop	0	-999	117.4	250.6	220
2	John.Smith	1	Go	-999	450.8	-999	-999	-999
3	John.Smith	1	Go	-999	257.4	-999	-999	-999
4	John.Smith	1	Go	-999	453	-999	-999	-999
5	John.Smith	1	Go	-999	689.3	-999	-999	-999
6	John.Smith	1	Stop	1	-999	115.3	-999	220
7	John.Smith	1	Stop	1	-999	170.4	-999	220
8	John.Smith	1	Go	-999	534.9	-999	-999	-999
9	John.Smith	1	Go	-999	514.8	-999	-999	-999
10	John.Smith	1	Stop	1	-999	115.7	-999	220
11	John.Smith	2	Go	-999	490.9	-999	-999	-999
12	John.Smith	2	Go	-999	480.2	-999	-999	-999
13	John.Smith	2	Go	-999	650.3	-999	-999	-999
14	John.Smith	2	Stop	1	-999	217.1	-999	240
15	John.Smith	2	Stop	1	-999	253.3	-999	240
16	John.Smith	2	Go	-999	601.2	-999	-999	-999
17	John.Smith	2	Stop	1	-999	202.5	-999	240
18	John.Smith	2	Go	-999	505.8	-999	-999	-999
19	John.Smith	2	Go	-999	511.6	-999	-999	-999
20	John.Smith	2	Stop	1	-999	57.1	-999	240

Showing 1 to 20 of 20 entries, 8 total columns

Figure 3: Sample SimSST R software package(R studio version 4.1.3) simulated fixed SSD based SST data output

Tracking SSD

```
line #1:> mySSTdata2<- simssgen(
                pid = c("Jane.McDonald", "Jane.McDonald"),
                block = c(1,2),
                n = c(10,10),
                m = c(4,4),
                SSD.b = c(220,240),
                dist.go = c("ExG", "ExG"),
                theta.go = as.matrix(rbind(c(440,90,90),
                c(440,90,90))),
                dist.stop = c("ExG", "ExG"),
                theta.stop = as.matrix(rbind(c(120,80,70),
                c(120,80,70))),
                rho=c(0,0),
                d=c(50,50))
line #2:> mySSTdata2
```

Tracking SSD

Filter

	Participant.id	Block	Trial	Inhibition	GORT	SSRT	SRRT	SSD
1	Jane.McDonald	1	Stop	1	-999	263.8	-999	220
2	Jane.McDonald	1	Go	-999	609.7	-999	-999	-999
3	Jane.McDonald	1	Stop	1	-999	78.6	-999	270
4	Jane.McDonald	1	Go	-999	350	-999	-999	-999
5	Jane.McDonald	1	Stop	0	-999	138.8	392.1	320
6	Jane.McDonald	1	Go	-999	593.4	-999	-999	-999
7	Jane.McDonald	1	Stop	1	-999	81.1	-999	270
8	Jane.McDonald	1	Go	-999	524.2	-999	-999	-999
9	Jane.McDonald	1	Go	-999	427.1	-999	-999	-999
10	Jane.McDonald	1	Go	-999	430.1	-999	-999	-999
11	Jane.McDonald	2	Stop	1	-999	175.5	-999	240
12	Jane.McDonald	2	Go	-999	457.6	-999	-999	-999
13	Jane.McDonald	2	Stop	0	-999	175.6	443.4	290
14	Jane.McDonald	2	Go	-999	351.2	-999	-999	-999
15	Jane.McDonald	2	Stop	1	-999	74	-999	240
16	Jane.McDonald	2	Go	-999	479.3	-999	-999	-999
17	Jane.McDonald	2	Stop	0	-999	277.6	436.1	290
18	Jane.McDonald	2	Go	-999	709.8	-999	-999	-999
19	Jane.McDonald	2	Go	-999	521.9	-999	-999	-999
20	Jane.McDonald	2	Go	-999	555.1	-999	-999	-999

Showing 1 to 20 of 20 entries, 8 total columns

Figure 4: Sample SimSST R software package(R studio version 4.1.3) simulated Tracking SSD based SST data output

Package Generalization Directions

- Include other parametric forms of GORT/SSRT :
  - Gamma
  - Lognormal
  - Weibull

- Include Trigger Failures(TF) in stop trials:
  - Here: $p(TF) = 0$
  - Generally: $p(TF) > 0$

[1] Soltanifar, M., & Lee, C. H. (2023). SimSST: An R Statistical Software Package to Simulate Stop Signal Task Data. Mathematics, 11(3), 500. https://doi.org/10.3390/math11030500

[2] Comprehensive R Archive Network (CRAN). (2023, January 9). Simulated Stop Signal Task Data [R package SimSST version 0.0.5.2]. https://cran.r-project.org/package=SimSST


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THANK YOU
Any Questions?