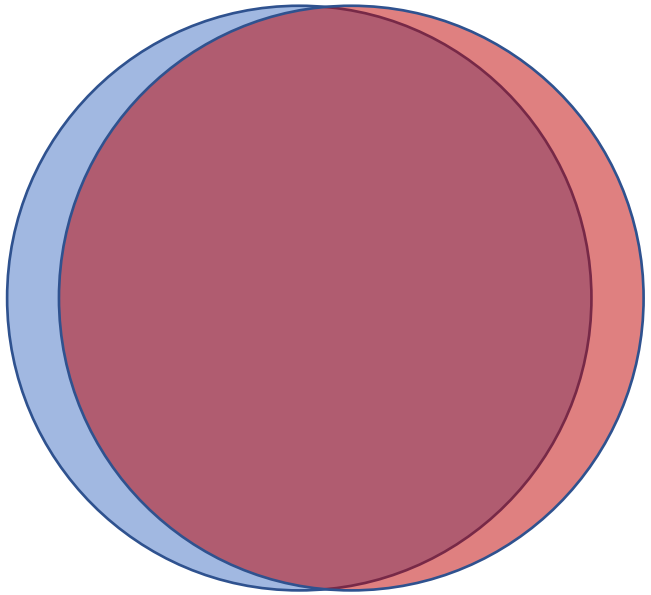
Wave-models of Cognition & Mental Health Chris Ma 2022

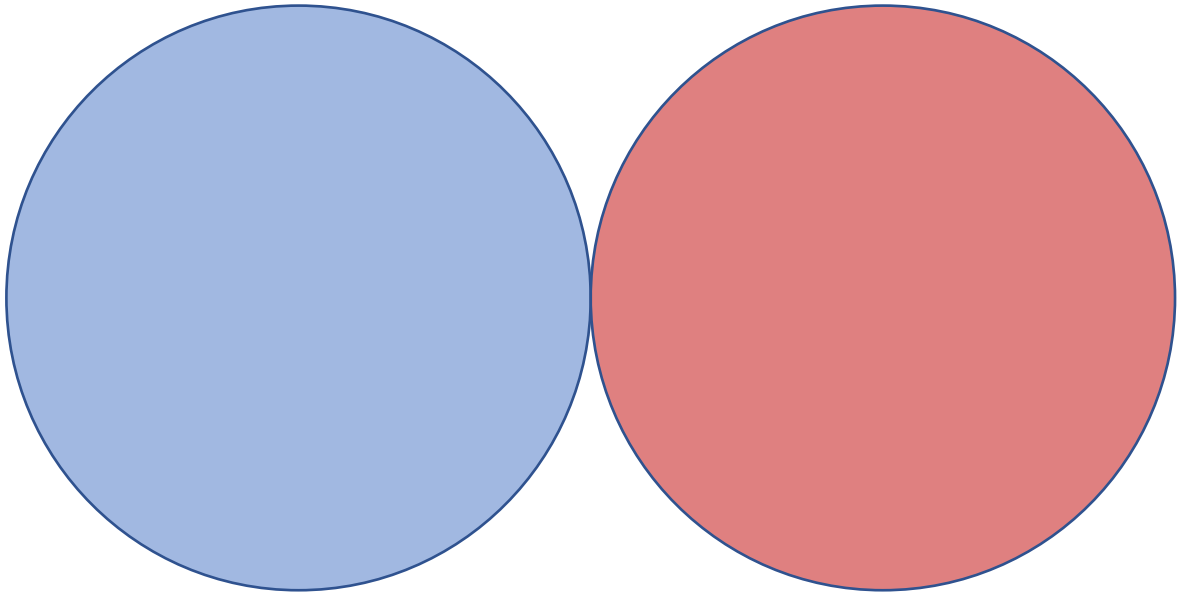
- *Unrelated to quantum-bio/mind/consciousness*
- *Related to neural networks, quantum computing*

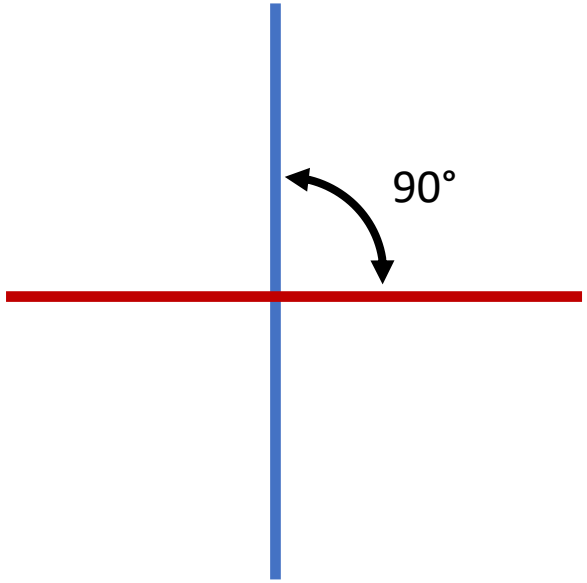
- Is human dignity rational? i.e. is suicidality irrational?
- CBT v.2: Can we diagnosis *a priori* when talk therapy will help?
- Longterm: Can we restructure our language/culture/society such that non-invasive treatments are more effective more often?



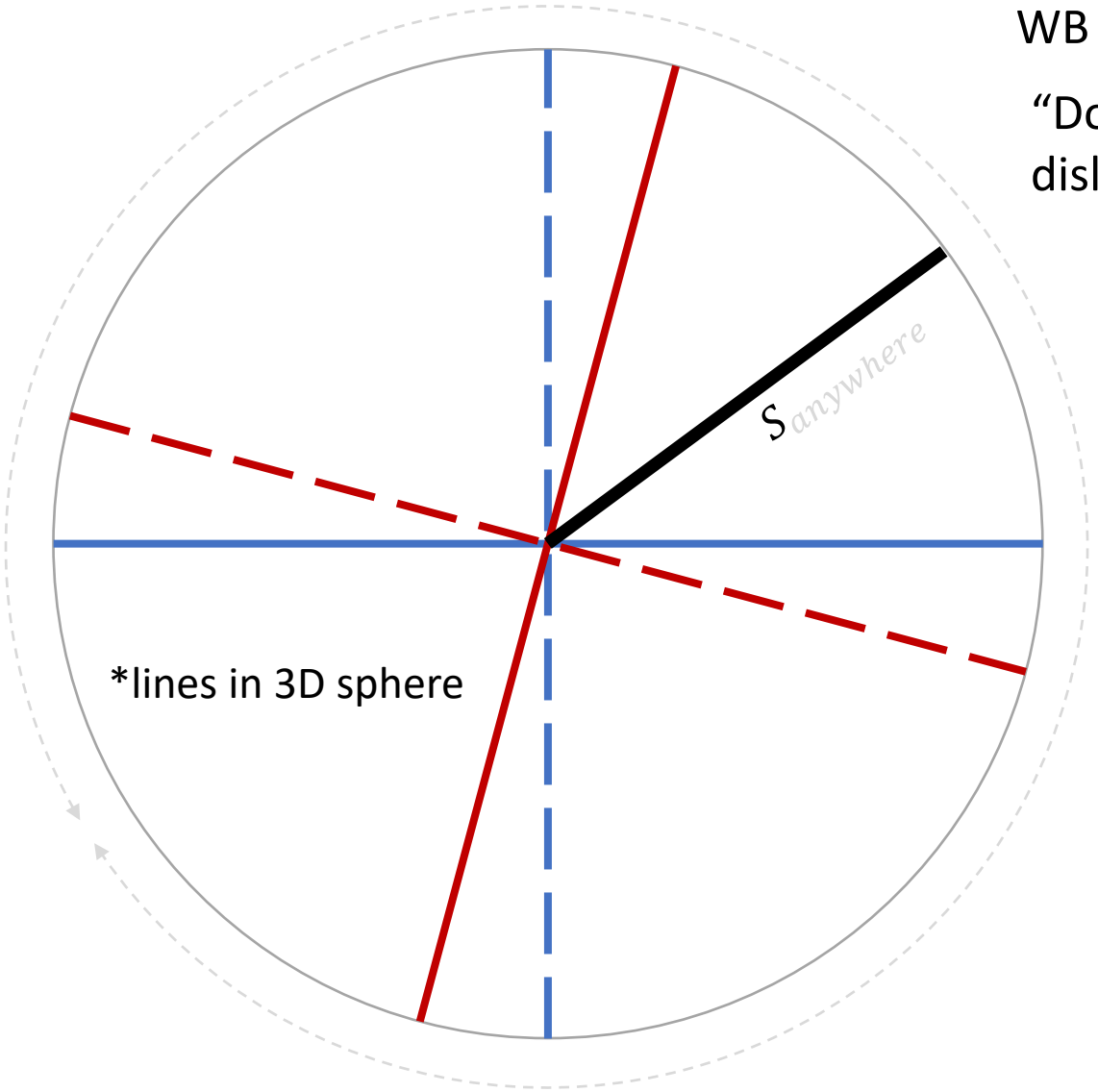
$$P(x) + (1 - P(x)) = 1$$

$$\cos^2\theta + \sin^2\theta = 1$$





*like doing stats with Pearson's R (correlation) and R^2 (variance explained)



WB / BW

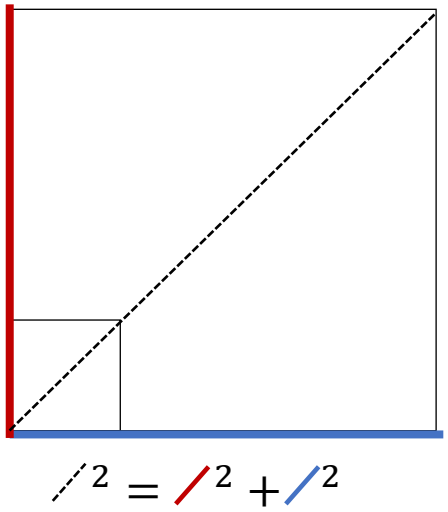
"Do you think W people dislike B people?"

	By	Bn
Wy	.40 / .40	.02 / .13
Wn	.16 / .05	.42 / .40

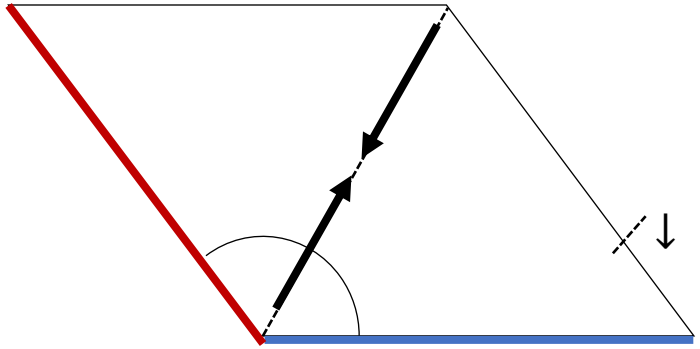
	By	Bn
Wy	.40 / .40	.02 / .13
Wn	.16 / .05	.42 / .40

$$(\cos\theta\cos\varphi)^2+(\sin\theta\cos\varphi)^2=(\cos\varphi\cos(\theta+\varphi))^2+(\cos\varphi\sin(\theta+\varphi))^2$$
$$\cos^2\theta+\sin^2\theta=\cos^2(\theta+\varphi)+\sin^2(\theta+\varphi)=1$$

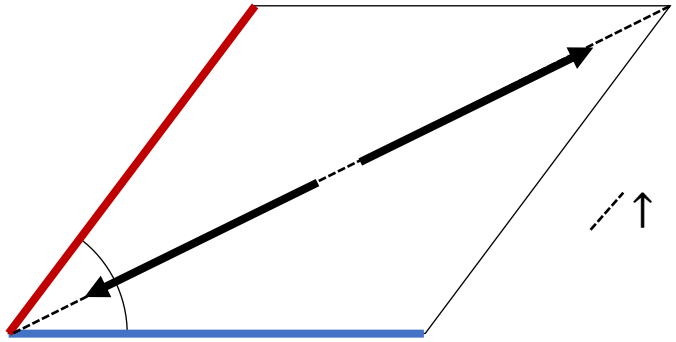
A given B or C? *(typical data)*
Gamble again given Won or Lost?
(two-stage gambling task)
Cooperate given Opponent cooperates or defects?
(prisoner's dilemma)



A|B	A|C	A|?
.30	.10	.21



G|W	G|L	G|?
.60	.55	**.35**



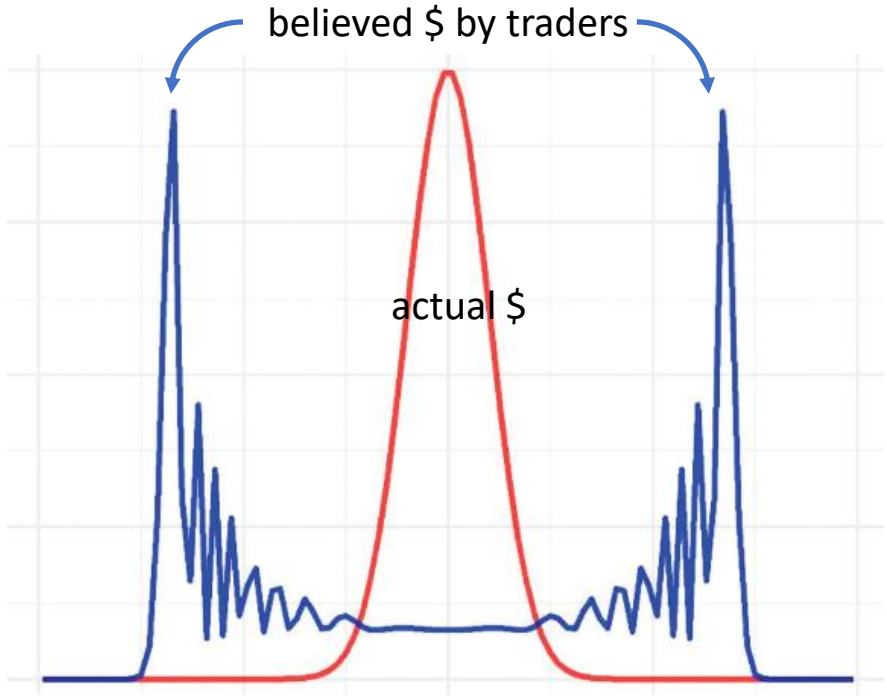
C|Oc	C|Od	C|?
.26	.13	**.36**

$$P(A) = P(A|B)P(B) + P(A|G)P(G)$$

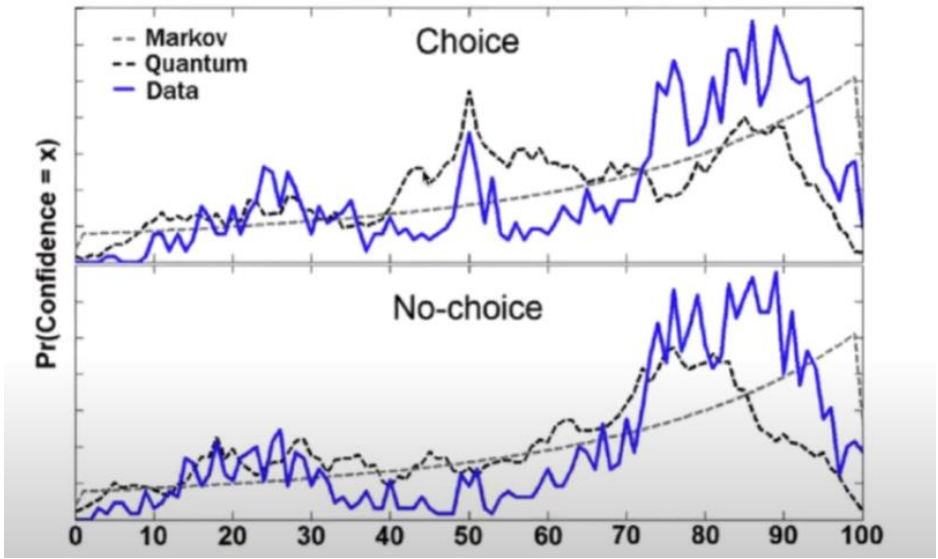
$$P(A) \approx \frac{P(A|B) + P(A|G)}{2}$$

$$P(A) = \frac{P(A|B) + P(A|G)}{2} + \sqrt{P(A|B)P(A|G)}\cos\theta$$

Future stock prices



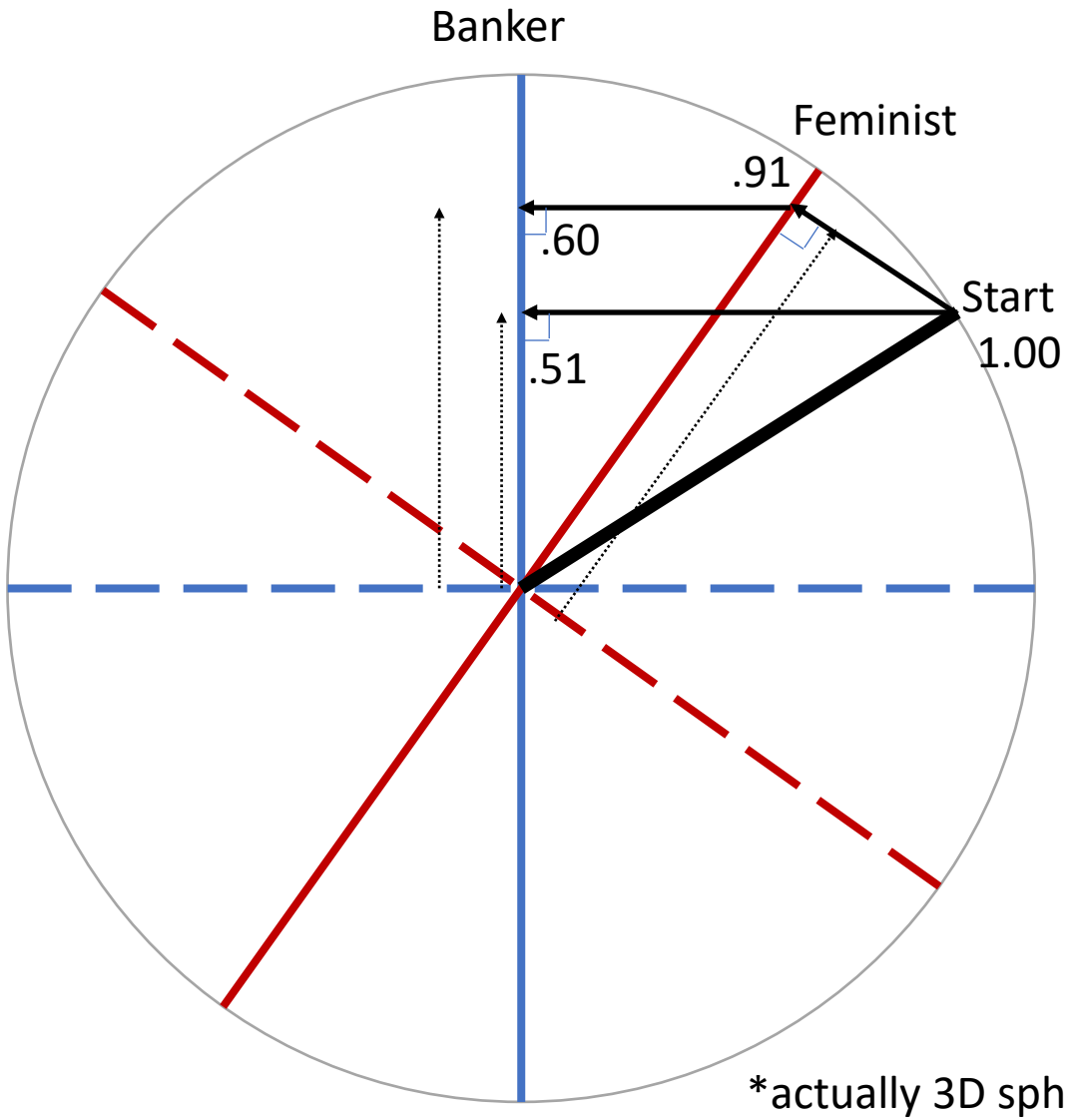
Oscillating confidence after choice/no-choice



images: Orrell, 2020. *SSRN*. Q Walk model of Fin Options
Busemeyer, 2020. *Youtube*. Q Cognition and Decision

Ψ = probability amplitude

Probability of x = $\Psi(x)^2$



*actually 3D sphere

Story: Linda was a student at UC Berkeley who majored in philosophy and she was active in the anti-nuclear movement.

Task: Rate the probability of the following events (Morier & Borgida, 1984)

- Linda is a feminist **(.83)**
- Linda is a bank teller **(.26)**
- Linda is a feminist and a bank teller **(.36)**

Projection(F ← S) = .91

$.91^2$= **.83**

Projection(B ← S) = .51

$.51^2$= **.26**

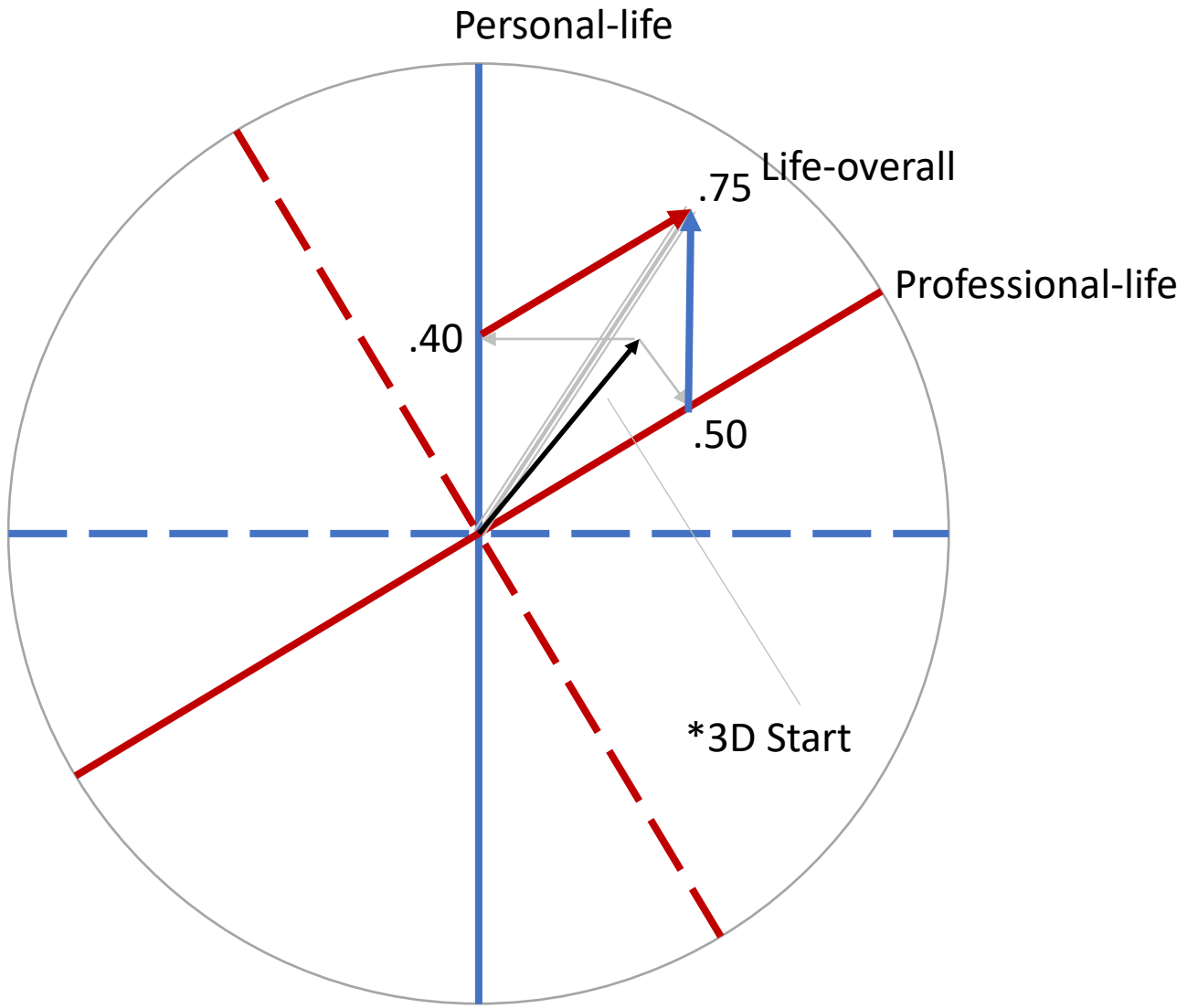
Projection(B ← F ← S) = .60

$.60^2$= **.36**

https://jbusemey.pages.iu.edu/quantum/Quantum%20Cognition%20Notes.htm

Ψ = probability amplitude

Probability of x = $\Psi(x)^2$



Interference & Mental Health

Ex1. Content despite challenges

- Are you doing well in your personal-life? **(.16)**
- Are you doing well in your professional-life? **(.25)**
- Are you doing well overall? **(.56)**

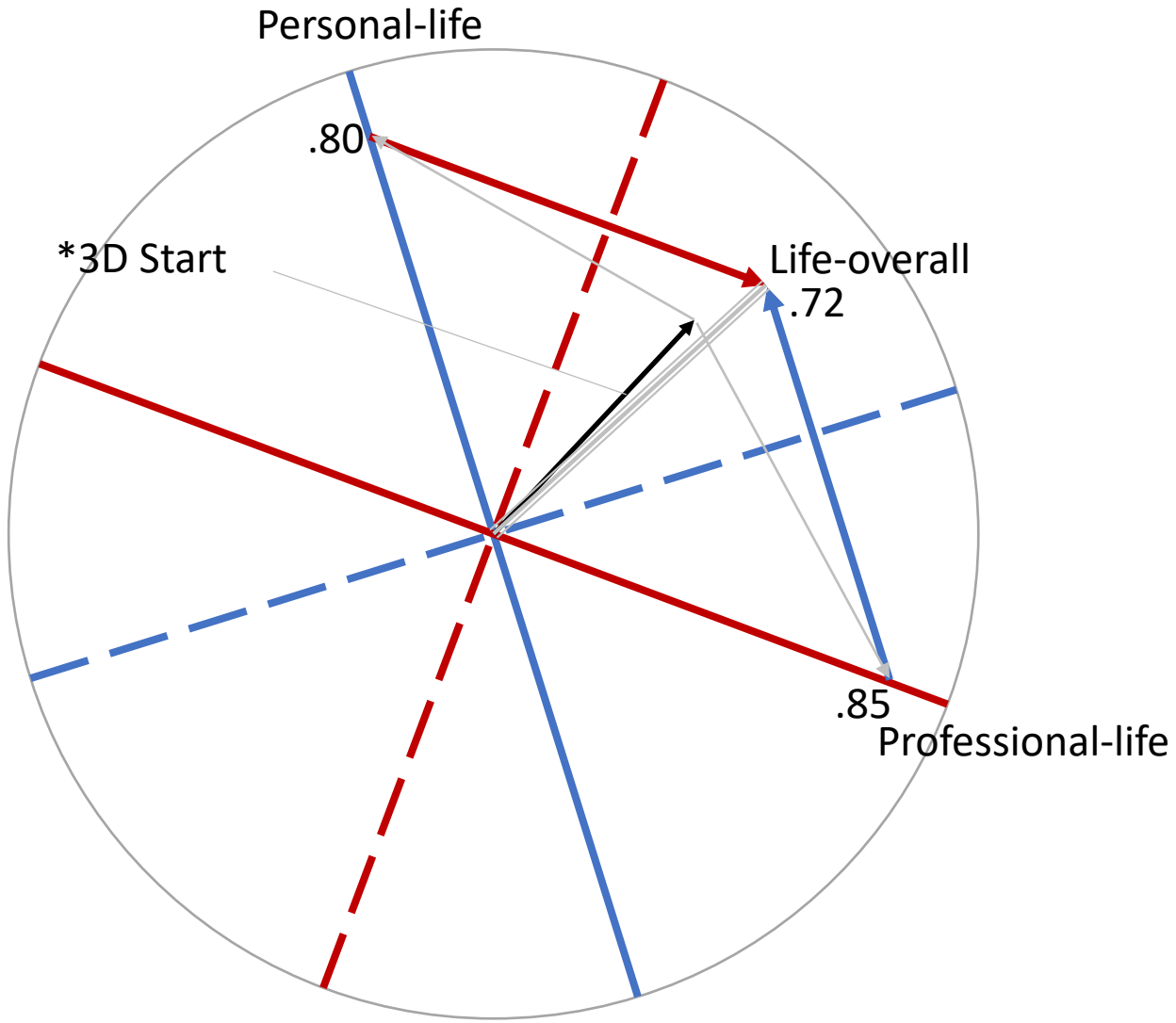
Can be split (family, friends, work, school).

Applications: narcissism, anxiety, mania, overconfidence, biases, etc.

H1: people feel happy despite challenges if there are multiple happy thoughts they can easily switch between (i.e. small rotation between happy categories of thoughts)

Ψ = probability amplitude

Probability of x = $\Psi(x)^2$



Interference & Mental Health

Ex2. Sad despite doing well

- Are you doing well in your personal-life? **(.64)**
- Are you doing well in your professional-life? **(.72)**
- Are you doing well overall? **(.51)**

Overall << (Personal+Professional)/2

Can be split more finely (family, friends, work, school).

Applications: depression, anxiety, imposter syndrome, loss aversion etc.

H2: people feel sad despite doing well if the categories they're doing well in are far apart (i.e. large angle)

Wave-Models of Cognition & Mental Health Chris Ma 2022

- community of interest
- the social issue
- outlines the core theoretical and research considerations
- a key change agent
- highlighted core recommendations directed to that change agent

- psych/neuro/soc-sci/MH researchers
- non-replication, contradictory findings, research stagnation
- possible fundamental stats problem: *classical vs wave probabilities*
- gov/non-gov funding bodies, institutes, agencies, foundations (*Open Science*)
- need *open data* to test wave-MH
- need *Q tools* in R, SPSS, Excel, webapps. *Built-in by default*
- need nuanced CBT/social-structures

Hn

- religion, identity, practices etc: interference effect that sets canonical S resets
  - idiom: thinking about clearing your one's interferes with clearing one's mind
  - humility: feeling proud of being humble
  - irony/sincerity, sarcasm/earnestness, honesty/deception, threat/feint
- family crimes overlooked: orthogonality of family/ingroup and morality
- courtrooms: clever lawyers rotate witnesses into certain/uncertain frames of mind re topic at hand
- persuasion/rhetoric: flipping someone's opinion (i.e. rotate 90°) takes min 4 reasons carefully spaced and sequenced for half or three-quarters success rate. $(cos^4(22.5°))^2 = .531, (cos^9(10°))^2 = .759$
  - antivax, truckers, warmongers
  - quantitative prediction of chains of arguments (e.g. disproportionate effect of large jumps)
- restores intrinsic human identity and free will into psychology contra behaviourism: no Hilbert spaces are the same
  - probabilistic proportions are not due to noise or randomness, but due to adversarial adaptive conditions making entropy maximization gametheoretically optimal (e.g. RPS)
- restores human agency into psychology: no abstract "forces" or factors that affect you, only specific things that can be grouped into factors or forces in linguistic discussion, but can't truly be generalised.
  - solutions can be individual specific
- quantitatively articulate modelling of social construction theories

Wave-Models of Cognition & Mental Health Chris Ma 2022

- potential obstacles
- potentially unwanted implications

- misused “quantum” label in popular culture
- Philosophical implication of giving up on knowable “determinism” (God plays dice, Schrodinger’s cat)
- Implication that chaos or pure randomness can be optimal in adversarially adaptive systems

Wave-Models of Cognition & Mental Health Chris Ma 2022

- Short-term: CBT v.2
- Long-term: Humanity v.3 (Evolutionary theory v.2)
  - non-intrinsic socially constructed self
  - ingroup/outgroup (religion, family, identity etc)
  - cognitive distortions
  - heuristics and biases in probabilistic thinking
  - argumentative fallacies
  - persuasion and rhetoric in law
  - corruption in politics and organisations
  - reconciling secular/religious human dignity
- Downsides:
  - the indignity of mathematising human dignity
  - proving some ppl can't be helped non-invasively (or that everyone can be helped)
  - psychological manipulation made more effective for good and bad actors

Wave-Models of Cognition Primer

Chris Ma 2022

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