

# Any further progress in smoking cessation treatment?

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The release of the US Public Health Service's quantitative review of smoking treatments, *Treating Tobacco Use and Dependence* (TTUD; Fiore, Bailey, Cohen *et al.*, 2000, AHRQ Publication, USDHHS), is a fitting occasion to revisit a question posed by Shiffman (1993, *Journal of Consulting and Clinical Psychology*, 61:718–722): has there been any recent progress in smoking cessation treatment? Using TTUD meta-analyses as a rough guide, we present an overview of current elements of clinical treatments (structure, content, and pharmacotherapy) with statistical claims to efficacy. We note characteristics of treatment, or treatment research, that may retard accumulation of critical knowledge, including the hegemony of multi-component treatments and a seeming disinterest in treatment process. Finally, we sketch avenues of potentially generative research that might foster new insights and improved treatments. It is concluded that not much has changed since Shiffman's (1993) review, and that his call for a rededication to basic research is still prudent but largely unanswered.

## Introduction

Several years ago, Shiffman (1993) wrote a critical review of the smoking cessation literature in which he warned that smoking treatment research had fallen into a 'rut'. Shiffman noted that: (1) treatment innovations were slowing and tended to be pharmacological rather than behavioral, (2) the efficacy of our treatments appeared to be stagnant, (3) treatment matching represented an important but unrealized goal, and (4) relatively little attention was being paid to treatment process and basic theoretical issues that might inform treatment design.

In June 2000, the United States Public Health Service released *Treating Tobacco Use and Dependence* (TTUD; Fiore *et al.*, 2000), an evidence-based clinical practice guideline that updated the AHCPR's 1996 *Smoking Cessation Clinical Practice Guideline* (Fiore *et al.*,

1996). This document provides both a blueprint for the standard of care in tobacco cessation and a quantitative synthesis of the efficacy data supporting a wide array of cessation treatment strategies. The release of this document at the turn of a new century strikes us as an appropriate occasion to revisit the question posed in Shiffman's earlier review: has there been any progress in smoking cessation treatment?

This article focuses on 'formal' or clinic-based treatments, rather than on public health interventions.<sup>1</sup> Our intention is not to provide an exhaustive narrative of all relevant studies or a new quantitative synthesis of outcome data. Instead, we attempt to 'take the pulse' of smoking research today, using the TTUD findings as convenient and timely springboards for discussion. This article focuses on three treatment parameters frequently manipulated with the intention of improving long-term cessation outcomes: *treatment structure*, *psychosocial content*, and *pharmacotherapy*. In our consideration of each domain, we try to go beyond dry summary statistics, identifying unresolved issues and offering interpretive commentary. The status and potential of relatively new wrinkles in each domain are also considered: *stepped-care* protocols as a structural variant, *treatment matching* of psychosocial content to smoker subpopulations, and *combination pharmacotherapy*.

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**Table 1.** Summary of TTUD meta-analyses assessing impact of various elements of treatment structure

Structure variable	Number of study arms	Estimated OR (95% CI)	Estimated abstinence rate (95% CI)
<b>Level of contact (43 studies)</b>			
No contact	30	1.0	10.9
Minimal counseling (<3 min)	19	1.3 (1.01, 1.6)	13.4 (10.9–16.1)
Low intensity counseling (3–10 min)	16	1.6 (1.2, 2.0)	16.0 (12.8–19.2)
Higher intensity counseling (>10 min)	55	2.3 (2.0, 2.7)	22.1 (19.4–24.7)
<b>Total amount of contact time (35 studies)</b>			
None	16	1.0	11.0
1–3 min	12	1.4 (1.1, 1.8)	14.4 (11.3, 17.5)
4–30 min	20	1.9 (1.5, 2.3)	18.8 (15.6, 22.0)
31–90 min	16	3.0 (2.3, 3.8)	26.5 (21.5, 31.4)
91–300 min	16	3.2 (2.3, 4.6)	28.4 (21.3, 35.5)
>300 min	15	2.8 (2.0, 3.9)	25.5 (19.2, 31.7)
<b>Number of person-to-person sessions (45 studies)</b>			
0–1 session	43	1.0	12.4
2–3 sessions	17	1.4 (1.1, 1.7)	16.3 (13.7, 19.0)
4–8 sessions	23	1.9 (1.6, 2.2)	20.9 (18.1, 23.6)
>8 sessions	51	2.3 (2.1, 3.0)	24.7 (21.0, 28.4)
<b>Type of clinician (29 studies)</b>			
No clinician	16	1.0	10.2
Self-help	47	1.1 (0.9, 1.3)	10.9 (9.1, 12.7)
Non-physician	39	1.7 (1.3, 2.1)	15.8 (12.8, 18.8)
Physician	11	2.2 (1.5, 3.2)	19.9 (13.7, 26.2)
<b>Number of clinicians type (37 studies)</b>			
No clinician	30	1.0	10.8
One type	50	1.8 (1.5, 2.2)	18.3 (15.4, 21.1)
Two types	16	2.5 (1.9, 3.4)	23.6 (18.4, 28.7)
Three or more types	7	2.4 (2.1, 2.9)	23.0 (20.0, 25.9)
<b>Format (58 studies)</b>			
No format	20	1.0	10.8
Self-help	93	1.2 (1.02, 1.3)	12.3 (10.9, 13.6)
Proactive telephone counseling	26	1.2 (1.1, 1.4)	13.1 (11.4, 14.8)
Group counseling	52	1.3 (1.1, 1.6)	13.9 (11.6, 16.1)
Individual counseling	67	1.7 (1.4, 2.0)	16.8 (14.7, 19.1)
<b>Number of formats (54 studies)</b>			
No format	20	1.0	10.8
One format	51	1.5 (1.2, 1.8)	15.1 (12.8, 17.4)
Two formats	55	1.9 (1.6, 2.2)	18.5 (15.8, 21.1)
Three or four formats	19	2.5 (2.1, 3.0)	23.2 (19.9, 26.6)

OR, odds ratio; CI, confidence interval.

Adapted from Fiore *et al.* (2000), Tables 12–18. Original tables are in the public domain. Odds ratios and abstinence rates refer to long-term (>5-month) follow-up.

After reviewing these areas, we sketch some suggestions for future research.

### Treatment structure

A treatment's structural components include factors such as the number of sessions provided, the length of each treatment session, the format (i.e., in person, phone, printed materials, etc.) of the intervention, the timing and spacing of sessions relative to the quit date, the provider delivering the treatment, and so on. Every smoking treatment can be characterized according to such structure variables, but the deliberate manipulation of these treatment features within the same study is comparatively rare. Thus, treatment structure characteristics are often confounded with one another and/or with the provision of pharmacotherapy.

The relative dearth of studies explicitly manipulating a single treatment's structural elements is unfortunate, because the available evidence suggests that structural features account for a great deal of the variability in long-term abstinence outcomes (see Table 1). Inferences about the impact of treatment structure must perforce remain speculative because of possible correlations between structural elements and other treatment features across studies. For instance, brief interventions may tend to involve biochemical confirmations of smoking status more than do longer treatments. Because of the great number of such potential confounds, TTUD researchers made little attempt to eliminate or control for such confounds in the analyses summarized in Table 1 (comparisons confounded by pharmacotherapy were eliminated).

Accepting the limitations of the data, treatment *intensity* and *duration* appear to be critical. Note that

Table 1 includes summary statistics for non-clinical interventions such as self-help materials because these data help to illustrate the broad linear relationship between treatment intensity and outcome. For instance, the number of person-to-person contacts, the length of individual sessions, and the duration of active treatment after quit date all appear to be positively related to the likelihood of long-term abstinence. *Personal contact* appears to be a key structural element of efficacious treatment; interventions featuring person-to-person counseling are more effective than self-help printed materials<sup>2</sup> (Table 1). Telephone contact with a cessation counselor produces quit rates that generally fall between these two extremes (Orleans *et al.*, 1991; Zhu, Stretch, Balanabis, Ropsbrook, Sadler, & Pierce, 1996).

Other structural elements of smoking treatments appear to be less critical. For instance, while person-to-person contact with a counselor is related to treatment success, it appears to be relatively unimportant whether the personal contact is delivered to an individual or in a group-counseling context. Healthcare providers with diverse professional backgrounds are generally equivalent in terms of their efficacy. There is a tendency for interventions delivered by a multi-disciplinary team of providers to produce higher long-term quit rates than those delivered by a single individual, but such interventions tend to include other potent structural features, such as a long duration and a large number of sessions (Kottke, Battista, DeFriese, & Brekke, 1988).

### Stepped care

Stepped-care protocols have generated considerable enthusiasm for nearly a decade (e.g., Abrams, 1993; Orleans, 1993). Stepped-care regimens recognize that available treatments can be roughly organized according to a hierarchy of potency, ranging from simple advice to quit smoking and delivery of printed materials at one end, to intense, multi-session psychosocial counseling paired with high-dose pharmacotherapy at the other extreme. Implicit in the stepped-care philosophy is an acknowledgment that treatment potency is correlated with the expense of treatment, measurable in both time and money. The goal of stepped-care protocols is to boost *clinical efficiency* by starting most or all smokers on low-cost, low-intensity treatments. Smokers who succeed with these treatments are filtered out of the system, while treatment failures are stepped-up to more costly but more potent treatments iteratively until success is achieved. Because they emphasize efficiency, the major benefits from successful stepped-care algorithms would predominantly accrue to healthcare systems, rather than smokers or clinicians *per se*. The promise of stepped care cannot be ascertained because such clinical algorithms have rarely been subjected to empirical tests.

One potential pitfall of stepped-care designs is that, by definition, they require individuals at the highest risk of relapse to undergo iterative failure experiences before

they are given a treatment appropriate to their risk level. Such failure experiences may be counterproductive, undercutting the potency of subsequent, intense treatments, and this may offset any gain in efficiency achieved through the stepping process. This suggests that initial triage to intensive treatments for high-risk smokers may be an essential feature of successful stepped care (e.g., Abrams, 1993).

### Psychosocial content

Despite decades of research, surprisingly few systematic conclusions can be drawn about the relative efficacy of differing psychosocial treatment elements. This fact does not obtain because of a dearth of treatment styles; literally dozens of unique treatment contents have been devised and deployed by researchers (e.g., Schwartz, 1987; USDHHS, 2000). However, temporal trends in smoking cessation research have produced a research record that is difficult to interpret. As Shiffman (1993) noted, smoking cessation research in the 1960s and 1970s was vibrant, with new psychosocial treatment innovations being introduced regularly.<sup>3</sup> Unfortunately, studies performed at that time were generally characterized by small sample sizes and a lack of biochemical confirmation of abstinence outcomes, making them somewhat difficult to interpret and generalize. Secular trends in the smoking population over time also make older results difficult to interpret; many investigators suspect that today's smokers are more dependent, for example (Hughes, 1996; Irvin & Brandon, 2000; Shiffman, 1993).

As sample sizes grew and methodological conventions became more rigorous in the 1980s and 1990s, there was a concomitant trend toward the evaluation of multi-component treatment packages (e.g., Orleans, Kristeller, & Gritz, 1993; Shiffman, 1993). By commingling psychosocial treatment elements in diverse arms of the same study, treatment package studies have stunted the growth in our knowledge of the potency of particular treatment contents.

For these reasons, we will not attempt a detailed review of every treatment content variant. Instead, we focus on three broad classes of treatment contents found to be significantly superior to comparison treatments in TTUD meta-analyses: *skills training*, *aversive smoking*, and *intra-treatment and extra-treatment social support* (see Table 2). The meta-analytic results suggest that these are the treatment contents with the most reliable empirical support for their potency. However, it is important to remember that this conclusion derives from the statistical pooling of effect sizes across studies. The studies themselves differed in the fidelity with which treatments were implemented, the number of studies conducted in a particular content area, the point in history at which they were conducted, treatment structure variables, and many other factors. Hence, while these treatments represent statistically reasonable 'best guesses' as to which contents are most effective *on average*,

**Table 2.** Summary of TTUD meta-analysis assessing impact of various treatment contents (62 studies)

Content	Number of study arms	Estimated OR (95% CI)	Estimated abstinence rate (95% CI)
No counseling	35	1.0	11.2
Relaxation/breathing	31	1.0 (0.7, 1.3)	10.8 (7.9, 13.8)
Contingency contracting	22	1.0 (0.7, 1.4)	11.2 (7.8, 14.6)
Weight/diet	19	1.0 (0.8, 1.3)	11.2 (8.5, 14.0)
Cigarette fading	25	1.1 (0.8, 1.5)	11.8 (8.4, 15.3)
Negative affect	8	1.2 (0.8, 1.9)	13.6 (8.7, 18.5)
Intra-treatment social support	50	1.3 (1.1, 1.6)	14.4 (12.3, 16.5)
Extra-treatment social support	19	1.5 (1.1, 2.1)	16.2 (11.8, 20.6)
General problem-solving	104	1.5 (1.3, 1.8)	16.2 (14.0, 18.5)
Other aversive smoking	19	1.7 (1.04, 2.8)	17.7 (11.2, 24.9)
Rapid smoking	19	2.0 (1.1, 3.5)	19.9 (11.2, 29.0)

OR, odds ratio; CI, confidence interval.

Adapted from Fiore *et al.* (2000), Table 20. Original table is in the public domain. Odds ratios and abstinence rates refer to long-term (>5-month) follow-up.

we recognize that different studies of the same putative treatment may show quite discrepant findings. Similarly, omission from this list does not necessarily mean that a particular treatment content is never effective or could not be improved.

#### *Skills training: the ubiquitous treatment*

Perhaps the most popular psychosocial content element in use today is skills training. 'Skills training' describes a broad range of interventions that emphasize that lapse/relapse episodes are linked to particular situational or contextual cues and that people can be taught to recognize and anticipate such cues. Moreover, skills training treatments assume that individuals can be taught responses that will either reduce the likelihood of a person's encountering a lapse situation, or will render the situation less threatening to the person's abstinence. While these strategies and assumptions are universal among skills training treatments, different skills training interventions will add additional components.

Perhaps the most well-described and ambitious skills training intervention is relapse prevention training (RPT), which derives from the theoretical model of relapse and the cognitive-behavioral treatments advanced by G. Alan Marlatt, Judith Gordon, and their colleagues (e.g., Curry, Marlatt, Gordon, & Baer, 1988; Marlatt & Gordon, 1980; 1985). The RPT model grew out of research on the natural history of drug lapses and relapse, and hinges on the proposition that relapse is not an all-or-none event, but rather an *orderly process of change* that can be short-circuited through the timely application of self-control techniques (Marlatt, 1985). Other major tenets of the RPT model hold that: (1) a lapse event need not (and often does not) eventuate in full-blown relapse, (2) the specific attributions an individual makes about the causes of a lapse event can modify the probability of subsequent relapse, (3) there are identifiable, common situations that put persons at high risk of resumed substance use, and (4) relapse is

choice behavior, governed in part by cognitive processes such as expectancies and self-efficacy.

The RPT treatment model jibes with major clinical features of smoking relapse (Curry & McBride, 1994; Shiffman, Paty, Gnys, Kassel, & Hickcox, 1996), has an intuitive appeal to both clinicians and smokers (Lichtenstein & Glasgow, 1992), and can be easily adapted to diverse treatment modalities (Brandon, Collins, Juliano, & Lazev, 2000; Curry *et al.*, 1988). Thus, it is not surprising that treatments based on the RPT model have been widely recommended for clinical use (e.g., Glynn & Manley, 1989; National Institute on Drug Abuse, 1999).

The evidence for the efficacy of skills training/RPT treatments is mixed. Interpretation of the literature is made difficult, however, because skills training content has become so popular and has been so widely disseminated that it has become increasingly difficult to find 'uncontaminated' alternative treatments with which to compare it (Carroll, 1996; Curry & McBride, 1994). A TTUD meta-analysis showed skills training methods appear to be associated with increased quit rates relative to no-counseling control conditions (see Table 2). However, the confidence intervals for skills training (termed 'General Problem Solving' in TTUD analyses) overlapped with the confidence intervals for all other interventions, suggesting that skills training might not be superior to other *treatments*. The TTUD estimate integrates data from a variety of skills training interventions, not just pure RPT packages.<sup>4</sup>

Examination of individual studies of RPT, strictly defined, yields a mixed pattern of findings (see Carroll, 1996; Curry & McBride, 1994; Irvin, Bowers, Dunn, & Wang, 1999, for reviews). While manipulations of treatment content permit clean inference in some of these RPT studies, many suffered from small sample sizes or other methodological problems (Carroll, 1996; Davis & Glaros, 1986; Emmons, Emont, Collins, & Wiedner, 1988). A large-scale, methodologically rigorous study by Stevens and Hollis (1989) provides the most convincing

evidence for the efficacy of RPT content relative to a time-matched control intervention.

RPT is distinguished from many other smoking cessation interventions in that it is grounded in an explicit theoretical model of relapse. This gives rise to a number of explicit process hypotheses that can be scrutinized and that may complement conventional abstinence outcomes in the evaluation of RPT. Some empirical evidence from RPT treatment studies and general relapse research bolsters the RPT method. For instance, in contrast to comparison subjects, smokers treated with RPT show evidence of greater skills for coping with challenges to abstinence (Davis & Glaros, 1986; Zelman, Brandon, Jorenby, & Baker, 1992).

However, other data challenge crucial contentions of the RPT model. Prospective studies of relapse have confirmed that smokers often report negative psychological sequelae after lapse events (e.g., Shiffman, Hickcox, Paty, Gnys, Kassel, & Richards, 1997). However, neither these reactions nor smokers' attributions regarding the cause of the lapse appear to be related to later relapse in the manner predicted by the model (Borland, 1990; Brandon, Tiffany, Obremski, & Baker, 1990; Shiffman, Hickcox *et al.*, 1996; Shiffman, Hickcox, Paty, Gnys, Kassel, & Richards, 1997). A more central problem is that relapse curves for RPT-treated groups tend to closely parallel those produced by comparison treatments (cf. Goldstein, Niaura, Follick, & Abrams, 1989; Minneker-Hugel, Unland, & Buchkremer, 1992; Stevens & Hollis, 1989).

As is true of other interventions, the absolute quit rates associated with RPT content are related to treatment intensity, and its relative efficacy depends upon the comparison conditions with which it is contrasted (Carroll, 1996; Lichtenstein & Glasgow, 1992; Stevens, Glasgow, Hollis, Lichtenstein, & Vogt, 1993). Moreover, though unique in its appeal and scope of use, RPT is comparable to other pharmacological and behavioral smoking cessation interventions in that it does not prevent the majority of treated smokers from relapsing. At least in this sense, one must consider the name 'relapse prevention training' something of a misnomer.

#### *Aversive smoking: the orphaned treatment*

Skills training essentially represents a 'top-down' approach to relapse management in which higher cognitive functions are recruited to shape and control urges, temptations, and strong affective reactions to abstinence. In contrast, aversive smoking interventions represent more of a 'bottom-up' approach that attempts to inculcate visceral reactions to smoking stimuli, promoting abstinence by making smoking unappealing.

Though several variants of aversive smoking have been evaluated (e.g., Best, Owen, & Trentadue, 1978; Hackett & Horan, 1978), by far the best studied technique is the rapid-smoking method developed by Lichtenstein and colleagues (Lichtenstein, Harris, Brich-

ler, Wahl, & Schmahl, 1973; Schmahl, Lichtenstein, & Harris, 1972). The rapid-smoking procedure attempts to take advantage of two processes: (1) oversmoking produces rapid toxicity and profound malaise (Horan, Linberg, & Hackett, 1977), and (2) taste aversion learning can produce strong, enduring shifts in consummatory preferences (Bures, Bermudez-Rattoni, & Yamamoto, 1998; Garcia, Hankins, & Rusiniak, 1974). In theory, after several sessions of rapid smoking, smokers should come to associate the gustatory and olfactory cues that attend smoking with physical illness, and thus develop a conditioned aversion to these cues. While learning theory motivates rapid smoking, it also suggests there may be limits to its efficacy (e.g., Mausner, 1971). For instance, conditioned taste aversions accrue most rapidly and strongly to novel flavors (Garcia *et al.*, 1974); because the typical treated smoker has smoked cigarettes on a daily basis for many years, it may be difficult to forge associative links between malaise and smoking cues.

The evidence supporting the efficacy of rapid smoking is encouraging, but not conclusive. The TTUD meta-analysis found aversive smoking to be superior to no-treatment comparison conditions (Table 2). Another recent quantitative review found an odds ratio of 2.08 (95% CI=1.39–3.12) for rapid smoking, as well as a trend toward a dose–response relation between aversive exposure and long-term abstinence rates (Hajek & Stead, 2000). Some process evidence suggests that aversive smoking works via the mechanisms through which it is purported to exert its effects. For instance, the magnitude of post-treatment heart rate responses to cigarettes (presumably a defensive reflex), negative post-treatment cigarette taste ratings, reports of malaise, and the occurrence of emesis during treatment have each been associated with long-term abstinence or slower relapse in smokers treated with rapid smoking (Merbaum, Avimier, & Goldberg, 1979; Norton & Barske, 1977; Tiffany, Martin, & Baker, 1986; Zelman *et al.*, 1992). Rapid-smoking sessions also produce immediate reductions in cigarette urges and tend to result in decreased cigarette consumption when smokers are given *ad lib* access to cigarettes (cf. Erickson, Tiffany, Martin, & Baker, 1983; Houtsmuller & Stitzer, 1999; Tiffany *et al.*, 1986).

The evidence summarized above suggests the isolation of a fairly potent treatment that makes contact with substantial basic literatures on learning and motivation. However, interpretation of the rapid-smoking literature is complicated somewhat by its age. No significant treatment study using rapid smoking has been published in nearly a decade, and the majority of trials were published in the 1970s. Consistent with conventions in favor at the time, many rapid-smoking trials used small samples (often 20 or fewer smokers per cell), lacked biochemical confirmation of abstinence outcomes, and utilized short-term follow-ups (Danaher, 1977a). Reasons for the abandonment of rapid-smoking treatments probably include concerns over the safety of the procedure (e.g., Hall, Sachs, Hall, & Benowitz, 1984; Horan, Hackett,

Nicholas, Linberg, Stone, & Lukaski, 1977), changes in research funding priorities (Glasgow & Lichtenstein, 1987), the rise of pharmacotherapies, and the shift in psychology from learning models to an emphasis on cognitive science and its allied treatments, such as RPT (Tiffany, 1991).

The abandonment of rapid smoking by a field in which innovation and efficacy are wanting should be viewed quizzically. The available data suggest that rapid smoking is at least as effective as other prominent therapies, such as RPT or nicotine replacement. Moreover, rapid smoking operates through mechanisms that are quite different from other available 'verbal' treatments, suggesting it might complement more popular approaches. Indeed, some research hints that rapid-smoking and RPT techniques may be complementary (cf. Danaher, 1977b; Hall, Rugg, Tunstall, & Jones, 1984; Tiffany *et al.*, 1986). There is a need for a revival in rapid-smoking research to determine how well it fares when applied to today's smokers, when evaluated with prevailing methodological standards, and when combined with contemporary behavioral and pharmacological treatments.

#### *Intra-treatment and extra-treatment social support: the heterogeneous treatments*

Treatments providing social support during treatment contacts (intra-treatment social support) and those fostering support in the patient's social milieu (extra-treatment social support) also appeared to be efficacious in the TTUD quantitative review (Table 2).

Common elements of intra-treatment supportive contents include the provision of encouragement, communication of caring and concern, fostering discussion, sharing, and personal disclosure, and providing basic information about the quitting process. Intra-treatment social support may be provided by the healthcare professional, or it may derive from contacts with other members of a cessation group. As used in the TTUD review, the term 'intra-treatment social support' referred to a relatively loose class of treatments that were united only insofar as social supportive elements were identified as a crucial part of a multi-component intervention by a study's authors. Thus, while some treatments have been explicitly conceived and described as supportive (e.g., Digiusto & Bird, 1995; Ginsberg, Hall, & Rosinski, 1992), this category comprised more heterogeneous interventions than other distinctions in the treatment literature. Because the supportive elements of these treatments were almost always paired and confounded with other treatment contents, it is difficult to determine whether the supportive elements *per se* were crucial to improving abstinence outcomes.

Strategies for fostering extra-treatment social support for quitting include training patients in skills to elicit support from family, friends, and coworkers, providing regular reminders or prompts to encourage support-seeking, and/or formal arrangement of outside support

(e.g., pairing patients in a 'buddy system'). Like intra-treatment supportive contents, extra-treatment support protocols have been widely varied across different studies, making it difficult to rank-order various supportive manipulations in terms of efficacy. Because these treatment features are often confounded with other elements of a multi-component program, it is also difficult to determine the potency of the supportive elements *per se*.

Low perceived social support has been found repeatedly to predict smoking relapse in prospective studies (e.g., Gulliver, Hughes, Solomon, & Dey, 1995; Hanson, Isacson, Janzon, & Lindell, 1990; Nides *et al.*, 1995). Thus, it is perhaps not surprising that investigators have tried to devise cessation treatments that boost support in the hopes that it will buffer patients against relapse risks. Unfortunately, clinical trials designed specifically to evaluate the incremental efficacy of supportive regimens have generally produced negative results (e.g., Ginsberg *et al.*, 1992; Lichtenstein, Glasgow, & Abrams, 1986). The disjunction between findings in this focal literature and the TTUD summary statistics may illustrate the influence of the potential meta-analytic confounds described above. Substantively, the findings of these studies might suggest that social support is a 'person variable' that is not easily modified by clinicians in a significant way. For instance, levels of perceived support might predict cessation in correlational studies partly because they are *markers of personal traits* that permit 'supported' smokers to engage in meaningful, sustained interpersonal relationships. Such relationships might be necessary conditions for support to influence abstinence outcomes. A counseling program may be able to replicate certain *structural* features of 'supported' smokers' social networks for 'unsupported' smokers, but it is much harder to ensure that persons *benefit* from these similarly.<sup>5</sup>

Another view is that it is possible that supportive treatments do indeed boost cessation rates, but that their effects are relatively weak, and thus are manifest only when gauged over pooled studies. One final hypothesis is that social support actually works as a quality marker in the TTUD data set. That is, it may mark those studies that maximized non-specific effects of treatment (e.g., empathy, communication of concern), and excluded those treatments employing a rote, mechanistic approach to intervention.

#### *Treatment matching*

As recognition of the heterogeneity of the smoking population has grown (e.g., Fagerstrom, 1991; Shiffman, 1991), interest has risen in providing individual smokers with treatments that are matched to their pretreatment characteristics (e.g., Digiusto & Bird, 1995; Niaura, Goldstein, & Abrams, 1994; Shiffman, 1993). Treatment-matching strategies draw inspiration from the recognition that certain characteristics, such as depres-

sion history or high nicotine dependence, place some smokers at an elevated risk for relapse. This suggests that smokers who possess these extra risks require adjunctive treatment elements capable of short-circuiting the mechanisms through which the risk factor instigates relapse. In practice, successful treatment matching is demonstrated by the detection of treatment×risk interactions; persons having the risk factor should show abstinence rates that are equivalent to, or better than, low-risk smokers when given the risk-appropriate treatment, but should show poorer outcomes when given a risk-inappropriate treatment. Though intuitively and theoretically appealing, such interactions have been notoriously difficult to detect and replicate in various treatment literatures (Breslin, Sobell, Sobell, Buchan, & Cunningham, 1997; Project MATCH Research Group, 1997; Smith & Sechrest, 1991). TTUD did not include a separate analysis of this topic in its quantitative review due to a paucity of matching studies in the smoking literature. We take up the topic here because, as Shiffman (1993) noted in his review, treatment matching is something of a 'holy grail' for treatment investigators.

The smoking treatment matching literature to date has been unsystematic. As an illustration, we consider a set of studies attempting to match smokers with affective vulnerabilities to optimal smoking treatments. Hall and colleagues (Hall, Munoz, & Reus, 1994; Hall *et al.*, 1998) have shown that a cognitive-behavioral counseling regimen combining smoking cessation and depression prevention components is especially beneficial to smokers with a positive history of depression. On the other hand, Zelman *et al.* (1992) found evidence that depression-prone individuals (a different, but presumably overlapping subpopulation of smokers) fared worse with a cognitive-behavioral regimen than with an alternative, supportive treatment. A follow-up using similar interventions, however, provided only weak support for this finding (Smith *et al.*, 2000). All of these studies differed from one another in treatment structure and content, so their findings may not be irreconcilable. These studies nicely illustrate the interpretive quandaries that exist in this literature. Given the elusive nature of aptitude-treatment interactions, there is a need for careful and systematic scrutiny of putative matching successes when they are detected (e.g., Smith & Sechrest, 1991). In particular, confidence in the reliability of matching effects will advance when treatment regimens and risk group definitions are standardized and these standards are applied by independent investigators at diverse clinical sites. Care should be taken to avoid confounding other treatment elements, such as pharmacotherapy or treatment structure variables, in replication studies of matching effects.

### Pharmacotherapy

Five major pharmacotherapies, including four nicotine delivery systems, have been identified as 'first-line' treatments and have been widely adopted in clinical use:

nicotine gum, nicotine patches, nicotine nasal spray, a nicotine inhaler, and bupropion hydrochloride. Each of these therapies was found to be superior to placebo preparations in TTUD analyses (Table 3). Other agents (e.g., clonidine, nortryptiline) have shown promise as smoking cessation agents, but we do not discuss them here because they are less studied and are not in wide use.

### Efficacy

Little is known about the relative efficacies of the first-line therapies since few head-to-head comparison trials have been conducted. In one of the few such trials, bupropion was shown to be superior to the nicotine patch in the production of long-term abstinence (Jorenby *et al.*, 1999). The generalizability of this trial has been questioned because the efficacy of the nicotine patch was only marginal (Hughes, 1999); therefore, the conclusion that bupropion outperforms the nicotine patch should be regarded with some caution pending replication.

In general, the quit rates produced by each pharmacotherapy appear to be a function of the intensity of adjuvant behavioral counseling provided; approximately 5–10% of treated samples will achieve long-term cessation in a dispensary mode, while as many as 30% will quit long-term with many weeks of behavioral counseling (Hughes, 2000). At each level of adjuvant counseling, active medications will tend to produce quit rates that are about double those found for a matched counseling+placebo treatment. There are gaps in the literature requiring some caution in interpreting this general trend. For instance, bupropion has not yet been evaluated across a range of counseling adjuvants (cf. Hurt *et al.*, 1997; Jorenby *et al.*, 1999).

### Mechanisms of action

Nicotine replacement therapies (NRTs) were developed to ease quitting by assuaging the nicotine withdrawal syndrome. All NRTs have been shown to reduce the severity of the abstinence syndrome (e.g., Gross & Stitzer, 1989; Jorenby *et al.*, 1996; Schneider, Olmstead, Nilsson, Mody, Franzon, & Doan, 1996; Sutherland *et al.*, 1992). However, it remains unclear whether this is the mechanism that accounts for their superiority relative to placebo. Expectancy or attributional effects, blunting of slip-related reinforcement, or cue extinction may represent alternative mechanisms of NRT action, but these explanations remain speculative (Hughes, 1993).

Relatively little is known about bupropion's mechanism of action for smoking cessation. Bupropion does reduce the severity of withdrawal symptoms (Jorenby *et al.*, 1999; Shiffman *et al.*, 2000). Also, given the manifold relations between negative moods and smoking behavior (Hall, Munoz, Reus, & Sees, 1993; Piasecki, Kenford, Smith, Fiore, & Baker, 1997), it is possible that bupropion exerts its effects through its antidepressant action, though evidence on this score is not strong (Jorenby *et al.*, 1999; Shiffman *et al.*, 2000).

**Table 3.** Summary of TTUD meta-analyses evaluating first-line pharmacotherapies

Condition	Number of study arms	Estimated OR (95% CI)	Estimated abstinence rate (95% CI)
Bupropion (2 studies)			
Placebo	2	1.0	17.3
Bupropion	4	2.1 (1.5, 3.0)	30.5 (23.2, 37.8)
Nicotine gum (13 studies)			
Placebo	16	1.0	17.1
Nicotine gum	18	1.5 (1.3, 1.8)	23.7 (20.6, 26.7)
Nicotine inhaler (4 studies)			
Placebo	4	1.0	10.5
Nicotine inhaler	4	2.5 (1.7, 3.6)	22.8 (16.4, 29.2)
Nicotine nasal spray (3 studies)			
Placebo	3	1.0	13.9
Nicotine nasal spray	3	2.7 (1.8, 4.1)	30.5 (21.8, 39.2)
Nicotine patch (27 studies)			
Placebo	28	1.0	10.0
Nicotine patch	32	1.9 (1.7, 2.2)	17.7 (16.0, 19.5)
Combination nicotine replacement (3 studies)			
One NRT	3	1.0	17.4
Two NRTs	3	1.9 (1.3, 2.6)	28.6 (21.7, 35.4)

OR, odds ratio; CI, confidence interval.

Adapted from Fiore *et al.* (2000), Tables 25–29 and 32. Original tables are in the public domain. Odds ratios and abstinence rates refer to long-term (>5-month) follow-up.

Our relatively poor understanding of *how* first-line pharmacotherapies work probably prevents us from taking full advantage of the pharmacopeia. Research that helps us glean how existing agents enhance abstinence outcomes would permit us to deliver those agents in a more rational, flexible and targeted fashion. At present, our relative ignorance, coupled with the dearth of comparative trials, means that patient preference may be the best guide for deciding among various pharmacotherapies (Hughes, Goldstein, Hurt, & Shiffman, 1999). The one exception to this rule of thumb is that heavily dependent smokers seem to benefit more from 4-mg than 2-mg nicotine gum (cf. Fiore *et al.*, 2000; Garvey *et al.*, 2000; Herrera, Franco, Herrera, Partidas, Rolando, & Fagerström, 1995; Sachs, 1995; Tang, Law, & Wald, 1994).

#### *Combination pharmacotherapies*

Combinations of first-line pharmacotherapies have received some study. Two strategies are potentially promising. One strategy, found to be efficacious in TTUD data analyses, combines the nicotine patch's steady drug delivery with another NRT for more flexible 'urge-crisis' dosing. Such combinations seem to produce quit rates that are higher than those obtained with either drug alone (see Table 3; see also Blondal, Gudmundsson, Olafsdottir, Gustavsson, & Westin, 1999; Kornitzer, Boutsen, Dramaix, Thijs, & Gustavsson, 1995; Puska, Korhonen, Vartianinene, Urjanheimo, Gustavsson, & Westin, 1995). A second approach is to combine bupropion – the only non-nicotine first-line pharmacotherapy – with one of the NRTs. This approach is attractive because the two treatments are *likely* to have different mechanisms of action, and the smoker may

benefit from each separately. The one clinical trial evaluating a patch–bupropion combination did not reveal statistical superiority of the combination treatment relative to either monotherapy (cf. Hughes, 1999; Jorenby *et al.*, 1999). It is possible that greater success would be obtained by pairing bupropion with one of the *p.r.n.* NRTs. Of course, our relative ignorance about the mechanisms through which particular pharmacotherapies exert their effects may limit our ability to discover the most effective combination drug regimens.

#### **Future directions**

In this section, we sketch out a handful of additional research directions we expect would hold promise for advancing knowledge pertinent to crafting better cessation treatments. Though the suggestions we offer will doubtlessly not exhaust the domain of potentially fruitful approaches to studying smoking treatments (and some may prove technically daunting), we offer these speculations in the hope they will stimulate creativity in treatment design and evaluation. Some of these ideas are innovative, others are downright boring or even 'unfunda-ble' – but each would help fill gaps in our knowledge and might contribute to the treatment advances.

#### *Content dismantling and process research*

As we have noted at various points above, the contemporary treatment literature is littered with multi-component interventions, and this complicates the identification of effective treatment contents. It is almost certain that many multi-component programs contain extraneous or weak content that might be profitably shed.

Systematic dismantling studies are the most convincing method for distilling the potent elements of effective treatments, yet they have fallen by the wayside in smoking research (see the early work of Lando and colleagues for an example of programmatic dismantling in smoking treatment; Lando, 1982; 1986). In dismantling research, several groups are treated with a multi-component intervention, with specific elements of each treatment carefully redacted across groups. By systematically varying particular treatment elements across random subsamples, one can isolate potent treatment contents. Dismantling studies may have fallen out of favor because of shifting funding priorities, because they are technically challenging to devise and implement, because they are not viewed as providing earth-shattering innovation, or because early attempts did not suggest that any particular treatment elements are vital for success. Disinterest in dismantling may also be a symptom of the increasingly atheoretical tone in smoking cessation research. In general, investigators seem to have become, to an extraordinary degree, uninterested in *why* a treatment works.

The field's shift from 'action' therapies (e.g., rapid smoking) to 'verbal' therapies (e.g., RPT) almost certainly contributed to the demise of dismantling research – it is much easier to vary systematically the parameters of a puffing procedure than to control verbal contents, especially when therapists are supposed to be unscripted and respond to the idiosyncratic concerns of individual smokers. The switch to verbal therapies complicates *experimental* decomposition of therapy content, but it need not prevent *correlational* approaches to identifying active therapy ingredients. There is a rich, though somewhat controversial tradition of process research in the general psychotherapy literature (e.g., Stiles & Shapiro, 1994; Weissmark & Giacomo, 1994). In typical studies, tapes of the therapy hour are coded for the frequency of particular events and communications, and then these content measures are correlated with treatment outcomes. Such studies have revealed surprising and important insights regarding the treatment of other disorders (e.g., Jones & Pulos, 1993). The need for exploratory process studies is buttressed by evidence suggesting that treatment contents may operate and be perceived by smokers in ways that are quite different from those that investigators intend (Schmitz, Spiga, Rhoades, Fuentes, & Grabowski, 1999). Process research is challenging and time-consuming – for instance, it requires that the researcher devise a system for measuring significant treatment contents, and requires that independent judges rate many treatment hours. However, the primary data (i.e., therapy tapes) would be relatively easy and inexpensive to collect in any active clinical research center.

The time has come to scrutinize our multi-component interventions and to consider paring them down through careful study. The promise of dismantling and process studies is that treatment time currently devoted to inert contents could be reallocated to the most effective

components of treatment, which might, in turn, boost long-term abstinence rates. If this concentration of treatment could be achieved, structural elements of treatments might prove less important in accounting for treatment outcomes; fewer contacts might be required to obtain the same clinical outcomes. On the other hand, a programmatic series of dismantling or process investigations might determine that there are few critical, stand-alone treatment contents. Such findings would reinforce the importance of treatment structure, and would also suggest that intensive, multi-session treatments might be delivered more widely and economically by paraprofessionals (e.g., Christensen & Jacobson, 1994). Finally, a systematic program of content dismantling or process research might reveal that effective components exist, but that the impact of particular contents depends upon characteristics of the smokers being treated. Thus, content and treatment matching research may be complementary strategies.

#### *Content timing research*

Another topic ripe for investigation is the temporal distribution of treatment elements. Quitting smoking is clearly a dynamic process in which different challenges to abstinence are likely to arise at various post-cessation latencies. Treatment researchers have recognized this fact, and have sometimes crafted interventions in which the content of treatment changes across the post-quit period to match the challenges presumed to be most pertinent at each treatment visit (e.g., Cinciripini, Cinciripini, Wallfisch, Haque, & Van Vunakis, 1996; Fortmann & Killen, 1995). However, this sort of staging has not been a major focus of outcome research; it is a nicety that sometimes characterizes studied treatments, but the studies themselves are not designed to test its impact.

Doubtlessly, our scanty knowledge of precisely how treatment elements work has discouraged ambitious time-matching studies. Dismantling and process-oriented research would help generate cogent hypotheses about which treatments are best delivered at which times. However, our knowledge of the relapse process continues to grow (e.g., Connors, Maisto, & Donovan, 1996; Shiffman, Paty *et al.*, 1996; Shiffman, Hickcox *et al.*, 1996), and findings from this descriptive research suggest the potential for treatment timing to have an impact on outcomes. For instance, distinct facets of perceived social support appear to be related to abstinence at different post-quit latencies (Lichtenstein *et al.*, 1986). Whatever the specific timing strategies implemented and studied, it seems clear that they will need to be carefully conceived and rooted in both theory and relapse research.

#### *Structural research*

As noted earlier, the structural components of smoking interventions, especially the number and length of

treatment sessions, account for a large proportion of the variance in treatment efficacy, yet structural features of treatment are rarely manipulated in the same study (e.g., Schmitz & Tate, 1994). Research of this kind is not particularly exciting, but it is needed. For instance, the 'frontloading' of treatment sessions – providing especially frequent contacts early in the quit attempt – has sometimes been advocated (e.g., Kenford, Fiore, Jor-enby, Smith, Wetter, & Baker, 1994), but has not been studied systematically (Fiore *et al.*, 2000).

Treatment structure manipulations might also play an important role in demonstrating the potency of particular treatment contents. Existing evidence would seem to suggest that if two treatment contents produce equivalent abstinence rates, but one of the treatments does so with fewer contacts, that treatment is the more potent of the two. Thus, structural manipulations may complement dismantling/process research, and could aid in the development of a 'hierarchy of potency' for available treatments.

#### *Relapse situations and processes as outcome criteria*

In general, the chief outcome criterion in studies of smoking treatments has been group differences in long-term abstinence outcomes. The emphasis on abstinence-based outcomes is reasonable and understandable. Nonetheless, abstinence rates need not be the only criterion upon which researchers focus. Substantive gains in treatment process knowledge might be gained by using alternative criteria.

As an example, we might speculate about the usefulness of *relapse situations and processes* as outcome criteria. A great deal of research has distilled a list of situations and psychological states in which relapse commonly occurs (Brandon *et al.*, 1990; Shiffman, 1982; Shiffman, Paty *et al.*, 1996). Such research has inspired treatment contents (e.g., RPT; Marlatt & Gordon, 1985), but the differential effects of treatments on the distribution of relapse events across situations have not been well characterized. Designing and refining a treatment to eliminate the risk of one focal situation may prove to be a generative course for treatment research. For instance, one team of researchers might craft and refine a treatment element that greatly minimizes the association between alcohol consumption and smoking lapses. We might call such a treatment an 'alcohol-relapse inoculation.' Even if this treatment did not produce superior abstinence outcomes to conventional treatments (e.g., if relapses that would otherwise have occurred during alcohol consumption ended up happening in other situations) it might still provide an important tool for researchers and clinicians. For instance, it raises the possibility that independent researchers working on diverse 'relapse situation inoculations' could together divine the elements of the 'ultimate' multi-component intervention. The resulting treatment components might also provide a 'toolbox' for use in sophisticated treatment matching protocols. Obviously, one would even-

tually like to find that such discrete targets of treatment do eventually mediate higher long-term abstinence rates.

As research technology has advanced to permit better and better temporal resolution around key events such as lapses (e.g., Shiffman, Paty *et al.*, 1996; Shiffman *et al.*, 1997), we have begun to get closer views of the *psychological processes* that occur in the those situations. Knowledge of these processes might aid the design of treatments for short-circuiting situation-lapse associations. Alternatively, modification of these processes, assessed in real-time at the point of maximal risk, might serve as important outcome criteria in and of themselves.

#### *The need for comprehensive theories of relapse*

Treatment research might be expected to advance in direct proportion to gains in our understanding of the problems we aim to change. Considerable basic research has been conducted on topics of tobacco dependence and motivation in recent years, but this research has had relatively little impact on treatment design. It is almost as though basic and clinical researchers do not speak the same language.

Significant treatment breakthroughs might accrue from focused studies in basic science laboratories. For instance, advances in measurement of key constructs, identification of the variables controlling motivational responses and clarification of important individual differences among smokers might each inform treatment design. However, there is a need to integrate the diverse streams of basic science research into unitary, coherent, and meaningful *theoretical models of the entire relapse process*. The flurry of research activity triggered by the RPT model demonstrates how comprehensive theories of relapse can promote integration and cooperation between laboratory and clinical investigators. Sufficiently compelling theories permit both basic and clinical data to make substantive contributions to evaluating model validity. Similarly innovative, bold theoretical conjectures may hold the best hope for the future.

#### **Summary and conclusions**

Smoking treatments have been intensively investigated, but progress has not been as rapid or as complete as was once expected (Glasgow & Lichtenstein, 1987), and significant gaps in our knowledge remain. Looking on the bright side, one could take comfort in the fact that the field has cobbled together some hard-won lessons about the effectiveness of diverse parameters of psychosocial treatment structure and content. The fact that we continue to treat successfully a substantial proportion of clinical samples may be viewed as encouraging, especially in light of a reputed increase in the dependence of those who continue to smoke (e.g., Hughes, 1996).

On the other hand, it remains difficult to argue with the fact that no single treatment or multi-component

intervention can be shown to produce long-term abstinence rates that consistently approach or top 50%. Moreover, the muddled inference that results from studies of multi-component interventions and the field's dearth of process-oriented treatment research would seem to bode ill for the future accrual of new knowledge or meaningful gains in treatment efficacy.

We are struck by how little has changed, at least at a molar level of appraisal, since Shiffman's (1993) review. Years later, it would appear that the rut has deepened. The introduction of new NRTs and bupropion are significant, but they represent the only major, recent treatment innovations. Treatments appear to be declining over time in terms of absolute efficacy (Irvin & Brandon, 2000). Treatment matching, stepped care, and other much-discussed treatment models remain appealing concepts rather than validated strategies, and we still know relatively little about how efficacious treatments work. Clearly, there are a great many important research questions to be investigated. Careful thinking and programmatic research rooted in the best basic and applied theory and data remain the paths to meaningful progress.

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### Notes

- 1 The TTUD offers recommendations regarding all forms of tobacco use. In this paper, we focus primarily on smoking cessation per se because the vast majority of tobacco cessation research has focused on cigarette smoking.
- 2 In fact, the TTUD analyses suggest that, despite their status as mainstays of public-health approaches to tobacco control, self-help materials do not appear to be effective aids to smoking cessation. We suspect it is reasonable to assert that such approaches have small impacts and form the low end of a continuum of treatment intensity. Whether or not self-help techniques are ever effective is an open question, and one that is only partially addressed by the meta-analysis. For instance, the TTUD analysis pooled diverse self-help interventions (e.g., pamphlets, taped programs), but the majority of studies evaluated printed materials. If these are the least effective materials, their over-representation could obscure larger effects obtained through other media. Also, secular trends could have blunted the impact of some self-help materials; for instance, a 'trickling down' of information about high-risk situations, coping strategies, etc. through the general media may have salutary effects at the population level, but rob self-help materials of their incremental efficacy. In general, self-help approaches have shown reliable evidence of efficacy for behavioral problems (Christensen & Jacobson, 1994). The time is ripe for a detailed review of the smoking cessation self-help literature.
- 3 One reviewer wryly suggested that this period might be described as 'mindless' rather than 'vibrant'. The point was that the era was marked by an enthusiastic importation of behavior therapy techniques that had been developed to treat other behavioral problems. In the process, there was little reflection about the unique characteristics of smoking behavior. We agree with this characterization of the times, but also note that the prevailing behavior therapy zeitgeist encouraged the marriage of basic science and treatment and fostered a keen interest in how treatments work – admirable features of the field that seem to have eroded somewhat over time.
- 4 For instance, a major tenet of RPT is that smokers should be trained to view lapses as normative and taught skills for coping with lapse events. It is often not clear from published reports whether this component is included in skills training packages. Lapse training is probably the most common element of classic RPT to be dropped because some clinicians may fear that it tacitly gives patients permission to smoke after the quit date. However, one study suggests that this particular feature of RPT may not contribute any incremental efficacy (Curry *et al.*, 1988).
- 5 An apt analogy might be a computer dating service; persons with social skills deficits (e.g., intensely shy or boorish persons) might use the service to produce a structure of social interactions that simulates the dating patterns of their socially skilled peers. However, enduring social skill deficits would lower the prior probability of any of these new social interactions culminating in a satisfactory outcome such as sustained, happy marriage.

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