

# Comment and Reply on Jayne's "The Neuro Economics of Applied Knowledge"

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David G. Tucek, MA, MBA

## Introduction

In Volume 3, Issue 2, of *Forensic Rehabilitation and Economics*, Kent Jayne presented a short discussion of recent progress made in neuro-scientific research dealing with the brain's mirror neuron system, attempting to link these findings to decisions by forensic economists (FEs) dealing with input and methodological choices in the production of economic damage reports. Specifically, Jayne sought to demonstrate that the profit motive may lead FEs to utilize faulty inputs in order to minimize production costs at the expense of producing a mediocre or deficient work product.

To demonstrate his point, Jayne offered the following example dealing with the use of published estimates of work life expectancy (WLE):

In Forensic Economics an example of this process might be seen in using worklife expectancy tables that assume past labor market decisions as representative of distant future decisions. Such tables are suspect in that they assume the decisions made by a 60-year-old today to enter or leave the labor market will be the same decisions made by today's 20-year-old 40 years from now. The forensic economist's or vocational expert's decision to use these table values "off the shelf" represents a mirror neuron response to what is perceived as authoritative statistical research that is attractively perceived to be goal directed. In reality the worklife expectancy tables are based on unreliable underlying foundational logic, and are the product of questionable extrapolation of the data. The qualifying statement by Shirley Smith in the opening sentence of Bulletin 2254 (1986) should alert forensic economists to the shortcomings of such methodology.

Additionally, Jayne made the claim that a forensic expert who uses WLE estimates absent professional application of clinical judgment addressing a specific individual, and without supporting documentation or logical argument, runs the risk of failing to meet the test of reliability under Federal Rule of Evidence 702. This Reply offers some general comments on

Jayne's overall discussion and replies to the charges against WLE estimates made in the above-quoted passage, and to the claims concerning clinical judgment and Rule 702.

### **General Comments**

The first 60 percent of Jayne's discussion accomplishes three things: (1) it provides a very brief description of the research dealing with the brain's mirror neuron system; (2) it characterizes that research as supporting the contention that human beings will mimic or copy the successful behavior or strategies of others; and (3) it raises the possibility that the profit motive may lead decisions by FEs that minimize production costs even though the result is a mediocre work product.

This discussion is unremarkable: while the mirror neuron system research may be useful in explaining or furthering the understanding of humans' tendency to copy successful behavior, it is not necessary to establish the fact that such behavior exists. That it does exist is seen in institutional safeguards regarding patents and copyright protection, as well as in the common admonition to not "reinvent the wheel". Observing that the profit motive can lead to mediocre or deficient products is equally unremarkable. This is made generally evident by many product liability lawsuits, and more narrowly in many plaintiff reports I have seen come across my desk. Thus, to paraphrase Jayne, drawing the reader's attention to the mirror neuron system is nothing more than a pseudo-technical frosting to make his opinion of WLE estimates appear more legitimate.<sup>1</sup>

### **Reply to Charges Made Against WLE**

As a threshold matter, it is worth noting that coupling the above-quoted example with legitimate observations about the tendency of humans to mimic successful behavior, or the potential for negative consequences arising out of the profit motive, does not validate the example. This is most easily seen by rewriting the example so that it reads:

In Forensic Economics an example of this process might be seen in using a specific age, such as the Social Security retirement age, at which to end an earnings loss as if

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<sup>1</sup> Indeed, Jayne's short note can be viewed as mimicking the behavior of others who have sought to publish journal articles opposing or supporting a particular forensic economic view or methodology. See for example, Ireland (2010), Smith, *et al.*, (2010) and Gamboa, *et al.* (2009).

the earnings would have been realized with certainty. Such an age-certain approach is suspect because it simply ignores all factors (for example, death, illness or disability) that might lead to a smaller earnings loss. The FE's or vocational expert's decision to use an age-certain approach represents a mirror neuron response to what is perceived as a successful profit-maximizing strategy.

Linking this conclusory assertion about the age-certain approach to a mirror neuron response (or to a stipulated tendency of humans to mimic successful behavior) does not validate the assertion – it must stand or fall on its own merits. The same is true for Jayne's criticisms of WLE estimates.

It is clear that these criticisms do not withstand even superficial scrutiny. Specifically, they founder with respect to:

- (1) the view that work-life transition probabilities model labor market decisions;
- (2) the assertion that WLE estimates are a statement of what will happen to a specific individual and require the application of clinical judgment; and
- (3) the characterization of Shirley Smith's opening sentence of Bulletin 2254 as some sort of signal of the shortcomings of the methodology underlying WLE estimates.

Each of these topics is addressed below.

#### *WLE Transition Probabilities*

Jayne's core criticism of WLE estimates is contained in the following statement:

Such tables are suspect in that they assume the decisions made by a 60-year-old today to enter or leave the labor market will be the same decisions made by today's 20-year-old 40 years from now.

This statement is false, or at best, misleading, because the transition probabilities underlying the WLE tables do not exclusively model voluntary decisions to enter or leave the labor force since labor force entry or exit is often the result of events such as death, sickness or disability. Put simply, a deceased person, or a person afflicted with a debilitating disease or injury, does not simply decide to exit the labor force – the decision is made for him as a result of an external event.

It is possible to reword the above statement so that it is true:

Such tables assume the distribution of events leading to today's 60-year-olds to enter or leave the labor market will be the same distribution confronted by today's 20-year-olds 40 years from now.

However, it is still incorrect to maintain that the WLE tables are suspect on the basis of this reworded statement. Doing so ignores the obvious fact that the future is uncertain, with the main role of an FE being to help the trier of fact make decisions in the face of this uncertainty. Indeed, in discussing the need for expert witnesses the notes to Federal Rule 702 state:

There is no more certain test for determining when experts may be used than the common sense inquiry whether the untrained layman would be qualified to determine intelligently and to the best possible degree the particular issue without enlightenment from those having a specialized understanding of the subject involved in the dispute. (Quoting Ladd, *Expert Testimony*, 5 *Vand.L.Rev.* 414, 418 (1952)).

While it is reasonable to expect an untrained layman to understand, for example, that an injured plaintiff was not guaranteed continuous employment until age 67, it is not reasonable to expect the layman to quantify the risks of death, illness, or disability in determining the plaintiff's expected time in the labor force. The FE's testimony on WLE provides this quantification. Put another way, with respect to WLE, the FE's role is to point the trier of fact towards the center of the distribution of possible outcomes, and away from the tails.

Quantifying this distribution via a Markov model using recent estimates of transition probabilities is part of a long history of statistical analysis and decision making in the face of uncertainty. The most familiar example is the life table used to calculate both the probability of survival and/or the remaining life expectancy as of a given age. The most commonly used life tables are known as period life tables because they project the experience of a synthetic cohort of individuals, based on the death rates by age for a recent year. (Arias, 2010). In effect, the life tables and resulting life expectancy estimates are based on the assumption that the death rates experienced by today's 20-year olds 40 years from now will be the same as the death rates experienced by today's 60-year olds. The alternative type of life table is the cohort life table, which is based on the year-by-year experience of a given birth cohort, say all individuals born in 1910. (Arias, 2010). A pure cohort table is not relevant to the issues faced by FEs, since the mortality experience of individuals born over ninety years ago would not account for the many factors – for example, changes in smoking habits or medical care – affecting today's 20-, 30- or

even 60-year olds. That period life tables are used in many court cases, and by life insurance companies, is a telling commentary on the relative value of the information content of the two forms.

Still, some labor force entry and exit decisions are voluntary. For example, some individuals simply decide to retire in order to enjoy the fruits of a lifetime of labor and savings. However, even individuals who are similar in a multitude of respects will not exhibit the same savings rates, experience the same investment results, or have the same post-retirement financial requirements. The effects of these, and of other differences, on WLE cannot be known 30 or 40 years in advance – they can only be modeled as a random or stochastic process.<sup>2</sup> This is what published WLE tables are based on.

#### *WLE Estimates, Specific Individuals and Clinical Judgment*

Jayne uses the notation “N=1” to denote a specific individual with a “unique profile of medical and vocational capacities and demographics that can be identified with professional tools.”<sup>3</sup>

Specifically, Jayne states:

The forensic expert who uses such data absent a professional application of clinical judgment addressing an N=1 and without supporting documentation or logical argument, runs the risk of failing to meet the test of reliability under Federal Rule of Evidence 702.

The reliability requirement of Federal Rule of Evidence 702 is addressed later in this Reply; for now, the focus is centered on Jayne’s concern about the “N=1” case and the “professional application of clinical judgment” that he contends is required.

With respect to WLE, Jayne’s concern about the “N=1” case seems to be grounded in the belief that a particular WLE estimate is presented as the number of years a specific individual will remain an active labor force participant. No competent FE can, or would, make such a claim, if

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<sup>2</sup> Arguably, there are some structural changes that can be expected to shift WLE in one direction or another. For example, the scheduled increases in the normal Social Security retirement age may serve to increase WLE for individuals born after January 1, 1938. Likewise, the prospect of subsidized access to health care may serve to decrease WLE. Perhaps the best way to handle such structural changes is to report damage estimates for a range of years before and after the estimated WLE.

<sup>3</sup> Private communication with Mr. Jayne.

only because for any given individual there is an infinite number of possible answers to the question of how long the individual will actually be active in the labor force. Most professional and casual observers would agree that not all of these outcomes are equally likely, and that some can be judged to be more or less likely than others. As explained earlier, the FE's role is to point the trier of fact towards the center of the distribution of possible outcomes, and away from the tails.

When faced with a multitude of possible outcomes, picking from the center of the distribution is a common decision rule. For example, even in the absence of detailed records, to estimate the travel time from one's home to one's place of employment, a person will base the estimate on their subjective average estimate. Firms will staff call centers based on the average number of calls received in a given hour and the average time needed to complete each call. Similarly, shoe stores will stock their inventory based on the more common, or average, shoe sizes. In all of these examples, the "average" being considered is based on a measure of statistical expectation – an estimate of the typical or expected outcome based on consideration of the underlying probability distribution of outcomes. Use of the average or expected value is not a statement that a specific trip from home to work will take a set amount of time; or that a specific call will be handled in a certain number of minutes; or even that the next customer will purchase a shoe size from the center of the distribution. Similarly, use of a tabulated WLE estimate is not a statement that the individual in question will remain (or would have remained) active in the labor force for the specified number of years.

Nevertheless, clinical judgment can play a role in choosing a WLE estimate and it is worthwhile to examine the various circumstances in which this might occur. In defining clinical judgment Choppa, *et al.* (2004) makes it clear that the "clinical" aspect involves "direct observation of the patient". They concluded that clinical judgment "encompasses all relevant factors germane to the weight of the case while discarding those factors which are not relevant, and which are allowed by the court."

Consider first the task of estimating the WLE of an injured plaintiff "but for" the injury. Absent time travel or an unlikely prior encounter, it is impossible for anyone to engage in direct

observation of the plaintiff in an uninjured condition, even though that is what clinical judgment requires. This is not to say that information about the pre-injury status of the plaintiff is not, or should not be, used. Indeed, as discussed in a later section of this Reply, at times such information may invalidate, or require some adjustment of, tabulated WLEs. Even if we ignore the impossibility of direct observation and accept Jayne's implicit contention that clinical judgment comes into play in the evaluation of pre-injury WLE, rejection of WLE estimates on the basis Jayne's flawed transition probability argument excludes factors – the risks of death, sickness and disability -- germane to the weight of the case and deprives the trier of fact of assistance in reaching a decision on the amount of damages to be awarded.

Clinical judgment and direct observation of the injured plaintiff post-injury is clearly possible and appropriate. It may be that the injury is such that all parties agree there is no post-injury earnings capacity, in which case, WLE is not an issue. If residual earnings capacity exists, clinical judgment can certainly aid in forming an opinion as to whether WLE has been affected due to the injury. Consider, for example, a case I was recently contacted about. This case involved an owner of a surveying company who suffered an injury to his foot that did not impact his remaining life expectancy, but that prohibited him from working on job sites in the field. The injured owner experienced no loss of salary and was able to shift responsibilities to eliminate personal visits to the field. Despite the fact that there was no loss of salary, the injured owner claimed a loss due to his inability to solicit new business while visiting a job site. (I declined the engagement in this case because it was really a lost profits case and beyond the scope of my practice.) Based on my conversation with the plaintiff attorney, it was clear that reduced WLE was not a factor that could successfully be argued. Readers are undoubtedly familiar with cases in which the opposite conclusion was reached – the point to be made is that clinical judgment can be useful in assessing post-injury WLE but that usefulness has nothing to do with the broad criticism that Jayne has leveled against WLE tables.

*Shirley Smith's "Qualifying" Warning Statement*

This is the opening sentence from Bulletin 2254:

It is estimated that if mortality conditions and labor force entry and exit rates held constant at levels observed in 1979 to 1980, males born during those years would

work about a third longer (38.8 years) over their lifetimes than would their female counterparts (29.4 years).

Jayne points to this statement and states that it “should alert forensic economists to the shortcomings of such methodology.” He apparently has concluded that because the assumption concerning stable mortality and labor force entry and exits rates will not or may not be valid, there is no informational value in the resulting work life expectancies.

The fact that the input assumptions underlying a model or an estimation methodology do not match reality does not mean the results are without value. As an example, consider the MapQuest<sup>®</sup> time estimate for traveling along I-70 between St. Louis and Kansas City. The software assumes that the distance will be traveled at the posted speed limit. I have driven along this route frequently enough to know that the posted limit is closer to the lower bound on the vehicles’ speed rather than the average. Nevertheless, the MapQuest<sup>®</sup> estimate provides information on how long the drive between the two cities might take, just as an estimate of WLE informs the trier of fact as to how long an earnings loss might last.

Moreover, Bulletin 2254’s “qualifying statement” is not unique. In their discussion of the Markov assumption, Foster and Skoog (2004) made it clear that that the WLE estimates assume that the probabilities observed in one year will remain unchanged in the future. Likewise, Skoog and Ciecka (2001a and 2001b) make it clear that the transition probabilities underlying their WLE tables are based on data from the Current Population Survey for a specific period. If Jayne’s objection on this point had merit, then we would also reject use of the National Center of Health Statistics’ mortality tables not only in litigation, but also in all sorts of other public policy decisions and human undertakings.

### **Federal Rule of Evidence 702**

Rule 702 reads as follows:

If scientific, technical, or other specialized knowledge will assist the trier of fact to understand the evidence or to determine a fact in issue, a witness qualified as an expert by knowledge, skill, experience, training, or education, may testify thereto in the form of an opinion or otherwise, if (1) the testimony is based upon sufficient facts or data, (2) the testimony is the product of reliable principles and methods, and



(3) the witness has applied the principles and methods reliably to the facts of the case.

With respect to the requirement that the expert testimony be "reasonably reliable" and "substantially assist" the fact-finder, the notes to this rule state:

the court is called upon to reject testimony that is based upon premises lacking any significant support and acceptance within the scientific community, or that otherwise would be only marginally helpful to the fact-finder.

Jayne's caution that an FE applying WLE estimates to a specific individual "runs the risk of failing to meet the test of reliability under Federal Rule of Evidence 702" is as unremarkable as his discussion of the mirror neuron system. WLE estimates are both peer-reviewed and widely used, so the risk Jayne warns against does not arise out of lack of significant support and acceptance; it must arise out of a belief that WLE would only be marginally helpful or inconsistent with the facts of the case. Clearly there are situations when applying a tabulated WLE is not helpful and is inconsistent with the facts of a case. In discussing the appropriateness of using the Markov model to project individual behavior, Foster and Skoog (2004) recognize this (footnote deleted):

Labor economists have studied workers' degree of attachment to the labor force, and know that it varies systematically with age, education or race, and sex, as recorded in the BLS worklife tables. However it also varies with wealth, health, marital status, number of dependants, wage rates, alcohol and other drug use patterns, marginal tax rates, and occupation. The BLS tables do not track dependence on those variables because some of the information is not collected, because even for the information that is collected, sample sizes are inadequate to estimate the effects of all those variables using the BLS methodology, and because some of the statuses may change.

We should acknowledge, too, that even if these problems were overcome, the most careful economic study would not fully explain all of the variation we see in individuals' patterns of labor force participation. For given values of all the variables listed above, there will still be individual variations in behavior: some people are lazy, and others are industrious. We might describe those variations ("heterogeneity") as due to unobserved explanatory variables or as due to chance, but in either case, as in labor economics generally, econometric fits are not perfect and there is unexplained variation.

There are also regime changes: individuals become disabled or healed, reform their lives or suddenly throw away their opportunities, and make abrupt shifts in behavior that could not be predicted from the past.

One common example of such heterogeneity among individuals is that of an unmarried professional female. Consider the case of disabled, 32-year old single woman with a graduate degree, who was employed in a high-income, physically undemanding job that she found personally rewarding. The remaining WLE of 28.9 years taken from Skoog and Ciecka (2001b) includes the experience of all similarly educated females, some of whom are married, find their jobs to be unrewarding both personally and financially, and who may decide to exit the labor force either permanently or temporarily to assume child-rearing duties. Arguably, the tabulated WLE for such an individual may be too low. The FE can account for this by preparing loss estimates that are only adjusted for mortality risk or, alternatively, that are based on the 32.1 year WLE for initially active males with a graduate degree. Another option would be to report results based on the 75<sup>th</sup> and 90<sup>th</sup> percentiles for an initially active 32-year old female with a graduate degree.<sup>4</sup> The point to be made here is that no resource used by FE's is appropriate in all cases, and Jayne's caution about violating the reliability requirements of Rule 702 is nothing more than sprinkles added to his mirror neuron frosting.

### **Final Comments and Observations**

The above discussion has shown that Jayne's linking of the mirror neuron system to FEs' decisions dealing with input and methodological choices is tenuous at best and is more properly viewed as a smokescreen for his criticisms of WLE. Moreover, the discussion has shown that these criticisms are unremarkable and largely unfounded.

Jayne's paper has another, less obvious, shortcoming: it is silent on the question of how, absent relevant expert testimony, the trier of fact is to reach a decision on the amount of lost earnings that accounts for the diminishing likelihood that the earnings would have been realized as time progresses. That such an accounting is necessary has long been recognized by the courts. For example, in *Jones & Laughlin Steel Corp. v. Pfeifer*, the U.S. Supreme Court found:

In calculating damages, it is assumed that if the injured party had not been disabled, he would have continued to work, and to receive wages at periodic intervals until retirement, disability, or death. An award for impaired earning capacity is intended to compensate the worker for the diminution in that stream of income. . . .

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<sup>4</sup>These percentiles are 33.3 and 37.0 years, respectively. (Skoog and Ciecka, 2001b).

The lost stream's length cannot be known with certainty; the worker could have been disabled or even killed in a different, non-work-related accident at any time. The probability that he would still be working at a given date is constantly diminishing. *Jones & Laughlin Steel Corp. v. Pfeifer* 462 U.S. 523 (1983).

Consider the alternatives to a WLE approach. First, there is the Life/Participation/Employment (LPE) method in which earnings losses are reduced to account for the probability of survival, the probability of labor force participation given life, and the probability of employment given labor force participation. While both the WLE and LPE methods are legitimate techniques, neither is superior to the other in terms of the criteria proffered by Jayne. Both are based on the past behavior of a large number of individuals, both assume that their underlying probabilities will describe future behavior, and both will be inappropriate in specific instances. However, both methods account for the diminishing likelihood that the earnings stream would have been realized.

Second, there is the age-certain approach. This approach founders in that it ignores the effect of death, disability or illness, and of all other factors except an assumed voluntary retirement, on the extent of the earnings loss. In other words, it ignores the constantly diminishing probability that the decedent or plaintiff would still be working in the future.

Third, there is a variation on the age-certain approach: calculate losses out to say, age 70 or 75, and let the trier of fact decide when the loss ends. This approach abandons the FE's responsibility to inform the trier of fact, reducing him to nothing more than a financial calculator. More important, it leaves unanswered the question of how the trier of fact is to assess the risk of death, injury or disability without access to the specialized knowledge of a qualified expert.

Both *Pfeifer* and reality make it clear that there is a decreasing likelihood that an individual's future earnings will be realized as time progresses. Only the WLE and LPE approaches will provide the trier of fact with the information necessary to reach a decision that accounts for this decreasing likelihood.

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## **Biography**

**David G. Tucek, MA, MBA** is the General Partner of Value Economics, LLC, located in St. Louis, Missouri. He provides testimony and economic consulting services in tort actions involving personal injury, wrongful death and wrongful termination for both plaintiffs and defendants. Dave may be contacted at 314-434-8633.