Structural, Black Box and Ad Hoc Models Used To Determine The Worklife Expectancy Of A Child With Blood Lead Levels

SUBMITTED BY:

Jerome S. Paige
jpaige@paigeandassociates.com

Subodh Mathur
scmathur@gmail.com

Richard Lockley
rlockley@paigeandassociates.com

Moses Sawney
moses@sawney.com

Structural, Black Box and Ad Hoc Models Used To Determine the Worklife Expectancy Of A Child With Blood Lead Levels A Case Study

Jerome S. Paige (jpaige@paigeandassociates.com)
Subodh Mathur (scmathur@gmail.com)
Richard Lockley (rlockley@paigeandassociates.com)
Moses Sawney (moses@sawney.com)

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BACKGROUND OF PAPER

A Case Study

Our paper comprises a "case study." Its starting point is a "lead paint case" in the Circuit Court of Baltimore City in Maryland. The plaintiff's forensic economist (FE) claimed that the plaintiff, Robert Smith, would lose 22 years of worklife because of lead exposure at a young age. This number of years seemed extremely high to the defense attorney, who was our client.

This attorney had faced this issue in several of their cases. So, they asked us to write a note that:

- Summarized the findings of the literature related to the impact of childhood lead exposure to the worklife expectancy of the child, and
- Looked at whether the reports of the medical, vocational, and economic experts in the case had shown a definitive link between "lead exposure" and "worklife changes."

Our paper is a modified version of a draft of our confidential report to the attorney. The report was never finalized and never became a part of the public record. We've changed the case's and experts' names and modified our text for this paper's flow and readability.

Our Value Added

We believe our case study provides the following:

1. For Lawyers: They need to be aware of several potential flaws in the analyses of their experts. As our case study outlines, experts ended up entrapping themselves as they contorted their investigations to try to link "childhood blood lead levels" and "deficits."

    - Ignoring non-lead factors
        - Tests indicated that the Plaintiff had cognitive and other deficits. How much of the "deficits" resulted from "lead" and how much from factors other than "lead?" The Plaintiff experts didn't have an answer because they hadn't separated the effects of "lead" and "non-lead" causes of reduced worklife, earnings capacity, and earnings.

    - Using unrepresentative samples:
        - Their statistical samples didn't represent the characteristics of the Plaintiff. In this case, while several studies linked "lead" to "deficits," none of them included children who were born "low-weight," like the Plaintiff. The Plaintiff's characteristics didn't fit any of the studies the Plaintiff experts cited.

    - Using inappropriate models:

- The one worklife expectancy model the economic expert relied on also didn't fit the Plaintiff. The expert's model featured a temporary disability, while the claim was the Plaintiff's injuries were permanent.

- "Cherry-picking:"
  - The Plaintiff's vocational and economic experts relied on the American Community Survey in their discussion of "deficits," but they didn't report the findings in that data related to earnings losses, which is the ultimate goal of the occupational and educational analysis.

2. A review of the role structural, black box, and ad hoc models in FE's work

   Structural Models

   "Structural models" layout the full flow of causation, i.e., all the steps are laid out. Based on our review, we could not find any published studies that determine the effects of blood level exposure on worklife expectancy as used by the plaintiff's economic expert.

   We agree that the effects of lead in the blood are harmful. "Lead" can and does have deleterious effects on childhood development. However, the challenge for experts in a case like our sample one is to be able to

   - Sort out the "lead" and "non-lead" causes of "deficits" a child or young adult may have, and
   - Defend how we arrive at how those deleterious effects might influence the life-time earnings of a plaintiff.

   Figures 4.1, 4.2, 4.3, and 4.4 in our case study illustrate these two points. But isn't that what FE's are supposed to be doing anyway – sorting out causes and determining earnings losses -- not just when a case involves lead blood levels?

   Reduced Form Modelling

   "Reduced form" models are like a "black box." What do they do? They link an initial cause to the final effect without explanation. While reduced form models aren't typically used to determine economic damages, it's the "black box" approach that undergirds the testimony of the plaintiff's medical, vocational, and economic experts in this case.

   Ad Hoc Modelling

3. The "black box" approach morphs into an "ad hoc" one. "Ad Hoc" and "modeling" are oxymorons. In this case study, we illustrated how the Plaintiff's medical and economic experts assert a link. But they never provide convincing evidence as to why their assertions hold. It's as if they were saying: "Since we know something about lead, it must be true for Mr. Smith."

4. Useful reminders for FE's:

    - Tread carefully if you explicitly or implicitly take on the task of a causation expert in personal injury (PI) and wrongful death (WD) cases
    - Stick with the assumptions your client provides, and be wary of going beyond them, yet at the same time, don't let the given assumptions undermine the credibility of your analysis.

5. Useful reminders of various experts' roles:

    - Be aware of the assumptions other experts and the client provide you. FE's can often get off the hook by saying that the client asked them to accept certain assumptions. Or they can get by spinning "hypotheticals." However, as we indicate in our case study, there's an interplay among the medical, neuropsychological, and vocational opinions and the economic analysis. And it's not unusual for FE's to establish links independently of other experts in the case. Therefore, FE's must be vigilant to ensure that the assumptions the client and other experts provide and that the ones they make don't undermine the credibility of their analysis.

We Want Your Feedback

We want your feedback on all aspects of our analysis and our claims of "value-added." In particular, we would like to identify:

- Challenges economic experts face when they accept an assignment regarding the effects of childhood exposure to worklife expectancy and earnings
- Potential hidden dangers in this type of analysis

A New Role for FE's

We also think our report points to a new role for FE's in cases that determine economic damages in personal injury (PI) and wrongful death (WD) cases.

Our client was charting new ground in commissioning our report since this was not the type of work Adjusters willingly approve. Our client wanted an analysis to apply to a set of cases where plaintiff FE's argued that "lead" led to significantly reduced worklife expectancies. Fortunately, our client successfully got the Adjusters to spread the costs over several existing cases.

What's the new role for FE's?

The FE can tie together all the strings of the case's damages storyline. This role is separate from estimating economic damages.

While the critical economic assumption in this case was "worklife expectancy," we addressed the typical issues in a "damages report."

- Pre- and Post-Event
  - Earnings Capacity[1]
    - Educational age earnings versus occupational/competencies & skills
  - Earnings
  - Worklife expectancy
  - Growth rates
  - Fringe benefits
- Discount rates
- Net Discount rates

The key driver of the level of economic damages were the assumptions regarding worklife expectancy. In our companion economic damages report, we identify the suspect way the plaintiff's vocational experts defines the loss of earnings capacity. Our economic damages report is not a part of this case study.

But now, FE's may have a new role. We can position ourselves as the expert that can clearly articulate the overall economic damages storyline by assessing:

- The internal consistency of the expert reports that provide support for economic damages calculation. (For example, medical, neurological, vocational, and economic reports)
- The consistency of each report with the findings in the literature
- The consistency among the reports and the compatibility of the findings in the literature

In our case, we found that:

- Collectively the plaintiff's experts failed to distinguish between a structural and black-box approach.
  - The misspecification of the relationship among factors is the fundamental flaw in the Plaintiffs's case to establish a link between lead and deficits.
- The plaintiff's neuropsychological, vocational, and economic experts don't establish and link "lead" and Mr. Smith's "deficits."
- Nothing in the medical Plaintiff's expert's report supports their conclusions that there is a sound link between the "level of lead exposure" and "deficits."

[1] The link between "lead" and "earnings capacity" is also an issue. The plaintiff's vocational expert accepts the claims that lead had caused Mr. Smiths' cognitive deficits. But then through "sleight-on-hand" asserts that the effects on earnings capacity could be measured by the difference between two age-earnings educational levels. While the plaintiff's vocational expert makes their assertion based on their knowledge, skills and experience, they don't provide any studies to support their position. To refute there is a loss of earnings capacity, the defense vocational experts focus on Mr. Smith's skills and competencies and what types of occupations he could pursue. Their conclusions are that Mr. Smith has the potential to earn at rates as high or higher than the "age-earnings.'

- Their analyses lack the necessary formal models to link "lead blood levels" to "employment, earnings/earnings capacity and worklife expectancy outcomes."

Would this new FE role be useful for plaintiff attorneys as well?

Yes.

Lately, we've found that when the plaintiff's attorneys get around to contacting us, we have to deliver unpleasant news: From an economic perspective, the value of their case is much lower than they were expecting, even with the most favorable assumptions. We could have helped the plaintiff attorneys have a more informed understanding of their case's economic value if we had engaged us to construct the methodological strength damages narrative of their case.

Structural, Black Box and Ad Hoc Models
Used To Determine the Worklife Expectancy Of A Child With Blood Lead Levels
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Jerome S. Paige (jpaige@paigeandassicates.com)
Subodh Mathur (scmathur@gmail.com)
Richard Lockley (rlockley@paigeandassociates.com)
Jerome S. Paige & Associates, LLC[2]

EXECUTIVE SUMMARY OF REPORT/CASE STUDY

The purpose of our note is to determine whether there are studies that are available and able to estimate the effect of high blood lead levels in a young person on their worklife expectancy as an adult.

We are examining this issue in detail because the plaintiff's economic expert in the case of R. Smith asserted a questionable link between exposure to lead and worklife expectancy.

Specifically, the expert opined that because Smith's average blood lead level was 11 µg/dl when they were 1 to 5 years old, Smith would experience a 22-year reduction in their worklife. In other words, because of exposure to lead as a child, Smith would work 22 years less than if there was no exposure.

In a literature search related to the effects of lead exposure, we found that there are no studies that link lead and worklife expectancy.

We would have expected the plaintiff experts in the case to develop or offer their methodology or approach. However, they do not do this.

Without any methodological basis, the plaintiff's economist has no support for their conclusion that blood level exposure reduced Smith's worklife expectancy by 22 years.

In a typical case, such as that of Smith, economic experts base their opinions on non-economic experts' views, who provide a foundation for the economist's analysis and opinions.

So, the calculation of damages in a lead exposure case follows this sequence:

> **Step 1. Start with the medical and neuropsychological assessments.** Do they provide a sound numerical link between lead exposure and indicators such as IQ? Do they provide a sound, numerical link between lead exposure and worklife expectancy?

[2] Moses Sawney (moses@sawney.com), when he was an associate, laid much of the groundwork that led to our analysis. We acknowledge his contribution.

Step 2. **Move to the vocational assessment.** Does it provide a sound link between indicators such as IQ and the type of job that the plaintiff could expect to get?

Step 3. **Move to the economic analysis.** Does it provide sound estimates of the earnings from the plaintiff's job? Does it include a sound estimate of the worklife expectancy of the plaintiff, based on historical data?

Each report must be internally consistent and consistent with the findings in the literature. Further, there must be consistency among the reports, and the final results must be compatible with the findings in the literature.

For the Smith case, we found no internal consistency within each of the medical, vocational, and economic reports and none among them. Besides, their opinions are not consistent with the findings in the broader literature.

The Experts in the Case (Not Real Names)

We have given assumed names to the plaintiff and all the experts since this is the format that an actual case report would follow.

Table 1. Plaintiff and The Experts in the Case

Plaintiff	Mr. Robert Smith
Plaintiff's Experts	
Medical Assessment	Dr. Janet Jacobs
Neurological Assessment	Dr. Kevin Knight
Vocational Assessment	Mr. Marcus Martin
Economic Assessment	Dr. Lance Lucas
Defense Experts	
Neurological Assessment	Dr. William Wright
Vocational Assessment	Dr. Aaron Anderson
Economic Assessment	Dr. Baron Baptist

Methodological issues

First, we lay out a framework for a model of causation. This framework consists of the methodological and empirical basis for linking high child blood lead levels and future earnings outcomes.

The econometric literature has two types of causation-flow models: "structural" and "reduced form" models.

Structural models. Structural models layout the full flow of causation, i.e., all the steps are laid out. Based on our review, we could not find any published studies that determine the effects of blood level exposure on worklife expectancy as used by the plaintiff's economic expert.

In particular, we are unable to determine:

- whether those with lead blood levels have worklife expectancies different than those who don't; and
- whether there are differences in worklife expectancy among those with varying levels of lead in their blood.

Reduced Form. In contrast, "reduced form" models are like a black box, i.e., they don't show the flow of causation but just link an initial cause to the final effect. While reduced form models are not typically used to determine economic damages, it is the "black box" approach that undergirds the testimony of the plaintiff's medical, vocational, and economic experts in this case. Each expert asserts a link, but they never provide convincing evidence as to why their assertions hold.

Types of Studies to Determine the Effect of Blood Levels on Worklife

We identify four types of studies that would determine a link between lead and worklife expectancy:

Econometric studies

i. longitudinal
ii. cross-sectional

Non-econometric studies

iii. meta-analysis, and
iv. Markov analysis

In the Robert Smith case, we found that the plaintiff's experts, particularly the plaintiff's economic expert, did not use the first three types of studies.

Furthermore, the Markov models suggest that these tables are at best applicable to those with "short-term," not "permanent" disability. So, in addition to the GGWT using an inappropriate definition of "cognitive disability" when it comes to lead when the plaintiff experts rely on these tables, they are measuring the effects of **"temporary disability,"** while they are assuming Mr. Smith's deficits result from a **"permanent disability."**

Misapplication of Existing Models

The population study flaw. To the extent that structural models point to some relationship between lead and deficits, "population studies" provide the basis of these models. In the case of Mr. Smith, his characteristics exclude those studies from being applicable in his case. We see that clearly in the testimony of the plaintiff's medical expert.

The omitted, non-lead factors flaw. Here, the experts don't separate the effects of lead and non-lead causes of worklife, earnings, and earnings capacity.

The inappropriate model flaw. In addition to reviewing existing structural models and identifying ways to establish "causation," we assess how the experts arrive at "causation," the plaintiff's economic expert misapplies a method to support his opinions. Using GGWT is an example of this.

The "cherry-picking" flaw. Plaintiff's vocational and economic experts rely on the American Community Survey in their discussion of "deficits," but they don't report the findings in that data related to earnings losses, which is the ultimate goal of the occupational and educational analysis. According to disability data statistics for Maryland, persons with a "disability" as defined in the ACS data experience an annual reduction of $6,600 (8.8%), compared to the non-disabled.

Effects of Lead on Earnings Losses

While this analysis focuses on "worklife expectancy," the fundamental purpose of an economic report is to determine earnings loss. **And the existing data on the link between lead and earnings doesn't show significant losses because of the difficulty of untangling all the factors that affect earning capacity and opportunities.**

OBJECTIVE AND KEY FINDINGS

This note's objective is to assess whether Plaintiff experts are using methodologically sound ways to link the "level of lead exposure" (lead blood levels) on the one hand and "worklife expectancy" and "earnings" on the other.

There are two key issues we consider. These issues arose in the context of calculating damages from "exposure to lead at a young age."

- How does exposure to lead at a young age affect future adults' "earning capacity," "earnings," and "worklife"? Note that we have broadened the scope of the analysis to include 'earnings capacity.'
- In practice, do defense experts establish in a methodologically sound manner 'lead exposure' as the cause of reduced earnings and earnings capacity?

We base our analysis on (i) a review of available methodologies and literature to create such a link, and the (ii) reports filed by various experts in the case related to *Robert Smith.*

Our review of academic studies reveals:

- There are no studies that link "level of lead exposure" and "worklife expectancy" in a methodologically sound manner
- Some studies link "level of lead exposure" and "earnings."
    - There are small reductions in lifetime earnings when the reports account for blood lead levels.

We conclude that there have not been any published studies that can determine:

- whether those with lead blood levels have worklife expectancies different than those who don't; and
- whether there are differences in worklife expectancy among those with varying levels of lead in their blood.

Looking at the Robert Smith case, we find:

- **Dr. Lance Lucas (plaintiff's economist) relies on a spurious and disputed link to arrive at reductions in worklife expectancy due to lead**. For this reason, in his deposition testimony, in this case, **they backed away for opining, there is a link as part of his report and testimony.** The links are spurious because:
    - The plaintiff's neuropsychological, vocational, and economic experts don't establish and link lead and Mr. Smith's "deficits."

  - There is nothing in the medical Plaintiff expert's report that supports her conclusions that there is a sound link between the "level of lead exposure" and "deficits."

- **The claim of Janet Jacobs, M.D. (the plaintiff's medical expert), and Dr. Lucas that there is a link between "level of lead exposure" and "deficits" (which leads to reduced worklife expectancy and earnings) is not sound.** Their analyses lack the necessary formal models (discussed later in this report) to link "lead blood levels" to "employment, earnings/earnings capacity and worklife expectancy outcomes."

More generally, we expect our findings to be valid in other cases related to lead exposure.

STRUCTURAL, REDUCED FORM & AD HOC MODELS

One part of our interest is to ask whether the various experts correctly specify the causation flow from "lead exposure" to "earnings" and "worklife expectancy" in a methodologically sound manner? And then, do they estimate the magnitude of the effects correctly?

To address these issues, we look at how economists conventionally specify and estimate causation flows in their models.

One of the fields within economics is "econometrics." Econometrics consists of rigorous, formal statistical techniques that are suitable for use with real-world economic data. One of the oldest methods commonly used to calculate trend lines is "Least Squares Regression."

An econometric analysis begins by specifying the economic model to which we apply the statistical technique and real-world data.

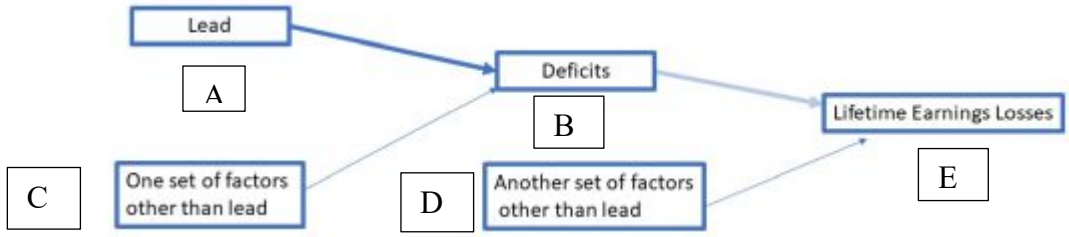
Here we have two types of models: structural models and reduced-form models. The fundamental difference between them is how they lay out the flow of causation between the various covered variables.

Structural econometric models layout the flow of causation in full detail. We provide an example in Figure 1 of a simplified flow of causation of the links between lead exposure and earnings:

- Variable B (deficits) is affected by Variable A (lead) and Variable C (other factors)
- Variable E (lifetime earnings) is affected by Variable B (deficits) and Variable D (another set of factors).

Thus, Figure 1 describes the role of lead and other factors affecting lifetime earnings.

Figure 1. The flow of causation between lead and earnings (structural)



Source: JSPA.

Reduced form models collapse the flow of causation into a black box. In the above example, we would simply say that Variable A affects Variable E.

Figure 2. The flow of causation between lead and earnings (black box)

There is no explanation of how the causality flows – it's just a black box (often invisible) between Variable A, and Variable E. "Black boxes" are rarely used in calculating damages because the parties to the case want to see the flow of logic.

Lead & Earnings: Literature Review of Structural Models

Literature on the effects of lead on earnings exists. We will look at Schwartz (1994), Salkever (1995), and Salkever (2014)

Schwartz Model 1994

Schwartz is a Professor of Environmental Epidemiology at Harvard University, School of Public Health. His research played a significant role in the phasing out of lead from gasoline.

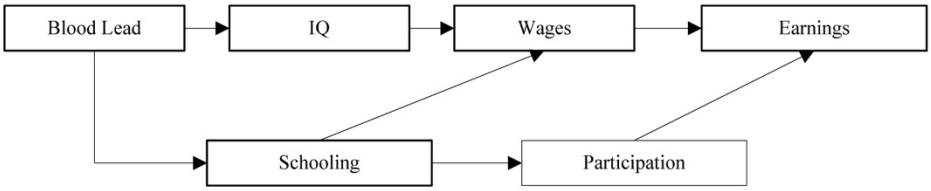
In his 1994 study, Schwartz estimated the benefits of a "1µg/dl reduction in population mean blood lead concentrations." He said his benefits are subject to considerable uncertainty, but since he made conservative assumptions, it's more likely that his estimates are too low rather than too high.

Schwartz links "lead exposure" and "earnings" as follows:

Figure 3. The Schwartz (1994) model flow of causation

Exhibit 2.1

RELATIONSHIP BETWEEN LEAD, IQ, AND EARNINGS: SCHWARTZ 1994



Source:
Based on Schwartz (1994a), Figure 1, p. 110.

Schwartz's structural model lays out the flow of causation explicitly. Schwartz states:

Lead can reduce IQ and thus result in lower wages and lower lifetime earnings. Lead can also reduce educational achievement, which has been linked to reduced wages and reduced participation in the work force, both of which, in turn, reduce lifetime earnings.

Now, Schwartz has to estimate the numerical values of the various effects he has described. We present his results in Figure 4.

Figure 4. The Schwartz (1994) model's effect of lead on earnings

Exhibit 2.2

EFFECT OF LEAD ON LIFETIME EARNINGS: SCHWARTZ (1994a)

Effect of Lead on IQ	Change in Earnings per One Point Change in IQ			
	Direct Effect of IQ on Earnings (a)	Effect of Lead on Schooling and Wages (b)	Effect of Lead on Schooling and Participation (c)	Total Effect on Lifetime Earnings (a+b+c)
0.245 IQ points per 1 µg/dl change in blood lead	0.50 percent	0.79 percent	0.47 percent	1.76 percent

The combined effects of a 1 µg/dl increase in blood lead levels reduces lifetime earnings by 1.76 percent.

In Figure 4, "participation" refers to "labor market participation." While the Schwartz Model in Figure 3 shows "participation" separately, Schwartz's estimates "participation" and "schooling" into a single measure.

Salkever Model 1995

Salkever is a Professor of Public Policy, UMBC. He used the same basic model as Schwartz. Salkever describes the differences in this way (with reference to his Figure 1). Salkever:

- Used Schwartz's basic approach with minor extensions to explicitly estimate the direct effects of IQ on educational attainment (Arrow 1A) and participation (Arrow 5A). The difference is that Schwartz estimated combined effects for Arrows 1 and 1A.
- Developed new estimates for Arrows 3, 4, and 5.
- Since the analysis was limited to recent economic data rather than new epidemiologic data, no new estimates are provided for the direct effect of lead exposure on educational attainment (Arrow 1) and the impact of exposure on IQ (Arrow 2).

Figure 5. The Salkever (1995) model flow of causation

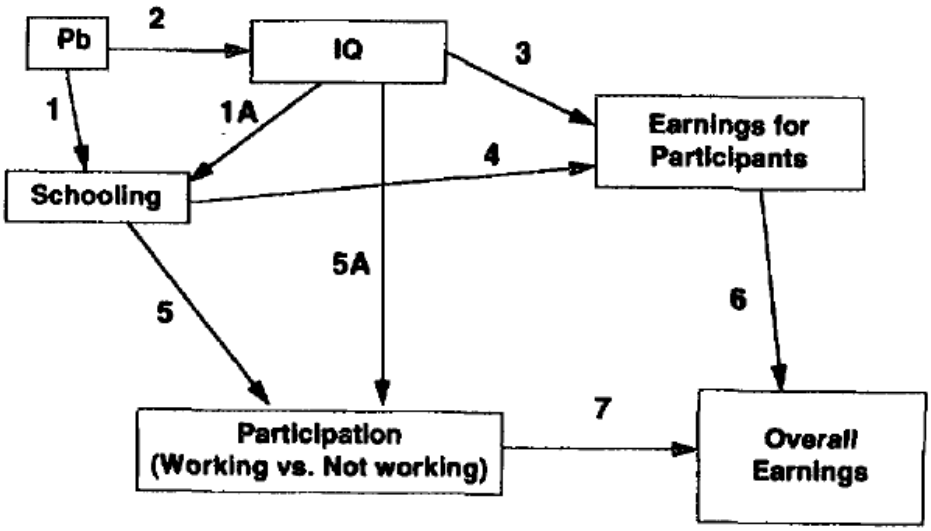


FIG. 1. Lead exposure effects on earnings.

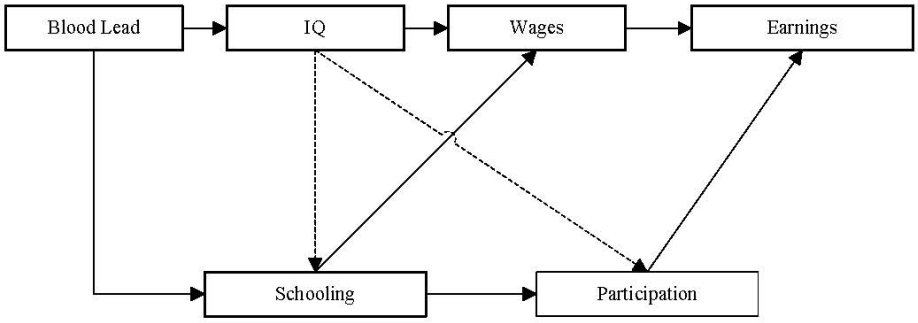
Source: Salkever (1995)

In Figure 6, we have presented Salkever's model in the same format as in Figure 3.

Figure 6. The Salkever (1995) model flow of causation in the Schwartz format.

Exhibit 2.3

RELATIONSHIP BETWEEN LEAD, IQ, AND EARNINGS: SALKEVER 1995



Source:
Based on Salkever (1995), Figure 1, p. 3.

Salkever's estimates of lead's impact are much higher than Schwartz's estimates, particularly for females. Overall, the combined effects of a 1 ug/dl increase in blood lead

levels reduce lifetime earnings by 3.23 percent, much higher than Schwartz's estimate of 1.76 percent.

We list the details in Figure 7.

Figure 7. Comparison of Salkever and Schwartz estimates

Exhibit 2.4

EFFECT OF LEAD ON LIFETIME EARNINGS:
COMPARISON OF SCHWARTZ (1994a) AND SALKEVER (1995)

Effect	Salkever (1995)		Schwartz (1994a)
	Male	Female	
Direct and indirect effect of IQ on participation	0.20 percent	0.81 percent	0.47 percent
Direct and indirect effect of IQ on earnings	1.73 percent	2.42 percent	1.29 percent
Total	1.93 percent	3.23 percent	1.76 percent

Source: Salkever (1995), Table 2, Lines 1-3, p. 4.
Notes:
When weighted to reflect the relative contribution of women and men to overall (national) earnings, the Salkever estimates average about 2.37 percent per IQ point.

Controversy about estimated values

There have been several other studies after these pioneering Schwartz and Salkever studies. Several of these later studies suggested that **the earlier studies had overestimated the impact of lead exposure on earnings. In part, prior studies had overestimated the effects of the loss of IQ in earnings.**

Salkever (2014) looked at the various reasons why earlier studies could have led to led to overestimates.

- Measurement and statistical issues. Salkever (2014) agreed that the issues raised in various studies were logical and valid but found no evidence that (i) these issues are important, and (ii) whatever bias exists points to over-estimates rather than under-estimates.
- Inconsistency with results from other studies. Salkever (2014) agreed that the results did appear inconsistent with the results from other studies related to wages but asserted that the observed difference could not be interpreted as supporting the overstatement hypothesis.
- Keep in mind the difference between wage rates and earnings. Salkever (2014) found that an important problem with the 'overstatement' studies is their failure to clearly and consistently differentiate between 'IQ impacts on **wage rates'** and 'IQ impacts on **annual**

earnings.' This confusion is also a problem that has occurred in the general economics literature on the importance of IQ and cognitive skills

Conclusions

- There is an agreement that a structural model should be used to estimate the impact of lead exposure on earnings, and therefore also on worklife expectancy.
- There is no consensus on the magnitude of the effect. Still, even the so-called "overestimates" appear to be relatively small, probably in the range of about 1-3% of lifetime earnings loss for every 1 µg/dl increase in blood lead levels.

CASE STUDY

An actual case that lays the structural relationships to determine the loss of earnings capacity and earnings typically

- starts with the medical and neuropsychological assessments.
- moves to the vocational assessment
- then to the economic analysis

That is:

- The medical and neuropsychological assessments estimate the impact of lead exposure on IQ and other associated indicators (deficits).
- The vocational assessment indicates the type of job and earnings the plaintiff can expect to hold, given the impact of lead exposure on IQ and other deficits.
- The economic assessment provides the earnings difference between the earnings possibilities "with" (given) and without (but-for) scenarios.

What is important is that all these steps be:

- undertaken, and that the results hold together, i.e., are internally consistent.
- broadly consistent with the findings in the literature that we have reported above.

An example of the Robert Smith case

We use the example of the Robert Smith case. We found (i) there is no internal consistency among plaintiffs' reports; and (ii) the findings the plaintiff experts opine as to the loss of earnings due to lead are not consistent with the literature's conclusions.

Furthermore, collectively the plaintiff's experts fail to distinguish between a structural and black-box approach. The misspecification of the relationship among factors is the fundamental flaw in the plaintiff's case to establish a link between lead and deficits in the case of Robert Smith.

For example, in this case, the plaintiff's medical expert opines a relationship exists but provides no supporting evidence for her claim. The "structural models" they rely on do not support their opinions. The neuropsychological assessments of both the plaintiff's and defense's **experts do not find any link between (i) levels of lead in Mr. Smith's blood and (ii) his psychological deficits**. The plaintiff's vocational expert doesn't attempt to establish a link. Finally, the plaintiff's economist states in his report a link exists but recants in his deposition.

The experts' opinions in the Robert Smith case

The figure below lists all the experts in the case.

Figure 1 Summary of Key Opinions of Plaintiff and Defense Expert Witnesses

Report	Expert	Assessment Type	Argument/Positions
Plaintiff Experts			
Transcript dated April 19, 2019.	Janet Jacobs, M.D.	Medical Assessment	Argues there is a link, but no foundation exists for her opinions.
Neuropsychological Evaluation of Robert Smith (March 20, 2018)	Kevin Knight, Psy.D.	Neuropsychological Assessment	Offers no opinion as to whether links exist.
"Employability Assessment – "Robert Smith" (August 3, 2018)	Marcus Martin, M.A. C.R.C.	Vocational Assessment	None of the results are linked to lead exposure
Report on Economic Losses of Robert Smith (September 29, 2018) Deposition of Lance Lucas, Ph.D.	Lance Lucas, Ph.D.	Economic Assessment	In his report, he links lead to neuropsychological functioning (deficits). Links to "cognitive disability." Links to the Gamboa-Gibson Worklife Tables. Adjusts the Skocog, Cieka, and Krueger (SCK) worklife expectancy model. However, in his deposition, he backs away from those links. He says he can't offer an opinion and falls back on relying on Martin, who does not establish any links between lead and deficits, as noted above.
Defense Experts			
Neuropsychological Evaluation of Robert Smith (November 12, 2018)	William Wright, Ph.D. ABPP/CN	Neuropsychological Assessment	For Mr. Smith, there is no evidence of a link between lead and cognitive disability
Vocational Assessment for Robert Smith (November 28, 2018)	Aaron Anderson, Ph.D.	Vocational Assessment	Mr. Smith will not experience any diminution in earnings due to lead because he: • is capable of continuing his education in a trade school setting; • is capable of completing on-the-job training; • has the capacity to maintain gainful employment; • will not experience an earnings capacity loss; • will not experience a reduction in worklife.

Economic Loss Report re: Robert Smith v. The Estate of George Michael (April 9, 2019)	Baron Baptist, Ph.D.	Economic Assessment	Mr. Smith finds no link between lead and the reduction of earnings, earnings capacity, and worklife.

Our focus is on the medical assessment in this report, as this is the foundation of the economic analysis. Given Dr. Lucas's recantation, the plaintiff's economist, the medical assessment is the only testimony available to support a claim that the link between "lead" and "deficits" contributes to a reduction in worklife expectancy and earnings capacity and earnings. However, for the sake of completeness, we have examined Dr. Lucas's report also.

Detailed opinions of the experts

Medical Assessment – Dr. Janet Jacobs (Plaintiff)

We reviewed the report and transcript of Janet Jacobs in the Robert Smith case. The transcript is dated April 19, 2019.

While Dr. Jacobs purports a link between lead and deficits, she doesn't provide a foundation for her opinions. We note that our views do not require any medical expertise. What we are examining are the methodologies that establish "causation."

In Dr. Jacobs's testimony, these issues arise:

1. Whether the reductions in cognitive ability is significant
2. Whether Mr. Smith fits the population that forms the basis for the research findings

Our findings related to the 14 studies discussed in Dr. Jacobs's deposition

Dr. Jacobs's report does not provide support for a link between lead exposure and earnings reduction.

On pages 24-26 of their deposition, there is a discussion of the analysis of Dr. Knight, the plaintiff's neuropsychologist. Dr. Knight refuses to establish a link between lead and earnings in his findings regarding Mr. Smith. Dr. Knight is not a medical doctor. Yet, Dr. Jacobs relies on Dr. Knight's report to make her determination.

In other sections of their deposition, Dr. Jacobs is asked about Dr. Knight's findings and whether they had any basis for accepting or refuting Dr. Knight's conclusions. Dr. Jacobs had none.

Based on our reading of her deposition, Dr. Jacobs's medical opinion is contrary to those of the plaintiff's neuropsychologist report.

Dr. Jacobs's sources do not appear to support their opinions.

Another line of questioning related to three key sources Dr. Jacobs relies on:

Low-Level Environmental Lead Exposure and Children's Intellectual Function:

An International Pooled Analysis, by Lanphear et al. Environmental Health Perspectives, vol 113, no 7 (July 2005)

Intellectual Impairment in Children with Blood Lead Concentrations below 10 µg per Deciliter, by Canfield, et al. The New England Journal of Medicine, April 17, 2003.

Lanphear, P. et al. The Contribution of Lead-Contaminated House Dust and Residential Soil to Children's Blood Lead Levels: A Pooled Analysis of 12 Epidemiologic Studies, U.S. Environmental Protection Agency, Environmental Research Section A 79, 51-68 (1998)

A key line of the questioning establishes that the results for each of three reports vary, and Dr. Jacobs has no way to account for the variations or how they apply to Mr. Smith. In particular, Dr. Jacobs cannot draw any inference regarding Mr. Smith from the population studies, particularly in the Canfield study. In this study,

> *Thirty-six of the 276 children in the original study were excluded from the current study because of premature birth (less than 37 weeks' gestation), low birth weight (less than 2500 g).*

Since Mr. Smith was a "low birth weight" baby, the Cranfield study doesn't apply to him.

Dr. Jacobs has not differentiated between lead-based and non-lead-based causes of cognitive differences.

We have created four graphics that summarize Dr. Jacobs's deposition.

Figure 2.1 Neurocognitive Impairments Have Lead And Non-Lead Causes

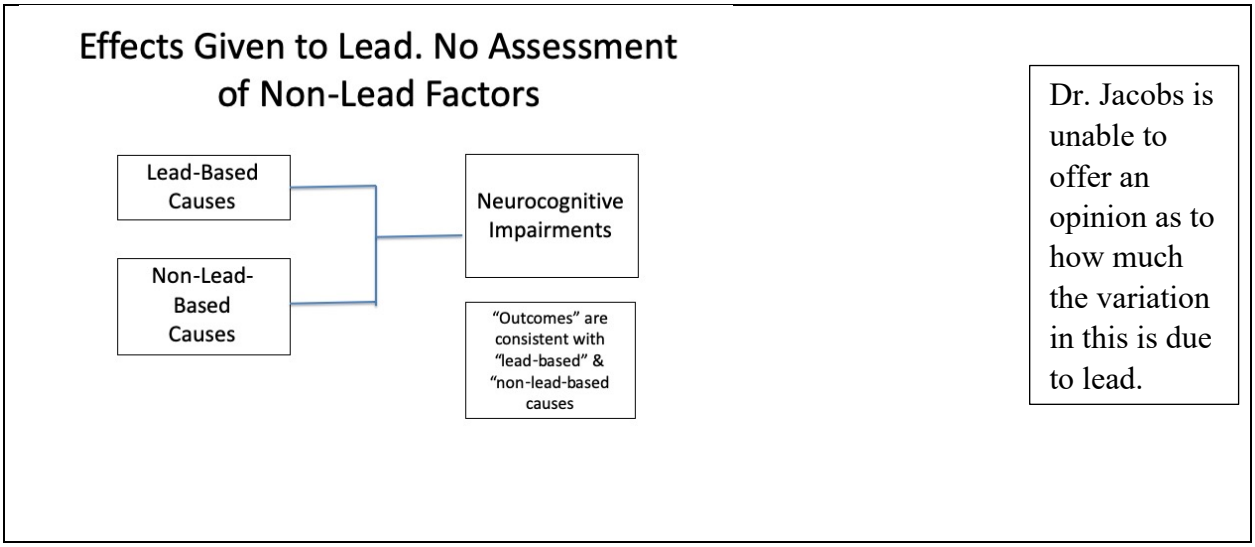


Figure 4.2 School Failure, Cognitive Impairment And Neurological Deficiencies Have Lead and Non-Lead Causes

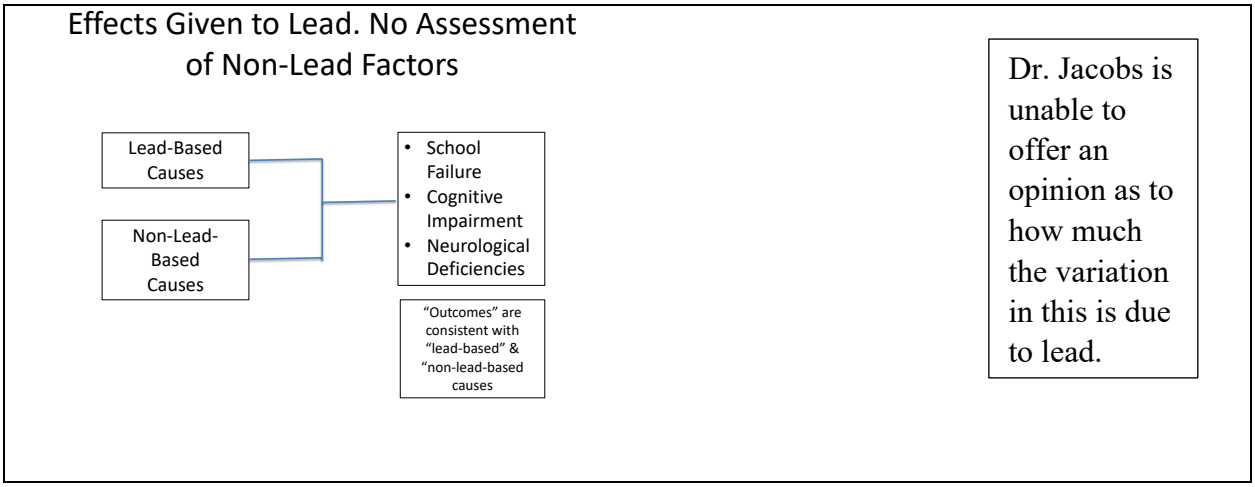


Figure 4.3 At Risk Of Developing School Difficulties Has Lead and Non-Lead Causes

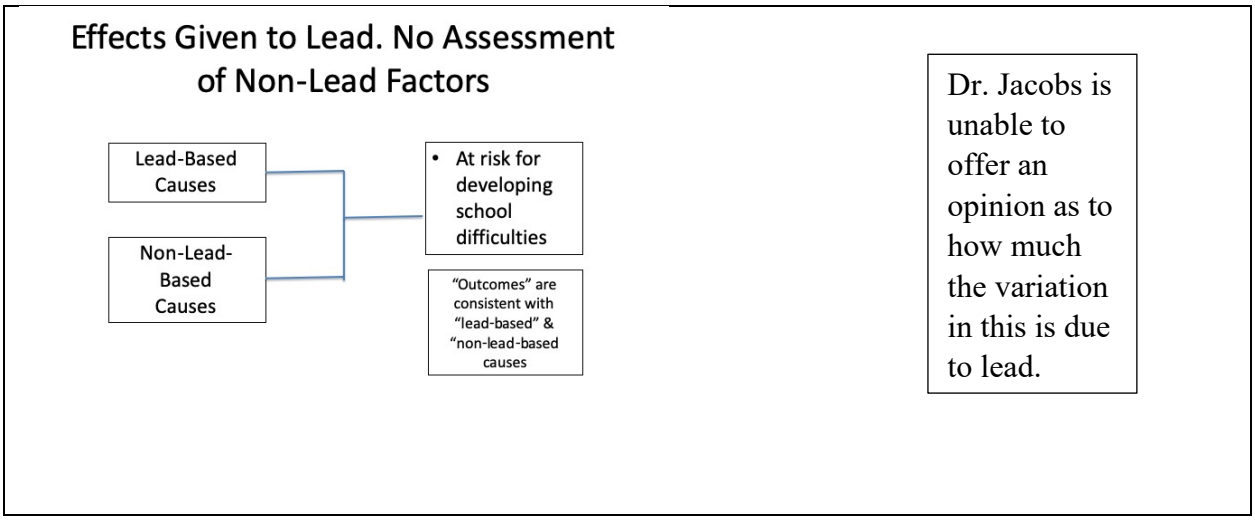
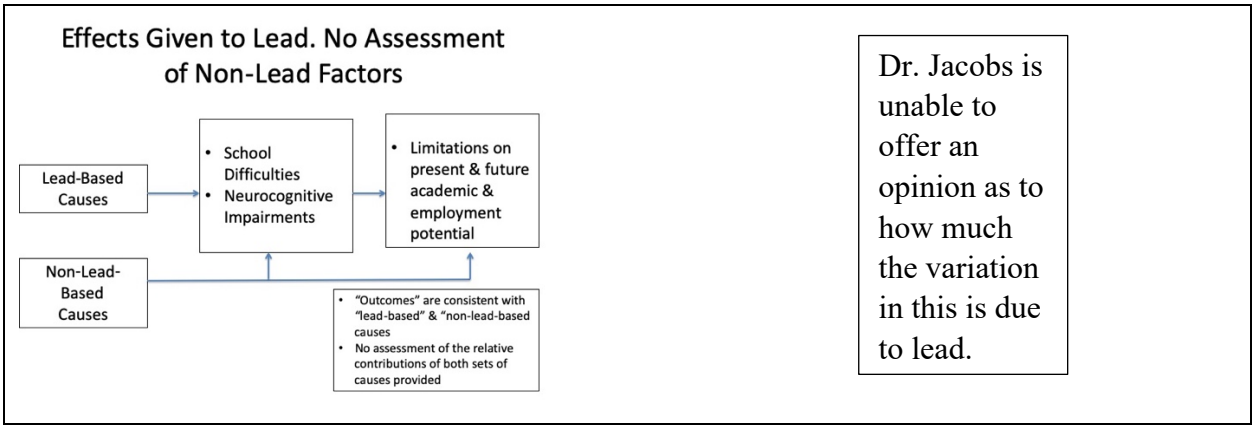


Figure 4.4 Limitations on Present & Future Academic & Employment Potential Have Lead and Non-Lead Causes



While there are many more "deficits" listed in their transcript, Dr. Jacobs cannot say how much of each of the deficits is caused by lead.

Neuropsychological Assessments- Dr. Kevin Knight (Plaintiff)

The neuropsychological assessments conducted by experts for both the defense and plaintiff do not find any link between the levels of lead in Mr. Smith's blood, psychological deficits, and a reduction in his lifetime earnings.

Furthermore, the defense's neuropsychologist opines the cohort that ranges in age between 29-43 does not show atypically high rates of the negative psychosocial outcomes that are sometimes attributed to childhood lead ingestion.

Given Dr. Jacobs's methodological confusion, it's no wonder the neurological assessments fail to establish a link between lead and deficits in Mr. Smith's case.

In short, the neuropsychological experts' reports do not support any links between the level of lead exposure and psychological outcomes.

Vocational Assessments- Mr. Marcus Martin (Plaintiff)

Neither the plaintiff nor the defense experts establish a link.

The defense's expert states a link, but he doesn't provide any support for his opinions.

Economic Assessments – Dr. Lance Lucas (Plaintiff)

The plaintiff's economist, Dr. Lucas, states a link between Mr. Smith's blood lead levels, deficits, and lifetime earnings. However, as noted in his deposition, he backs away from the statements in his reports and testifies he will not be asserting a link. In their report, the defense economic experts indicated: There are too many methodological issues to establish a reliable connection between "lead" and "deficits" in Mr. Smith's case.

The conclusion is that economic experts have not established verified links between blood lead levels and earnings.

While Dr. Lucas has recanted his opinion, it's still important to review his flawed analysis.

Dr. Lucas starts his analysis by assuming there is a link between lead and "deficits." He draws his conclusion based on his literature review on the effects of lead on IQ and earnings. He also relies on the statements of the plaintiff's vocational expert, Mr. Martin.

While the literature Dr. Lucas cites established "a link" between lead exposure and "deficits," the other neuropsychological, vocational, and expert experts do not link the lead in Mr. Smith's blood and to his "deficits."

According to the report of the defense expert Dr. Wright, based on their neurological examination of Robert Smith,

- Mr. Smith's childhood blood lead levels are substantially lower than average historical norms even as they surpass the current guidelines.
    - **His geometric mean blood lead level through age 5 was 11.8 µg/dL American children born 15 to 20 years earlier had an average blood lead level of 15 µg/dL** Dr. Wright cites the following as support. *Pirkle, J.L., et al., The decline in blood lead levels in the United States. The National Health and Nutrition Examination Surveys (NHANES). Jama, 1994.* ***272****(4): p. 284-91.*
    - Hence, more than 75% of children raised in the U.S. who are now in their late 30s/early 40s had childhood blood lead levels higher than Mr. Smith.
    - Yet, **this age cohort does not show atypically high rates of the negative psychosocial outcomes that are sometimes attributed to childhood lead ingestion.**

There is no indication that the historical blood exposures reduced the worklife expectancy of the cohort as a whole. However, the plaintiff's economic expert, Dr. Lucas, contends Mr. Smith's WLE is reduced by 22 years due to his deficits.

Of note, here is Dr. Lucas's use of the term "deficits." Based on the neuropsychological assessment of the defense expert Dr. Wright and the plaintiff's expert Dr. Knight, Mr. Smith has "deficits." **However, neither of these experts see "lead" as the cause of Mr. Smith's deficits.**

For example, **Dr. Wright finds no relationship between "lead" and Mr. Smith's "deficits."** Wright concludes:

> *Given Mr. Smith's academic and work history along with his test results, I cannot conclude with a reasonable degree of neuropsychological probability that childhood lead ingestion in any way compromised his development. (p 15)*

While Dr. Wright does not find any connection between lead and deficits, **Dr. Knight does not even try to establish a link**. Dr. Knight states:

> *Robert Smith is a 21-year-old plaintiff in a civil lawsuit claiming that he suffered an injury due to a childhood exposure to lead. His attorney for neuropsychological examination referred him.* ***The present evaluation will not offer opinions regarding the etiology of any observed deficits.*** *(p 1)* Emphasis added.

Dr. Lucas posits a relationship between lead and deficits, followed by a link between deficits and worklife expectancy. **However, he doesn't conduct a structural analysis similar to Schwartz or Salkever.**

Further, as we have noted above, **both the defense's and the plaintiff's neurophysiological experts do not claim that that lead is the cause of the deficits**. Similarly, both the Plaintiff's vocational expert, Mr. Martin, and the plaintiff's vocational expert Dr. Aaron Anderson do not claim any causal relationship between lead and deficits. Finally, the economic experts for the defense, Dr. Baptist, also do not link lead and deficits.

The Gamboa-Gibson Worklife Tables (GGWT)

A link between "lead" and "worklife expectancy" needs to have a sound basis. Consequently, we include a discussion of the Gamboa-Gibson Worklife Tables because Dr. Lucas used them in his calculations of the effect of "lead" on "worklife."

There have been numerous, exhaustive analyses, which have concluded:

- Previous and current "Gamboa Gibson Worklife" tables fail at numerous tests for validity and reliability. The data that establishes the basis for the tables is not appropriate for the measurement of disabled worklife.[3]
- U.S. Government sources used to define disability are not reliable, and they were not designed for measuring the prevalence of permanent disabilities.

Dr. Thomas Ireland goes on to note about the Gamboa-Gibson Worklife Tables:

> *The LPE method used by Gamboa and Gibson for deriving disability work-life tables from underlying government sources is not a valid methodology for doing so. Even if the underlying government sources were reliable for the purpose of measuring disability and the method used to derive disability work-life tables was a valid methodology, the data itself would be for a wide variety of disabilities and not applicable to an individual with a particular disability. In, short, they used the wrong method with the wrong data and*

[3] Thomas R. Ireland. 2009. "Markov Process Work-Life Expectancy Tables, the LPE Method for Measuring Worklife Expectancy, and Why the Gamboa-Gibson Worklife Expectancy Tables Are Without Merit. "The Rehabilitation Professional 17(3), pp. 111-126.

Critique of the 2010 GGWT: http://www.stat-analytics.com/Gamboa-GibsonErrors.htm. Also, see "Life and Worklife Expectancies", 2nd Ed. Hugh Richards and Michael Donaldson, eds. Lawyers & Judges Publishing Co., Inc. Tucson, AZ. (January 2010) See Chapter 14, Issues in Estimations of Worklife for a discussion of some of the unresolved challenges facing the New Worklife Expectancy Tables and the Gamboa-Gibson Worklife Expectancy Tables.

> *produced results that would not be applicable to a person with a specific disability even if the results were accurate in general.*[4]

Dr. Lucas relies on the peer-reviewed work of the economists Gary R. Skoog, James E. Ciecka, and Kurt V. Krueger.[5] Two of these economists, Krueger and Skoog[6], have assessed the validity and reliability of the Gamboa-Gibson Worklife Tables. They conclude:

> *The worklife models presented by Gamboa and Gibson (2006, 2010, 2015) and by Gamboa in previous years as far back as 1987 all assume that the disability transition probabilities age-to-age are fixed at 0%-the disability and non-disability statuses are unrealistically assumed (i.e., forced) to be permanent. Since the probability of being employed in the disabled state is lower than in the non-disabled state, a large number of years of a disability worklife penalty, or lowering due to an initial disability status, is claimed by those static models.*[7]

Krueger and Skoog also state:

> *A major implication of [our] findings is that during prime working years there is a small loss of worklife expectancy for those starting an age with a Census-measured disability as opposed to starting at an age non-disabled. Our general conclusions are: (1) that Census survey data regarding disability conditions, if used to study the impact of disability on worklife expectancy, produces small reductions, and (2) worklife disability tables operated under the assumption of "once-disabled, always disabled," produce large spurious reductions in worklife expectancy.*[8]

The implication of the Krueger-Skoog findings for Dr. Lucas's analysis is the data in *The Census Surveys (ACS, CPS and Survey of Income Program Participation (SIPP))* are data on a **temporary**, not a permanent disability.[9] Dr. Lucas is assuming Mr. Smith has a **permanent** disability when the sources he relies upon are related to people with a **temporary** disability. Consequently, the "Gamboa Gibson Worklife Tables" Dr. Lucas uses in his analysis are not valid

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[4] Ireland (2009) Why the Gamboa-Gibson Disability Work-Life Expectancy Tables Are Without Merit. *Journal of Legal Economics* 15(2): pp. 105-109. Note that Ireland's article was published in 2009. While the GGWT are dated 2010, the methodology did not change from the previous versions. The GGWT 2010 is still based on the LPE Method. The GGWT 2010 notes: "*As discussed in chapter 1, we developed the worklife expectancies in this publication using the Life, Participation, and Employment (LPE) model.* "

[5] Skoog, Ciecka, and Krueger (2011) "The Markov Process Model of Labor Force Activity: Extended Tables of Central Tendency, Shape, Percentile Points, Variation and Bootstrap Standards Errors," *Journal of Legal Economics*, 22(2), 2011, p. 165.

[6] Krueger and Skoog (2015) "Transitions Into and Out of Census Disability," *Journal of Forensic Economics* 26(1), pp. 17-51.

[7] Krueger and Skoog, p. 47.

[8] Krueger and Skoog, p. 48.

[9] Krueger and Skoog, p. 37.

and reliable. The implication is that Dr. Lucas has no basis for using these tables for shortening Mr. Smith's worklife expectancy.

Lack of studies that analyze the detailed impact of lead at an early age on worklife

Here we pose some detailed questions about the relationship between lead exposure and worklife (WL). Note that currently, there are no cross-sectional, longitudinal, or meta-analysis studies that answer this question. However, it is still important to look at the questions because they affect the calculation of damages.

One question is: What are the differences in the WL of those between the ages of 29-43 in 2020 and registered varying levels of lead in their blood when they were 1-5 years old?

Another question is: How does the impact vary by the level of lead exposure? That is, how does the WL for those in the 25th percentile with a 12.0 µg/dl level differ from the WL of those in the 50th percentile with a 15.0 µg/dl level, in the 75th percentile with a 19.0 µg/dl level, in the 90th percentile with a 24.0 µg/dl level; and the 95th percentile with a 28.0 µg/dl level?

The motivation for this question is the plaintiff reports in a case like Mr. Smith's. Mr. Smith had a geometric mean lead blood level of 11. µ8 g/dl between the ages of 1-5. He was age 1 in 1998 and age 5 in 2002.

Types of studies needed to establish a link between lead and worklife expectancy

To determine whether worklife expectancies are "atypical" because of lead exposure, comparisons would have to be made between those with and without lead and among the various percentiles with lead.

What types of studies would Dr. Lucas have to undertake, or what kind of studies would he have to rely upon to determine the relationship between people's worklife expectancy and the registered levels of lead in their blood?

Longitudinal Study

An example of this type of study researchers follow a cohort of those with lead in their blood and track their experience in the labor market.

The National Longitudinal Survey of Youth (NLSY79). The NLSY 1979 consists of men and women born between 1957-64 and were ages 14 to 22 when first interviewed in 1979. These individuals were ages 50 to 59 in 2015-16. The economic outcomes of the same cohort have been tracked since the study began. The NLSY1997 follows cohorts who ranged from ages 12 to 17 when they were interviewed in 1997. The most recent studies are for those in this cohort who are 34 to 39. This study does cover the effects of lead on worklife expectancy for lifetime earnings.

An economist should conduct or rely on a longitudinal study of a cohort's labor market participation rates with lead in their blood. For example, the economist should conduct or rely on a longitudinal study of those aged 1-5 1976-1990 are 29-43 today (2020).

Cross-Sectional Studies

An example of this type of study would identify 29-43 years old (in 2020) and who had blood lead levels when they were ages 1-5 during the years 1976-1990.

Dr. Lucas cites an example of a cross-sectional study in his report on Mr. Smith:

> *Pinc-04. Educational Attainment--People 18 Years Old and Over, by Total Money Earnings in 2014, Work Experience in 2014 Age, Race, Hispanic Origin, and Sex, U.S. Census Bureau.*

However, they do not conduct or rely on a cross-sectional study of a cohort's labor market participation rates with "lead" in their blood.

Analyzing Existing Studies or Conduct a Meta-Analysis

A third approach uses "meta-analysis." An example of this type of study is *"Benefits of Reduced Lead Exposure: A Review of Previous Studies" by Lisa Robinson*[10].

This study sheds some light on the effects of lead on labor market participation and earnings. One variation of this type of report is the one by Landrigan et al. we noted above.

Dr. Lucas doesn't conduct or rely on a "meta-analysis" of a cohort's labor market participation rates with "lead" in their blood. Dr. Lucas provides some cursory comments on the relationship between "lead" and "earnings." Still, as we have indicated, Dr. Lucas does not consider the findings and recommendations based on Dr. Robinson's summary of the models by Schwartz, Salkever, and others.

Disability Status Data Report

While not a source in the Smith case, we often encounter vocational and economic assessments using the "Disability Status Reports" to link lead, deficits, unemployment, and worklife.

[10] Lisa A. Robinson Independent Consultant Lisa.A.Robinson@comcast.net. EPA Contract Number: IEC EP-D-04-006 Work Assignment Number: 3-15 Subcontract Number: 8033 Robinson Review Draft September 2007.

For example, there is the 2013 Disability Status Report-Maryland.[11] However, there are several methodological problems with the 2013 Disability Status Report regarding linking lead, deficits, and earnings losses.

- The 2013 Disability Status Reports are not an independent study of "disability." These "reports" are presentations of the information about "disability" contained in the American Community Survey (ACS).
- As we have noted within the forensic economics literature, there is a major critique of using the Current Population Survey (CPS) and the American Community Survey (ACS) as a basis for defining and measuring disability. There are peer-reviewed papers that challenge the application of the ACS definitions to determine economic damages.
- All critiques of using the ACS definitions of "disability" apply to the 2013 Disability Status Data Reports.

  As we have noted within the forensic economics literature, there is a major critique of using the Current Population Survey (CPS) and the American Community Survey (ACS) as a basis for defining and measuring disability. There are peer-reviewed papers that challenge the application of the ACS definitions to determine economic damages.

While the data is inappropriate for determining economic damages based on cognitive disabilities, the data suggest the magnitude of earnings losses using the ACS definition of "cognitive disability." For example, the 2013 disability data for Maryland notes that while people with a "disability" have an "employment rate" that is 51.5% less than those without a disability overall and are employed 43.4% less full time/full year, they only have an 8.8% reduction (a $6,600-per-year) reduction in their annual earnings. The data series is for ages 21-64 -- a 44-year period. See Table 1 (Row 3) below.

Table 1 Employment and Earnings Gaps[12]

		Pre-Event	Post-Event		

[11] Erickson, W. Lee, C., & von Schrader, S. (2012) Disability Status Report: The United States. Ithaca, NY: Cornell University Rehabilitation Research and Training Center on Disability Demographics and Statistics. http://www.disabilitystatistics.org/

[12] Erickson, W. Lee, C., & von Schrader, S. (2013) *Disability Status Report: the United States*. Ithaca, NY: Cornell University Rehabilitation Research and Training Center on Disability Demographics and Statistics. http://www.disabilitystatistics.org/

		Without Disability (All)	With Disability (One or More)	Gap Points (3)-(2)	Gap Percent (3)/(2)
		Maryland	Maryland		
	(1)	(2)	(3)	(4)	(5)
(1)	Employment Rate All (2013)	80%	41.2%	-38.8	51.5%
(2)	Employment Rate: Full Time/Full-Year Employment (2013)	62.9%	27.3%	-35.7	43.4%
(3)	**Annual Earnings (Full-Time /Full-Year workers) (Median) (2013)**	**$52,900**	**$46,300**	**-$6,600**	**8.8%**

Some experts use the Disability Status Data to support the understanding of "disability" and its effects on employment and educational outcomes. However, they fail to rely on it when estimating earnings losses. Keep in mind, the concern of the expert economist is with loss of earnings.

SUMMARY & CONCLUSION

Our analysis is based on a (i) review of available methodologies and literature to create such a link, and the (ii) reports filed by various experts in the case related to Robert Smith.

Our review of methodologies reveals:

- Some studies link "level of lead exposure" and "earnings"
- There are no studies that link "level of lead exposure" and "worklife expectancy" in a methodologically sound manner
- There are small reductions in lifetime earnings when blood lead levels are accounted for

We conclude that there have not been any published studies that can determine:

- whether those with lead blood levels have worklife expectancies different than those who don't; and
- whether there are differences in worklife expectancy among those with varying levels of lead in their blood.

Specifically, in the example of the Robert Smith case, there is no internal consistency among the plaintiff reports. What findings the plaintiff experts opine as the loss of earnings due to lead is not consistent with the literature's findings.